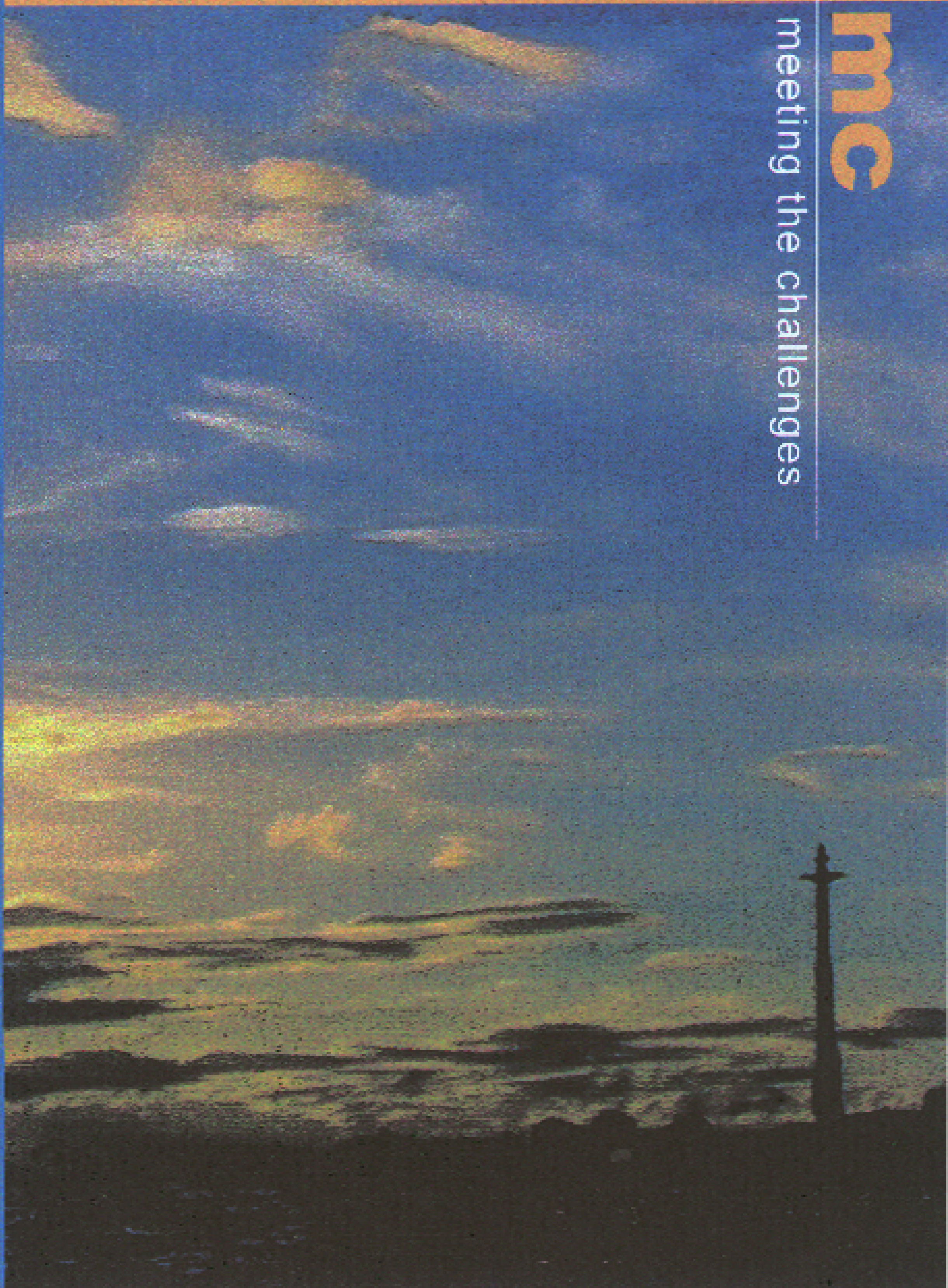
a needs analysis for the strengthening of

PACIFIC ISLANDS METEOROLOGICAL SERVICES

August 2000

PMSmc

meeting the challenges



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This report was prepared for the South Pacific Regional Environment Programme by

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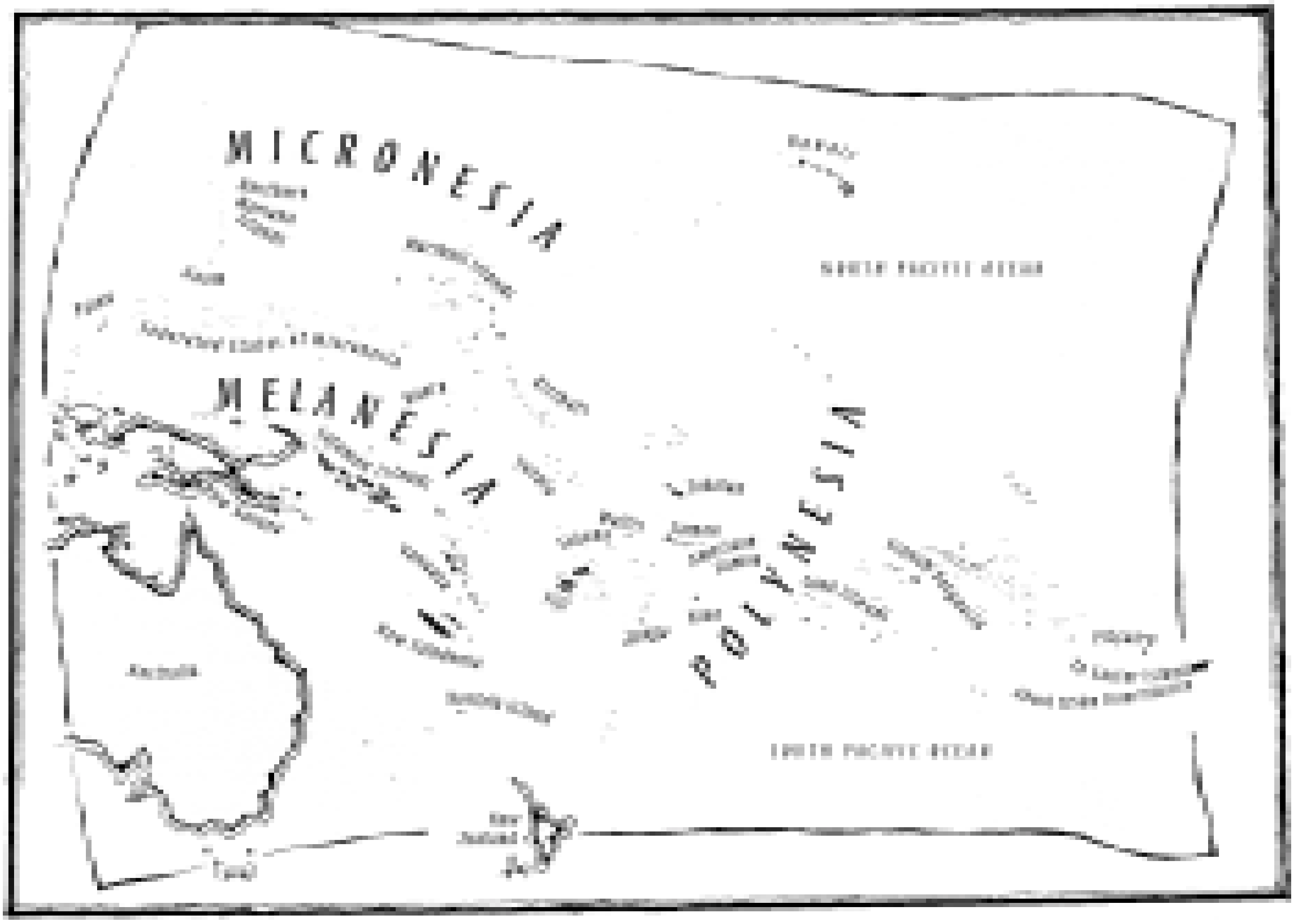
Countries and Territories covered by the Pacific Meteorological Service



Introduction

This report was commissioned by the South Pacific Regional Environment Programmme (SPREP) in early 2000, and forms part of SPREP's initiative to: identify the requirements of the National Meteorological Services (NMSs) of twenty Pacific island SPREP member countries and territories, package the requirements for aid consideration, and further, to coordinate and administer any consequential aid projects.

To identify the requirements, SPREP engaged an Expert Team representing the World Meteorological Organization (WMO), SPREP, the NMSs of developed countries (Australia, France, New Zealand and USA) in the region, and the Fiji Meteorological Service (FMS), including experts in specialised areas. The Pacific Meteorological Services Needs Analysis Project (PMSNAP) team members are listed in Annex 2. The PMSNAP is funded by the Australian Agency for International Development (AusAID), and the Team Leader is Mr Ram Krishna from the Australian Bureau of Meteorology.

The goal of the PMSNAP Project is to:

> *"Support continued strengthening of the capability of NMSs in the Pacific region to meet growing public demand for improved weather and climate services and products to ensure the safety, security and general well-being of the people, to contribute to achieving sustainable development and to fulfil SPREP members' commitments and obligations under regional and international agreements and conventions."*
>
> Strategic Action Plan for the Development of Meteorology in the Pacific Region, 2000-2009, Bureau of Meteorology, December 1999.

This report completes a series of twenty-one reports under the PMSNAP. It synthesizes the common needs and strategic directions identified by each of the twenty national country reports (NCRs), and focuses on the common needs of NMSs of Pacific island SPREP member countries and territories that could be addressed at the regional level. The NCRs provide in detail the specific needs of each of the countries and territories.

The report is divided into four parts although there is overlap between the parts. Part One provides the project overview. Part Two describes common needs of NMSs and of users across the countries and territories. Part Three details development projects identified by the PMSNAP team. Part Four outlines the conclusion of the PMSNAP team.

Assistance Programmes

Prioritisation and regional commonality of the needs of users and of NMSs, which emerged from the analysis, provide the basis for the assistance programmes recommended. Two clear common priority areas of need that emerged for all countries were:

1 improved severe weather warning services; and

2 seasonal and climate prediction services, especially drought.

These are also areas of investment that is expected to provide the greatest returns. Improvement in the provision of these services requires the strengthening of support structures, specifically:

3 weather and climate observational networks;

4 telecommunication networks; and

5 physical infrastructure and institutional strengthening.

Regional development assistance programmes have been assembled around these five themes. These programmes are intended to build on past efforts by national governments and assistance programmes funded by development partners (primarily Australia, France, the European Union, Japan, UNDP, United Kingdom, USA, and WMO) in the region, and are intended to reverse the decline in the capacity of NMSs in the last two or three decades. In recent years, other countries e.g. Finland, Denmark and Italy have shown an interest in supporting meteorological development in the region. Coordinated and integrated implementation of these programmes should see significant improvements in most weather and climate services in the region. However, significant financial assistance will be required to implement these programmes.

Recommended Projects

The following projects, packaged as regional projects, are recommended for implementation. Several small projects have been packaged together into each of the major regional projects. These small component sub-projects may, in many instances, be implemented without affecting other projects.

LIST OF PROJECTS

Project 1	Strengthening Observing Systems	Indicative budget (US$000)
1.1	Restore and upgrade the human-operated surface observational network.	750
1.2	Provision of Data Collection Platforms (DCP)/Automatic Weather Stations (AWS)	3,160
1.3	Marine meteorological data reporting, collection, dissemination, and training	530
1.4	Basic meteorological observer training	110
1.5	Restore and upgrade the regional upper air observation network	2, 600
1.6	Provision of high resolution satellite imaging systems	430
1.7	Lightning detection systems for Pacific Islands National Meteorological Services	670
1.8	Pacific states radar network	10, 200
1.9	Technical maintenance back up	500.

Project 2	Strengthening Telecommunication Networks	Indicative budget (US$000)
2.1	Provision of high frequency radio transceivers for the collection of weather reports from outstations	1,200
2.2	Provision of Local Area Networks (LAN) for National Meteorological Services	700
2.3	Provision of Small EMWIN (Emergency Managers Weather Information Network) Receiving Terminals	650
2.4	Regional Pacific Intranet (RPI)	3,600

Project 3	Improve Severe Weather Warnings	Indicative budget (US$000)
3.1	Human resources development	
3.1.1	Professional meteorological training	250
3.1.2	Training of support forecasters to assist the professional meteorologist	240
3.1.3	Training in specialised tropical cyclone analysis, forecasting and warning	150
3.1.4	Training workshops and attachments in tropical cyclone forecasting and warning centres	600
3.1.5	Training of meteorological personnel on aviation awareness, and safety and economy sensitivity of aviation operations	120
3.1.6	Public education and awareness on severe weather (including	500

	tropical cyclones, drought, floods) and the role of climate variability	
3.1.7	Awareness and education of small craft (boats) operators	500
3.2	Storm surge prediction models	120
3.3	High resolution numerical weather forecasts for Pacific islands	120

Project 4	**Cimate Data Management, Analysis and Application**	**Indicative budget (US$000)**
4.1	Climate analyses and applications	100
4.2	Climatology training	250
4.3	Pacific Regional Climate Bulletin	300
4.4	Expanding and enhancing the prudent use of climate predictions	620

Project 5	**Institutional Strengthening, Including Infrastructure Support**	**Indicative budget (US$000)**
5.1	SPREP Meteorology/Climatology Officer (MCO)	360
5.2	SPREP Meeting of Regional Meteorological Service Directors (RMSD)	320
5.3	Buildings and accommodation	6,000
	Total	**35,650,000**

The projects are aimed at assisting NMSs to further strengthen their capacity to fulfil national, regional and international obligations. The projects have been designed based on the requirements of NMSs and the needs of users consulted during the course of this project. Some projects were originally identified by previous studies, and had either been funded but discontinued, or had not been funded. The proposed projects (as detailed in Part 3 of this report and summarised in the above table) can be broadly divided into two categories, short-term and long-term.

- Short-term projects are designed to assist in developing technical support structures to ensure basic operations are sustained. The projects will address areas such as basic observing systems, telecommunications and ongoing maintenance of existing equipment.
- Long-term projects are designed to reinforce and develop the benefits obtained from short-term assistance. Areas addressed include technical staffing levels, training, general coordination between all NMSs and a pooling of resources and technical capacity.

This approach has been adopted to ensure continuity and the sustainability of proposed projects. Most countries recognise that there is a cost to infrastructure donated through external assistance, and this is manifested in depreciation costs (where accrual accounting is used) and perhaps other operational costs such as electricity, maintenance and telecommunications. Consequently, the position of most countries regarding aid is that they must be sustainable within the approved in-country Meteorological Service budgets, and that assistance may be required with ongoing costs.

Conclusion

We are pleased to present to you our findings and recommendations from the Pacific Meteorological Services Needs Analysis Project (PMSNAP). We have called this report "**Pacific Meteorological Services: Meeting the Challenges (PMS:MC)**" because throughout our consultations, two consistent themes emerged. Firstly, the majority of National Meteorological Services (NMSs) in the region are struggling, and often failing to provide basic services for the citizens and industries of their countries. Secondly, the position of most countries regarding development programmes is that they must be sustainable within the approved in-country NMS budgets, and that assistance may be required with ongoing costs. This poses a dilemma to development partners that in our experience prefer not to be committed to any on-going costs that may be associated with the provision of technical infrastructure.

Since the release of the "The Changing Climate in Paradise" report in 1991, which catalysed regional work in weather and climate matters, we have found some significant improvement in the services provided by NMSs within the Pacific region. We have found greater cooperation and collaboration amongst the region's Meteorological Services as they strive to meet the increasing expectations of their governments and users. In the midst of major reforms and push by governments to cut budgets, NMSs are working hard with very limited resources to fulfil their commitments to their governments and users, and under very difficult circumstances in some cases.

We hope this report will provide NMSs not only with the necessary remedies urgently needed to meet the challenges identified in the PMSNAP, but more importantly, to provide users of meteorological services and products with an appreciation of the work implemented and provided by these services. We have focused our attention on key priority areas identified by users and NMSs. We have avoided idealistic recommendations as we believe they would be unsustainable. For these reasons, technologically advanced solutions proposed herewith have been restricted to those tested and proven elsewhere.

CONSULTANTS' REPORT AND RECOMMENDATIONS

We believe the projects proposed in our report represent the minimum level required to effect noticeable short-term improvements in weather and climate services in the region. At the same time, these projects will lay the foundation for sustainable and longer term commitments by governments and development partners alike to meet the needs and aspirations of NMSs, set out in the Strategic Action Plan for the Development of Meteorology in the Pacific region, 2000-2009. This strategy was adopted by all 26 SPREP Members in 1999 and endorsed by the 11th SPREP Meeting in Guam 2000.

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1.1 BACKGROUND

1.1.1 Natural environment of the Pacific islands

The natural environment of the region is strongly influenced by weather and climate. Tropical cyclones, prolonged heavy rain with accompanying floods, droughts, and extreme weather conditions attributable to the large seasonal and inter-annual variability related to the El-Niño/La-Niña Southern Oscillation (ENSO) phenomena are an integral part of the climate of the region. Ocean-atmosphere interaction processes dominate these phenomena, which in turn impact very significantly on the social and economic well being of this widely scattered group of islands in the most vast of oceans, the Pacific Ocean.

1.1.2 Socio-economic status of the Pacific islands

Pacific Island Countries and Territories are largely dependent on the natural environment for their socio-economic sustenance. Table 1 summarises basic socio-economic indicators of islands and territories covered in this report.

Agriculture, fisheries, tourism, mining and forestry (the latter where there are large islands) are the main economic sectors for most islands. Subsistence lifestyles dominate the activities of most rural communities in many islands. Both the subsistence economy and commercial activities (the latter confined mainly to urban areas) are dependent on the resources of the land and the sea. Transportation by sea and air are necessary due to the vast distances between these islands and bigger commercial markets.

Table 1
SPREP member countries and territories basic socio-economic indicators

Country	Land area (km^2)	Total population	Annual growth rate (%)	Density (people/km^2)	Urban population (%)
American Samoa	200	46,773	3.7	233	48
Cook Islands	197	46,800	0.4	237	59
FSM	710	105,506	1.9	149	27
Fiji	18,333	772,655	0.8	39	46
French Polynesia	3,521	219,521	1.9	62	54
Guam	541	133,152	2.3	246	38
Kiribati	811	77,658	1.4	96	37
Marshall Islands	181	43,380	4.2	240	65
Nauru	21	9,919	2.9	472	100
New Caledonia	19,103	196,836	2.6	10	71
Niue	259	2,082	-1.3	8	32
Northern Mariana Islands	471	58,846	5.6	125	90
Palau	488	17,225	2.4	35	71
Papua New Guinea	462,243	3,607,954	2.3	8	15
Samoa	2,935	161,298	0.5	55	21
Solomon Islands	28,370	285,176	3.4	10	13

Country	Land area (km^2)	Total population	Annual growth rate (%)	Density ($people/km^2$)	Urban population (%)
Tokelau	12	1,507	-0.9	125	0
Tonga	747	97,784	0.3	131	36
Tuvalu	26	9,043	1.7	348	42
Vanuatu	12,190	142,419	2.8	12	18
Wallis and Futuna	255	14,166	0.6	56	0

1.1.3 Meteorology and sustainable socio-economic development

Due to the heavy reliance of the economic and social activities of these islands on the natural environment, these activities are very sensitive to weather and climate, and particularly to extreme weather events.

NMSs can contribute very significantly to the success of all national activities. Timely and accurate severe weather warnings and climate services (including seasonal predictions) can contribute substantially to social well-being and economic development. Agriculture (commercial and subsistence), forestry, fisheries, aviation, maritime transport, water resource planning and management, tourism, animal husbandry, banking and financial services, disaster management, telecommunications, construction and engineering, energy (renewable and non-renewable) generation and supply, tourism, environmental protection, food production, health and medical services, insurance, legal services, manufacturing, offshore operations, port and harbour management, leisure activities, retails, sports, urban planning, and land use planning can all benefit from the work of NMSs.

While some of these sectors may not be well developed in the region, consultations with users of meteorological services and products clearly indicated that a number of current and potential users in many sectors would benefit significantly from enhancements in weather and climate information and services.

It is important to recognise that while the work of NMSs have large short term and long term socio-economic impacts, pre-eminently, the enormous benefits of the services provided by them in all islands are of a social nature, which relate directly to safety of life and property and which are largely taken for granted. These include:

- The avoidance of loss of life that would otherwise occur if the general public did not have an official centre to issue advance warnings on the onset of severe weather and climate events such as tropical cyclones and droughts;
- The enormous contributions to the safety and security of the travelling public, especially those travelling by air and sea, because of the international, regional and national arrangements put in place for rapid exchange of data, information and warnings for the marine and aviation communities;
- The ubiquitous contribution to the day to day safety, comfort, enjoyment, and general convenience of citizens through access to weather and climate information which assist them in their planning, making decisions on what to wear, where to go, what to do and when to do it; and
- Other indirect forms of social benefit, including the ease of mind of having access to latest information on developments affecting distant communities; the cultural values associated with maintaining reliable records of major weather related disasters; the contribution to the integrity of the justice system from the legal uses of official weather records and the pleasure and satisfaction from increased understanding of the phenomenon of the natural world.

Of particular importance to small island states is the preservation and storage of historical weather and climate records. These historical records have been of immeasurable value in helping the region unravel past changes in climate, and assisting to understand and formulate appropriate response measures to the potential impacts of climate change and sea level rise.

1.1.4 Weather and climate related natural disasters

Recent studies have revealed that about 70 per cent of all natural disasters worldwide are attributable to weather and climate. The region has a fair share of these disasters. Users consulted during the course of this project confirmed that weather related disasters have caused record losses and destruction in many instances.

The increasing concentrations of population, development and infrastructure in coastal areas, increasing intensity and frequency of tropical cyclones, and sea level rise are contributing to heavy destruction, record losses, disruption and economic setbacks, breakdown of traditional agricultural and ecological systems, human suffering, poverty and disease outbreaks.

Often a single such weather related disaster can overwhelm a small island, and cause severe social and economic losses, resulting in the diversion of national resources intended for other development programmes such as health and education to recovery, reconstruction and rehabilitation. In Fiji for example, Cyclone Kina alone in 1993 caused one of the worst flooding episodes ever to strike Fiji and one of the highest damage impacts to date of around US$120 million, estimated at 2.4% of Fiji's GDP. In 1990 in Samoa, tropical cyclone Ofa caused an estimated US$120 million in damages, about 25.5% of Samoa's GDP. A year later, Cyclone Val caused a further US$200 million of damage, about 45.5% of Samoa's GDP. These two cyclones set back the development of Samoa some 20 years. In 1986 cyclone Namu caused the worst disaster in the living memory of Solomon Islanders. It caused severe flooding, massive landslides, and huge storm surges, resulting in extensive damage along coastal areas. In just over four days, Namu killed 103 people, left 38 persons missing, and more than 1,000 injured. 90,000 people, a quarter of the population, were left homeless. Major external assistance was sought by the government to re-build the lives of its citizens and put the country back on a semblance of social normality. Many Pacific Island Countries (PICs) have had similar experiences.

The most marked ENSO event in 1997/98 triggered the most severe droughts in recorded history in many countries in the region. Grave social and economic impacts were felt - commercial agriculture was seriously affected, home gardens were decimated, water resources diminished, drinking water contaminated (resulting in disease outbreaks), the tuna catch diminished significantly, many poor people in rural areas experienced malnutrition and starvation, and in some islands, vegetable seeds and planting material had to be brought in from outside to revitalise agriculture.

These examples show the vulnerabilities of these islands to weather and climate related disasters and the need to strengthen the capacity of National Meteorological Services to minimise the impacts of these events through timely and accurate warning systems and appropriate preparedness and disaster reduction action.

1.1.5 Development priorities and constraints

The Pacific islands are micro-states with very small economies and resources. Skilled human resources are very scarce and difficult to sustain. They do not have the means of supporting even a small fraction of the infrastructure that developed countries consider necessary to provide weather and climate services for national benefit.

In recent years, faced with more immediate and socially more visible and pervasive problems such as health and education, governments throughout the region have found it expedient to allow even the very basic and not-so-visible meteorological services that existed in the past to deteriorate. The consequences are glaringly evident now: meteorological/climatological data networks; data quality; na tional, regional and global data exchange arrangements; and any service provision capability that existed in the last two or three decades have deteriorated in many countries. Despite considerable development assistance to the region in the last 20 years, many governments are facing negative economic growth and are finding it difficult to keep up with the rest of the world. Many have resorted to restructuring and are reforming their public services and re-directing development assistance to other areas. This has resulted in several countries in large reductions in the resources available to Meteorological Services, which has further contributed to the deterioration.

There is little scope for revenue generation through cost recovery in most NMSs, especially of the smaller countries, since the limited weather services and products provided in these countries are geared toward services to the public. Some of the larger NMSs generate a portion of recurrent expenditure through charges primarily to aviation. The highly politically charged climate change issue has changed some of these trends within some governments and development partners alike. However, resources allocated to NMSs in many countries remain the same or continue to decrease.

1.2 CONTEXT OF METEOROLOGICAL SERVICES IN THE REGION

1.2.1 The national role of Meteorological Services

The basic and essential functions of a National Meteorological Service can be summarised as follows:

- To plan, implement, operate and maintain surface and upper air observing networks over its territory;
- To provide and maintain systems for the collection, and quality control of observational data and their processing in support of meteorological research, the provision of real time weather and climate services, and assembly of a national climate record;
- To advance meteorological science and the development and improvement of its own operations and services through supporting research and development;
- To provide a range of weather information, forecast and warning services to the community at large, usually through the mass media;
- To provide a range of sector-specific operational meteorological services through the mass media and through other channels, to major user groups such as agriculture, shipping, aviation and national defence;
- To keep and maintain a national climate archive and the provision of climate data and climate monitoring and prediction services;
- To provide advice on meteorological and climatological matters to other government agencies and to its national community;
- To fulfil its obligations under regional and international conventions such as the SPREP Convention, the Convention of the World Meteorological Organization, the United Nations Framework Convention on Climate Change, the Vienna Convention, and the Convention to Combat Desertification, and Agenda 21.

Some PICs (e.g. Cook Islands, Solomon Islands and Vanuatu) have specific legislation (Meteorology Acts) prescribing the functions and responsibilities of their NMSs, and empowering them with the authority to carry out defined activities. Many more countries (including e.g. Fiji, Solomon Islands, Vanuatu) have designated their NMSs by statute as ‘essential services’.

In the last 15–20 years, due to the decline in meteorological support structures of many countries in the region, most noticeably those countries which formerly relied on Australia and New Zealand for support, there has been a significant deterioration in the quality and communication of weather data and the quality of climate records. This has adversely affected the provision of various services. The challenge of climate change and variability requires that this situation be reversed, as a high priority.

The extent to which these functions are performed varies greatly from the larger, better resourced to the smallest and poorly developed services. There are significant differences in capacity, and correspondingly, the level of dependence of small well-equipped Meteorological Services like Fiji, New Zealand and Australia. Part Two of this report details the present status of the twenty NMSs covered in this report.

1.2.2 Regional roles and obligations

In the past, the primary concern of NMSs in the region had been day-to-day observations and provision of forecast services for the public, marine interests and aviation. The Fiji Meteorological Service (FMS), which was formally established as a National Meteorological Service in 1975, took over most of the responsibilities previously held by the Nadi Meteorological Office, including the provision of tropical cyclone warnings for many Pacific islands, but excluding climate services. The establishment of the Regional Specialised Meteorological Centre (RSMC) in Nadi, Fiji, and its subsequent designation under the WMO World Weather Watch (WWW) as an official RSMC (with tropical cyclone specialisation), after a major upgrade funded by the Japanese government, re-affirmed it as the regional centre for many Pacific islands. The Weather Forecasting Centre of MetService New Zealand Ltd in Wellington is formally the designated back-up for the Nadi RSMC under the tropical cyclone operational plan for the region. The Nadi RSMC provides contingency back-up in respect of the Solomon Islands tropical cyclone advisories in the event of the failure of the Brisbane TCWC. The Brisbane TCWC provides back-up support to the Papua New Guinea National Weather Service (NWS) in the event of the failure of that Service to provide cyclone warnings.

In recent years, the climate change issue has added more responsibilities to most NMSs in the region, some of which do not have climate divisions or are too small to set up one. Meteorological Services are under increasing pressure to meet the national, regional and international obligations of their countries at a time of decreasing resources due to reform measures undertaken by several Pacific governments.

These new expectations from users and governments alike have placed the major burden of responsibility on NMSs to ensure the integrity (in terms of continuity, quality, homogeneity, and preservation) of climate records, since they have traditionally been the source of relevant expertise and, in recent years, the repository of climate and weather data nationally.

It needs, however, to be appreciated that while the quality of routine weather data for weather forecasting purposes is extremely important, to yield credible results in terms of monitoring climate and assessing climate change, the requirements for data integrity are more stringent. The support structures at all levels, personnel, equipment, on-going technical support, and the physical infrastructure for making the observations, communicating, analysing, managing and archiving the data require significant resources.

1.2.3 International obligations

Local weather and climate data are essential for NMSs to meet national obligations, i.e. the provision of daily national forecasts, warnings, and climate services. However, this cannot be achieved without regional and international data. Weather and climate transcend national boundaries. To predict the weather, modern meteorology depends upon near-instantaneous exchange of weather data and information across the entire globe. The global nature of meteorology (including climate) requires ongoing cooperation among all nations to freely exchange and share weather and climate data in order to understand, monitor, and predict weather and climate.

The primary regional and global obligation of all NMSs, carried out in the national interest of all nations, is the free and unrestricted exchange of essential meteorological (including climatological) data, and the maintenance of the concomitant communications and other support structures required for it. These obligations are recognised in the Convention of WMO and the recently adopted WMO Congress Resolution 40, which reinforces the need for free and unrestricted exchange of essential data.

The WWW, which is the core of the WMO pro grammes, combines observing systems, telecommunication facilities, and data-processing centres —operated by Members of WMO— to make available meteorological and related geophysical information needed to provide efficient services in all countries. The WWW is a unique worldwide operational system to which almost every country in the world contributes, every day of every year, for the common benefit of all countries.

Through the WWW, members coordinate and implement standardisation of measuring methods and techniques, common telecommunication procedures, and the presentation of observed data and processed information in a manner which is understood by all, regardless of language.

The WWW facilities are coordinated and monitored by the WMO with a view to ensuring that every nation has access to all of the data and information it needs to provide weather services on a day-to-day basis for the protection of their citizens, as well as for longer-term planning and research. Satellite weather data acquired at very high cost are provided free of charge to all nations in the region by some advanced nations (e.g. Japan, and USA) under the WWW).

An increasingly important part of the WWW is the provision of support for developing international programmes related to global climate and other environmental issues, and to sustainable development. The Global Climate Observing System (GCOS) is based on the concept of the WWW, around the core of which the atmospheric component of GCOS is being built.

Data exchange is both a need and an obligation of Pacific Meteorological Services (PMSs*)*. Like all NMSs in the world, PMSs have the regional and global obligation to collect and exchange meteorological observations within the operational framework of the WWW in conformation with international standards, as specified in WMO Technical Regulations.

Thus the national observational and the telecommunication networks of Meteorological Services for collecting national data, and the regional telecommunication networks for exchanging data and guidance products are the regional support structures essential for the provision of services to countries in the region. The geographical isolation of individual island nations makes data from their surrounding oceans and neighbouring nations all the more important. The global impacts of the recent 1997/1998 El-Niño-Southern Oscillation phenomena is testimony to the importance of collecting quality data from the region.

1.2.4 Co-operative arrangements for the provision of processed guidance products and numerical forecast outputs

Under the Global Data Processing System (GDPS) of WWW, advanced data processing centres have been set up in countries that have the necessary national resources and are willing to establish such centres and maintain them. The GDPS is a system whereby advanced centres (e.g. Melbourne World Meteorological Centre) have accepted the responsibility to provide processed guidance products to other national and regional centres (e.g. Nadi RSMC), which in turn provide processed products (e.g. tropical cyclone advisories) to national meteorological centres. It is a cascading process in which national centres benefit from regional centres, which in turn benefit from more advanced world centres. A number of regional and international centres monitor closely the Southern Oscillation phenomena and generate and disseminate freely information for use by the world community.

1.2.5 The role of development partners

In a number of PICs, before they became independent, meteorological networks were maintained by colonial governments and industries (e.g. sugar industry in Fiji) prevalent at the time. These networks were mainly for servicing international aviation through the region, and provide climate data for the industries concerned. Other services e.g. public and marine forecasts and cyclone warnings were incidental to aviation services.

Following independence, PICs gradually took over responsibility for the networks, and support from colonial governments declined correspondingly, although in some cases colonial governments (e.g. New Zealand) continued budgetary support until recently. However, some developed countries have contributed substantially through capital projects, training, and institutional support in meteorology. Contribution by Australia, France, the European Union, Japan, New Zealand, and USA are summarised below.

It needs to be stressed that while national socio-economic development is the primary goal of development assistance, assistance in meteorology has significant regional and global benefits compared to other sectors. National data has global applications. Further, data from the tropical Pacific region is pre-eminently important to the world, because of the dominant role of the Pacific Ocean on global climate and its variability, as evidenced by the El-Niño Southern Oscillation phenomena and other major global climatic controls. Further, in respect of the adverse effects of climate change, developed countries have an acknowledged obligation to assist the Pacific Islands. These are strong motivating factors for development assistance in meteorology.

It is likely that the traditional donors in the region listed above and other countries e.g. Denmark, Finland, and Italy would participate in the development projects identified in Part 3 of this report.

Australia

Australia, through Australian Agency for International Development (AusAID) funding, and the resources of the Bureau of Meteorology, has contributed to significant development assistance in meteorology and climate-related programmes and activities in PICs. The Bureau has been involved in the provision of meteorological training and participation in bilateral and multilateral support programmes in collaboration with AusAID and other organisations, and more recently through a modest contributions to the Voluntary Cooperation Programme (VCP) of WMO.

Major activities include:

- Pacific Meteorological Services Needs Analysis Project (PMSNAP);
- Two weather radars for Fiji;
- Low resolution satellite imaging systems for a number of countries under the Voluntary Cooperation Programme (VCP) of WMO;
- Training: Diploma in Meteorology Training Course and Assistant Forecaster Course run by the Bureau of Meteorology Training Centre (BMTC); CLICOM Training Courses, funded by AusAID; and courses/workshops on tropical cyclone forecasting, marine meteorology, instruments and satellite meteorology, in co-sponsorship with WMO;
- Provided meteorologists and other personnel to some countries under AusAID's Australian Staffing Assistance Scheme;
- Support for PIC NMS staff attendance at various conferences (including those related to climate change) and workshops;
- Expert support to countries in specialised technical areas;
- Development of the Strategic Action Plan for the Development of Meteorology in the Pacific Region (2000–2009);
- Funding support and experts for the Pacific Meteorological Services Needs Analysis Project;
- Upgrading upper air systems in some countries (through Voluntary Cooperation Programme (VCP) of WMO)

Australia's contribution to development assistance in meteorology in the region in the last several years has ranged from about US$200,000 to 1.5 million per year.

European Union (EU)

A regional project funded by the EU on upgrading the regional tropical cyclone warning system was completed in early 2000, implemented through the Pacific Islands Forum Secretariat for Asia/Pacific Caribbean (ACP) member countries. It included the upgrading of disaster management capabilities of these countries in respect of tropical cyclones, and several items of equipment. The project provided EMWIN systems to a number of countries in cooperation with SPREP and the US NWS. The project assisted in upgrading local and international communication systems through the installation of Local Area Networks and TCP/IP links to the GTS via Melbourne. A number of high frequency transceivers were also provided to several countries. The project conducted a number of in-country and regional workshops and training courses to assist in tropical cyclone awareness and education in the region. The total funds provided for the project was over US$2.2 m dollars.

France

Regarding meteorological activities, France is present in the Pacific region, as Météo-France and is the official Meteorological Service for New Caledonia, Wallis and Futuna, and French Polynesia.

These two Services employ more than 210 persons: 100 for New Caledonia and Wallis and Futuna, 112 for French Polynesia.

The main centres are Nouméa (63 persons) and Tahiti (85 persons).

Météo-France operates the following observing station: -

- **New-Caledonia**
  Noumea,
  Magenta,
  Tontouta,
  Koumac,
  Poindimié (Grande-Terre) and
  Ouanaham (Lifou island),
- **Wallis and Futuna**
  Hihifo and
  Mahopoopo
- **French Polynesia**
  Bora Bora (Leward Islands)
  Faa'a (Tahiti island),
  Hiva Hoa (Marquises archipelago),
  Takaroa,
  Hereheretue,
  Mangareva (Tuamotu-Gambier archipelago),
  Tubuai,
  Rapa (Australes archipelago).

Météo-France operates a radiosonde station in New-Caledonia, and five radiosounde stations in French Polynesia, providing data seven days a week.

The typical yearly total budget for all the French meteorological services in the Pacific region is roughly 80 MFF (US$12 million).

Japan

The Japanese International Cooperation Agency (JICA) provided funding for a project to strengthen RSMC Nadi, Fiji, as a contribution to the regional cyclone warning system. The project was completed in 1998. The total cost of the project was over US$13 million. Components include:

- Purpose-built building for the RSMC and related facilities;
- Upper Air Observation Analyser to replace the existing old radiosonde facility;
- Meteorological calibration equipment for quality control of observed data;
- Computer systems for data processing and communication;
- Satellite receiving systems for high resolution data from the Japanese Geo-stationary Meteorological Satellite (GMS) and the NOAA Polar Orbiting Satellite;
- Seven Automatic Weather Stations (AWSs); and
- Two vehicles.

Implementation of a five-year project (under Japan's third country training programme) on human resources development in meteorology, in collaboration with and hosted by FMS, will begin in 2000. Training will include meteorology and disaster management personnel and the project has the objective of improving the warning system and optimising public response.

New Zealand

For over 50 years New Zealand has played a leading role in the provision and development of meteorological services in the South-West Pacific. A realignment of the type of support towards development over the last decade has meant that New Zealand now has a reduced or only back-up involvement in the actual provision of meteorological services. The focus has moved from directly managing Meteorological Services to providing advice and assistance on a project basis with funding from various sources including bilateral, multilateral and from Meteorological Service of New Zealand's (MetService of NZ Ltd) own funds. Some of the projects are in the form of long term consultancies and may last a few years. In this way the Meteorological Services of developing PICs are assisted to become self-sufficient in managing and operating their own services but there is always advice and specialist assistance available when required.

MetService of NZ Ltd maintains close contacts with many of the Meteorological Services and routinely monitors meteorological outputs from the region. This enables New Zealand to identify problems that countries may be encountering in either management or technical performance and to offer focused assistance. This approach is much less intrusive than the earlier programmes where New Zealand maintained expatriate staff in-country managing local staff, and it positively contributes to self-development.

In 1992 significant organisational changes occurred in New Zealand and the former government agency became corporatised. At this time the Research Division and climate monitoring staff of the former New Zealand Meteorological Service were combined with other national research groups to become the National Institute of Water and Atmosphere (NIWA). The corporatisation process, subsequent changes and development have been of interest to some PICs. Advice has been provided on corporatisation options, cost reduction, cost recovery, commercialisation, institutional strengthening, efficiencies, alignment of inputs and outputs, and quality systems for the monitoring of performance. Through MetService's continuing regular supportive and consultative involvement in the Meteorological Services of the South-West Pacific it has gained an intimate knowledge of meteorology in the region.

MetService directly manages upper air observation programmes that are primarily funded by United Kingdom Meteorological Office through the WMO, WWW and other Technical Cooperation Programs (TCP). These programmes operate at Tarawa, Funafuti and Penrhyn Island (Cook Islands). The programmes at Tarawa and Funafuti are operated by the country Meteorological Services with MetService providing financial management, logistical and technical support. At Penryhn, MetService provides more extensive support including programme operation by an employee of MetService.

The Pacific countries in which MetService is presently providing, or has recently provided, advice, assistance or installations through various funding sources are: Cook Islands, Fiji, Kiribati, Niue, Papua New Guinea, Pitcairn Island, Samoa, Tokelau Islands, Tonga, Tuvalu and Vanuatu. The total value of project work that MetService completed or managed in the region in 1999 was NZ$1,090,000 (approx. US$585,000).

United States of America

The US National Weather Service (US NWS) has provided considerable meteorological support to the Pacific islands, through the operation of first order Weather Service Offices (WSO), and Weather Service Forecast Offices (WSFO), in the post World War II era, with establishment of the following offices:

Honolulu	1904
Canton Island	1947 (Closed 1967)
Wake Island	1948 (Closed 1997)
Hilo, Hawaii	1950
Lihue, Hawaii	1950
Midway Island	1950 (Closed 1952)
Koror, Palau	1951
Yap, FSM	1951
Chuuk, FSM	1951
Pohnpei, FSM	1951
Majuro, RMI	1955
Guam	1956
Johnston Island	1958 (Closed 1984)
Eniwetok	1960 (Closed 1968)
Kwajalein	1960 (Closed 1975)
Kahului	1961 (To be closed 7/1/00)
Pago Pago	1961
Marcus Island	1963 (Closed 1968)

In 1989, in response to the termination of the U.S. Air Force's Typhoon Reconnaissance Program for the Tropical Northwest Pacific Ocean, based in Guam, the US NWS Pacific Region, in cooperation with the US Navy, has established a programme to install twenty (20) AWSs in Micronesia, and the five Micronesia Weather Service Offices (Yap, Chuuk, Majuro, Koror, Pohnpei) operating to 24 hours a day, and two upper air soundings per day.

Annual support provided by the U.S. to the Federated States of Micronesia, the Republic of the Marshall Islands, and the Republic of Palau, to operate the five Micronesian Weather Service Offices, is about US$3.9 million, US$650,000 to support operation of the Weather Service Office at Pago Pago, American Samoa, and US$2.5 million to op erate a regional forecast centre and maintenance depot on Guam, for a total annual contribution of more than US$7 million.

In response to the impact of Tropical Cyclones Ofa and Val in American Samoa, the US NWS Pacific Region installed eleven (11) AWSs throughout the Samoa islands, which allowed weather reports to be disseminated to forecast centres 24 hours per day, seven days per week, via satellite, and not be impacted by the shutdown of island telecommunication disruptions caused by storms.

In August, 1994, the US established the experimental Pacific El Nino Southern Oscillation (ENSO) Applications Center (PEAC) to conduct research and develop information products specific to the US Affiliated Pacific Islands (USAPI) on the ENSO climate cycle, its historical impacts, and latest long-term forecasts of ENSO conditions, in support of planning and management of activities in such climate-sensitive sectors as water resource management, fisheries, agriculture, civil defence, public utilities, coastal zone management, and other economic and environmental sectors of importance to the communities of the USAPI.

The implementation of the EMWIN broadcast on GOES-West in the Pacific, and the expansion of EMWIN receiving stations into Pacific Island NMSs and National Disaster Management Offices has gone a long way to ensuring receipt of meteorological data and products within each country/territory jurisdiction.

The US NWS and the US FAA also collect Pacific island meteorological data and products, for re-dissemination within the US and internationally through the Global Telecommunications Systems (GTS).

USA's Office of Foreign Disaster Assistance funded a high resolution satellite data reception and processing system for the FMS in 1986, and provided a hydrogen generator, as a contribution towards upgrading the region's cyclone warning system.

United Nations Development Programme (UNDP)

UNDP funded a four-year regional project in support of tropical cyclone activities in the region beginning in 1987. Significant benefits accrued from the project. However, further support over the next one or two UNDP programming cycles would have assisted in consolidating the gains made, as had been the case in the Northwest Pacific and Indian Ocean, where similar projects where implemented over several cycles.

World Meteorological Organization (WMO)

WMO continues to provide support through its Technical Cooperation Programme in various areas such as cyclone warnings, WWW facilities, climate data management, climate applications, and training, in collaboration with developed countries. The recent establishment of the WMO Sub-regional Office for the South-West Pacific has the objective of enhancing coordination of development activities in the region, in cooperation with SPREP.

South Pacific Regional Environment Programme (SPREP) and other CROP agencies

Apart from WMO Regional Association V, SPREP is the main regional organisation responsible for assisting NMSs. Since 1993, SPREP has been providing assistance to Meteorological Services via technical cooperation programmes, provision of equipment, arranging annual meetings of regional Meteorological Service Directors, and formulating project proposals on behalf of its members. SPREP offered to host the WMO Sub-regional Office within its headquarters in 1997. This has resulted in closer collaboration between the two organisations. SPREP has managed to secure well over US$6 million to assist Meteorological Services in the region in the past ten years.

Other regional agencies

Other regional agencies, such as the South Pacific Applied Geoscience Commission (SOPAC), the Secretariat for the Pacific Community (SPC) and the University of the South Pacific (USP) have provided direct or indirect assistance to Meteorological Services in recent years, training workshops and other training activities.

2.1 OVERVIEW

All SPREP members have a Meteorological Service. Most of these were established during the late nineteenth century by colonial governments and administrations occupying the region. In the post-independence era which began in 1962 for the region, with Samoa (formerly Western Samoa) becoming the first Pacific island country to gain independence, most independent Pacific Islands gradually took over full responsibility for managing their Meteorological Services, as support from former colonial governments and administrations was slowly phased out.

However, some advanced countries, most noticeably France and the USA, continue to provide assistance to some islands and territories. These countries have continued to provide or are planning to contribute substantially to capital (infrastructure) projects, human resource development and institutional support for meteorological services in their affiliated countries and territories.

In recent years Pacific island governments have realigned their priorities in response to diminishing resources and economic stagnation. Despite the threat of climate change, reduced resource allocation to meteorology in a majority of countries has led to a serious decline in standards of weather observations, telecommunications and services. Country summaries in the following section clearly highlight this scenario. The 21 national country reports prepared as a part of this study provide detailed information.

2.2 COUNTRY SUMMARIES

2.2.1 American Samoa

American Samoa is an unincorporated territory of the United States of America administered by the US Department of the Interior, although it is self-governed by Samoans. As such, the American Samoa Weather Service Office (ASWSO) is fully funded by the U.S government through a Federal appropriation administered by the U.S National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Pacific Headquarters, in Honolulu, Hawaii. Two well-qualified professional meteorologists supplement the office staff. It provides forecasting warning services (public, marine, and severe weather warnings) for American Samoa with the help of guidance products provided by the US NOAA NWS Forecast office in Honolulu, and RSMC, Nadi, Fiji. The Honolulu Forecast Office, co-located with the Central Pacific Hurricane Centre, issues aerodrome forecasts for Pago Pago. An Emergency Managers Information Network (EMWIN) system at the office provides access to additional sources of weather information. Numerical model guidance from the US NWS's National Center for Environmental Prediction are downloaded by ASWSO meteorologists for use in the forecast programme. High resolution satellite imagery is also available at the station.

The ASWSO coordinates closely and assists with the provision of severe weather warnings for Samoa (independent) under a new agreement signed by both countries in 1998. The new agreement formalised the assumption of full responsibility to American Samoa, and Samoa, to issue their own warnings and forecasts with RSMC Nadi and the Honolulu Forecast office providing guidance products only. The new agreement has been found to be a major success and during the WMO Congress in 1999, the Congress urged other NMSs in similar circumstances to use the 'Samoa model' in establishing formalised agreements with the Nadi RSMC for coordinating their national warnings.

In the aftermath of Cyclones Ofa and Val in 1990 and 1991, the US government, through the NWS, installed eleven (11) AWSs covering the whole of the Samoa Islands group (American Samoa and Samoa), transmitting hourly continuous meteorological data via the GOES-10 West Satellite, for dissemination both within their countries, as well as to the regional forecast centres in Nadi and Honolulu.

The ASWSO observational programme includes aviation weather observations, climate observations, and observations carried out on a co-operative basis by other organisations. There is one upper air station in Pago Pago, operating twice daily, providing wind/radiosonde observations. Additional upper air observations are taken during tropical cyclones. ASWSO supports national, regional and international data requirements. An EMWIN system provides alternative access to a range of weather information, independent of terrestrial communication links.

Since Cyclone Ofa and Val, there has been very significant improvement in the provision of weather services generally, and particularly tropical cyclone warnings. All surface and upper air data (including aviation reports) are archived locally and also at the US National Data Climate Centre (NCDC), in Asheville, USA. These archived data are available on CD. Data from cooperative observing stations are sent to the US NWS Pacific Regional Headquarters, Honolulu, which are then forwarded to NCDC for archiving.

The key users of ASWSO services and products are the general public, disaster management, government agencies, marine interests, aviation, and the media. Users are very happy with the services provided by the ASWSO as evident during consultations.

2.2.2 Cook Islands

The Cook Islands is a self-governing country with close association to New Zealand, and as such meteorological services were previously administered by the former NZ Meteorological Service (now MetService NZ Ltd). Expatriate staff from New Zealand managed the Cook Islands Meteorological Service (CIMS) until 1992 when the Cook Islands government assumed responsibility. Since then, CIMS has been fully localised. A Meteorology Act regulates the provision of meteorological services.

In around 1996, the Cook Islands government undertook major reforms, cutting back its public servants by nearly 50%. The CIMSs undertook massive downsizing of its staff as part of this reform. By 1996, operating resources were reduced by 33%, with savings achieved mainly through automation of surface observations.

CIMS has limited forecasting capability and as such relies fully on RMSC Nadi to provide severe weather warnings, public forecasts, some aviation forecasts (aerodrome forecasts, areas forecasts, and low- and mid-level route forecasts) and marine forecasts; and on the MetService of New Zealand Ltd for high-level aviation route forecasts.

At present, there are two human-operated observing stations in operation and seven AWSs covering the whole country. Prior to 1991, there were eight manual stations and one AWS. The radar wind programme which started at Rarotonga some 30 years ago continues. The radiosonde programme which was started in 1975 at Rarotonga was terminated in 1989. Similarly, earlier pilot balloon wind-measuring programme at Aitutaki and Pukapuka have recently been terminated. An upper air station (radar wind only) operates at present in Penryhn Island. This station is fully funded by WMO and the United Kingdom Meteorological Office, as part of the WWW and is staffed by an expatriate from New Zealand. Prior to 1989 twice daily (one radiosonde) observations were taken. All facilities at the station need to be replaced including the hydrogen generator. A satellite imaging system at Rarotonga provides low-resolution data. CIMS has limited capacity to maintain high-tech equipment.

Climate records for the Cook Islands are kept in New Zealand by the National Institute for Water and Atmospheric Research (NIWA). Climate data management and analysis is done by NIWA. CIMS has the CLICOM (Climate Computing Systems (a PC-based climate data management system), but no dedicated computer, no full-time CLICOM operator, and not all data have been archived.

For communications, an EMWIN system provides alternative access to a range of weather information. CIMS has access to a range of products on the Internet. Main users of meteorological services are: the general public, media, disaster management, environment, aviation, marine, tourism, and agriculture (mainly subsistence).

2.2.3 Fiji

Fiji is an independent country and one of the most developed in the region. With its central location, Fiji is the hub for the region. Fiji hosts the WMO Regional Specialized Meteorological Centre (RSMC) with tropical cyclone specialisation.

The Fiji Meteorological Service (FMS) 2000 annual budget is estimated to be about US$1.5 million. In comparison to other Meteorological Services in the region, the FMS is well resourced with about 55-60% of its operational costs recovered from charges to aviation. The FMS has been a nationally administered Meteorological Service since 1979 and was operated by the former New Zealand Meteorological Service prior to 1975, as a branch office primarily to meet regional aviation needs, under arrangements put in place by the South Pacific Air Transport Council.

The FMS operates the RSMC with regional tropical cyclone warning responsibilities. It provides Tropical Cyclone Special Advisories to Samoa and Vanuatu, and forecasting services and full severe weather warnings to the Cook Islands, Fiji, Kiribati, Niue, Tokelau, Tonga, Tuvalu, Wallis and Futuna.

FMS also provides marine weather bulletins (including warnings for high seas) and specialised aviation services for an extensive area of the South Pacific tropical region. The MetService of NZ Ltd Forecasting Centre in Wellington provides back-up to the Nadi RSMC in support of its role as the regional cyclone warning centre, under the regional tropical cyclone operational plan. The Brisbane TCWC, ABM, and the US NOAA NWS Central Pacific Hurricane Centre in Honolulu, provide supplemental meteorological information.

FMS has five human-operated surface observing stations, seven AWSs, and one upper air station (two observations are taken per day (one radiosonde)). It is the hub for regional meteorological telecommunications. An EMWIN system provides alternative access to a range of weather information.

FMS has well-developed infrastructure (automated data processing system, high resolution satellite data processing system, two radars, communications system, purpose-built building), which was upgraded recently, primarily through funding support from Japan, Australia and New Zealand.

FMS has a well-developed Climatology Division, with a large number of users of climate data, advice and information. The CLICOM system is well utilised with data entry completed for a large number of stations. The number of voluntary observing stations has declined in the last two decades. There is a strong need for development of applications in climatology in cooperation with industry.

A dearth of experience in tropical cyclone meteorology, and limited ongoing support for the high technology data processing and observational systems are concerns in terms of FMS continuing to satisfactorily fill the RSMC role. The FMS is slowly building up some capacity to maintain high-tech equipment (FMS relied on the Civil Aviation Authority of Fiji in the past). There is a slight risk of failure to provide adequate regional warnings if three or more cyclones develop in its region of responsibility, due to limited expert staff resources.

The primary users of meteorological services are aviation, marine interests, disaster management, public, the media, energy, environment, agriculture, water resources, forestry, and tourism. FMS has the capacity to provide weather observer training to national and regional personnel.

2.2.4 French Polynesia

French Polynesia is an overseas territory of France. Meteorological services are almost fully funded by the French National Meteorological Service, Meteo-France. The French Polynesia Territorial government funds a part of the budget dedicated to climatological activities.

The “Direction Interregionale de Meteo-France en Polynesie Française (DIRPF)” manages and operates the service.

This Service is characterised by a very extensive area of responsibility. It covers a domain as large as Europe, whereas the land area, especially inhabited land, is only a very small fraction of it.

The Service has implemented an observing network comprising of five upper air stations, three human-operated surface stations, eight AWSs and has a fully operational forecast centre open 24 hours, seven days a week. The equipment used, the instrumentation, the information processing systems and the telecommunications devices are of a technological level in general identical to those used in the French Metropolitan Service.

The personnel, including the observers on remote islands, amount to 112 people in French Polynesia. It is a technically well equipped service with well-trained personnel.

The DIRPF has a full forecasting capability with a good technically trained forecast team of 16 people. It provides severe weather warnings (tropical cyclones, intense precipitation, high swell), public forecasts, specialised aviation services, marine bulletins (including warnings for the high seas) and provides various products or studies to a number of customers. The forecast center produces approximately 15,000 bulletins each year, including 300 special bulletins.

The French Polynesia Meteorological Service has a developed Climatology-and-Studies Division, with a large number of users of climate data, advice and information. The number of voluntary climatological observing stations is about 80.

The primary users of meteorological services are disaster management, aviation, marine, public, media, tourism and energy. The service provides various training courses to its personnel.

2.2.5 Guam

Guam is a permanent, incorporated territory of the US. As in other US territories, the Guam Weather Forecast Office (WFO) and Micronesian weather stations are managed and supervised by the US NWS, Pacific Region Headquarters, Honolulu, Hawaii.

Meteorological operations are fully funded by the US government. Guam WFO provides public forecasts and warning services for the island territories of Guam, Commonwealth of Northern Marianas (CNMI), Republic of Marshall Islands (RMI), Federated States of Micronesia (FSM), and the Republic of Palau (ROP). It also provides aerodrome forecasts for these states. Guam WFO is the Meteorological Watch Office for the Guam Flight Information Region. It maintains a first order observational programme. Surface observations include those for routine weather forecasting purposes, aviation services, climate purposes and those made by other organisations under cooperative observations.

Guam WFO has oversight responsibilities for AWSs throughout Micronesia, and for the collection of synoptic, aviation, and upper air reports from other weather offices in Micronesia. Their upper air programme includes wind/radiosonde twice a day (special observations are taken during cyclones). The Guam WFO has an excellent complement of professionally qualified meteorologists, hydrometeorological assistants, and other technical support staff including computer experts.

The Office is led by a Meteorologist in Charge, a Science Operations Officer, a Warning Coordination Meteorologist, and a Data Acquisition Program Manager. A separate team of electronics technicians at the Guam Sub-Regional Maintenance Depot, collocated with the Guam WFO provides electronic technical support to other stations in Micronesia, and training to electronic technicians located at Majuro, Pohnpei, Chuuk, Yap, and Koror. The team also provides support to Automatic Surface Observation System (ASOS) and SAWRS (Supplementary Aviation Weather Reporting Stations), and install and assist with maintaining the Automatic Weather Stations (AWSs) in Micronesia.

All surface and upper air data (including aviation reports) are archived locally and at the NCDC, Asheville, USA. Archived data is available on CD. Data from cooperative observing stations are archived at the US NWS Pacific Regional Office, Honolulu. The main users include states of Micronesia, the military, government, marine, aviation, and the media

2.2.6 Kiribati

Kiribati is an independent country. In the past, Kiribati fully relied on New Zealand and the United Kingdom for the operation of its meteorology programme, including budgetary support. The Kiribati government took over full responsibility in the late 1980s. The government position regarding aid is that it must be sustainable and within the Kiribati Meteorological Service (KMS) budget, and new and additional assistance may be required for ongoing costs. There are limited resources available from the government to meet on-going costs.

The KMS is a small Service but plays a very important role in global meteorology due to its geographic location (located in the centre of the tropical western Pacific). The KMS provides a good service despite the run down (old) office buildings, poor infrastructure and limited professional staff.

There is no forecasting capability. It relies on the FMS for severe weather warnings, public forecasts, some aviation forecasts (aerodrome forecasts, areas forecasts, and low and mid-level route forecasts) and marine forecasts; and on MetService of NZ Ltd for high level aviation route forecasts.

There are seven surface human-operated stations (KMS plans to supplement these with an AWS). There is one upper air station (windfinding and radiosonde), funded by the WWW and administered by MetService of New Zealand Ltd. A satellite imaging system provides low-resolution data.

An EMWIN system provides alternative access to a range of weather information. Reports are collected by telephone, VHF, and HF radio, and sent to MetService of NZ Ltd by e-mail for insertion into GTS. The hydrogen generator is 20 years old. Office buildings are old and need replacing. Synoptic weather stations also serve as climate stations.

Climate data is managed and archived using CLICOM on a 486 PC which needs replacement. There are no reliable back-up facilities for data archives. There is only a half-time operator for CLICOM (only person trained on CLICOM). Not all data are archived. KMS staff also assist with the National Tidal Facility tide gauge and the NOAA wind profiler. An additional wind/radiosonde programme is recommended to cover the extensive area.

The primary users of meteorological services are the general public, disaster management (cyclones and droughts), environment, aviation, marine, and water resources.

2.2.7 Marshall Islands

The Marshall Islands is an independent country with free association with the United States. RMI's observational programme is fully funded by the USA under that Compact of Free Association, which is currently undergoing renegotiation with the USA. It is operated in cooperation with the US NWS Pacific Region Headquarters, Honolulu.

The Marshall Islands Weather Service Office (MIWSO) has little forecasting capacity. It has a strong complement of staff (total 11) with a range of requisite skills. A MIWSO employee is currently enrolled in university study in meteorology at the University of Hawaii, and will return to Majuro after receiving his BSc degree and completion of a nine-month meteorological internship in Guam. That person will eventually assume the position of Meteorologist in Charge of the MIWSO. The Majuro WSO uses guidance products from the Guam WFO to provide public forecasts for Majuro, and marine forecasts for coastal waters. Severe weather warnings are issued by the Guam WFO (cyclone guidance forecasts are issued the Joint Typhoon Warning Centre, Pearl Harbour, Hawaii to the Guam WFO, which has responsibility for the issuance of cyclone warnings to the public).

The MIWSO supervises a SAWRS at Majuro and five second order synoptic stations on outer islands. Observations include those for routine weather forecasting purposes, aviation services, climate purposes, those made by other organisations under cooperative arrangements and from AWSs. Upper air observations are taken at the Majuro WSO, and include wind/radiosonde twice a day (and additional special observations during cyclones).

All surface and upper air data (including aviation reports) are archived locally and at the NCDC, Asheville, USA. Archived data is available on CD. Data from cooperative observing stations are sent to US NWS Pacific Regional Headquarters, Honolulu, which forwards them NCDC for archiving. Areas needing improvement are: telecommunications, routine forecasts (extension to three to five days); weather radar to help with severe weather warnings; a new building; additional AWSs; and long-term seasonal/interannual predictions.

2.2.8 Federated States of Micronesia (FSM)

The Federated States of Micronesia is an independent country with free association with the United States. As such, all its meteorological activities are fully funded by the US government, under the Compact of Free Association signed in 1986, that is currently under re-negotiation. FSM is made up of four states: Kosrae, Pohnpei, Chuuk, and Yap. There are first order weather stations, called Weather Service Offices (WSOs) operating 24 hours per day, seven days per week at Pohnpei, Chuuk, and Yap, which provide observations, and public and marine forecasts based on guidance products provided by the Guam WFO. Each of the FSM WSOs now has a professional meteorologist assigned to their stations. The Yap WSO now has a meteorologist heading the office, and the Pohnpei Office will be headed by a meteorologist by the end of 2000.

Routine forecasts and severe weather warnings are provided by the Guam WFO and disseminated by the three first order offices. Aerodrome forecasts are also provided by Guam WFO. A Supplementary WSO (SAWSO) is located at the Kosrae International Airport. There are also a number of second order synoptic stations and AWSs operating throughout the country. Observations include those for routine weather forecasting purposes, aviation services, climate, and those made through cooperative arrangements with other organisations.

Upper air observations (wind and radiosonde) are taken twice a day at the WSOs, with special observations added on during tropical cyclones. All surface and upper air data (including aviation reports) are archived locally and at the NCDC, Asheville, USA. Archived data is available on CD. Data from cooperative observing stations are sent to US NOAA NWS Pacific Headquarters, Honolulu, which forwards them to NCDC for archiving.

Improvements required to weather services include increasing the density of observations at remote locations for aviation, marine weather forecasting, climate data and services, and weather and climate forecasting generally. Some buildings need replacing and relocating.

The main users of weather and services are the general public, disaster management, aviation, marine, environment, tourism, media, and fisheries.

2.2.9 Nauru

Nauru does not have an official National Meteorological Service. However, observations have been carried out on the island (at the airport) for a number of years to meet aviation needs. The sea level tide gauge and climate monitoring equipment provided under the Australian government funded Sea Level and Climate Monitoring Project also measures some meteorological parameters.

Nauru hosted the second of the US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) climate research stations – the "Atmospheric Radiation and Cloud Station (ARCS)". The US DOE ARM ARCS was commissioned in November 1998 and contains highly sophisticated and world class observing equipment, measuring cloud properties, solar and terrestrial radiation, and normal meteorological parameters (wind, pressure, temperature, etc.).

The present unofficial forecasts and warnings (narrative only) for Nauru are issued by the US NOAA NWS Weather Forecast Office in Honolulu. This ad hoc arrangement was entered into in 1999 by SPREP and ARM to assist scientists during the Nauru99 campaign. It was recommended that this ad hoc arrangement should continue until the Nauru government officially informs Fiji to provide an official forecast. An EMWIN system is already operating out of the US DOE ARM ARCS, which provides access to the narrative from Honolulu for Nauru as well as other weather and climate information. A satellite imaging system provides low-resolution data.

2.2.10 New Caledonia

New Caledonia is an overseas territory of France. Meteorological services are largely funded by the French National Meteorological Service, Meteo-France. The New Caledonia government funds a significant part of the budget dedicated to infrastructures and large-budget observing equipment.

The "Direction Interregionale de Meteo-France en Nouvelle-Caledonie (DIRNC)" manages and operates the Service.

The Service has implemented an observing network comprising one upper air station, six human-operated surface stations, 42 AWS provide real and non-real time data. The equipment used, the instrumentation, the information processing systems and the telecommunications devices are of a technological level, in general, identical to those used in the French Metropolitan Service. The personnel, including the observers on remote islands, amount to 80 people. It has good technical capability and well-trained personnel.

The DIRNC has full forecasting capability with a good technically trained forecast team. It provides severe weather warnings (tropical cyclones, intense precipitation, forest fire risks), public forecasts, specialised aviation services, marine bulletins (including warnings for high seas and lagoon conditions) and different products or studies to a number of customers.

The New Caledonia Meteorological Service has a well-developed Climatology Division, with a large number of users of climate data, advice and information. The number of voluntary climatological observing stations is about 50.

The primary users of meteorological services are disaster management, aviation, marine, public, the media, energy, agriculture, water resources, forestry and tourism. The Service provides various training courses to its personnel.

2.2.11
Niue

Niue is a self-governing country with close association with New Zealand and as such, meteorological services were administered by the former NZ Meteorological Service (now MetService of NZ Ltd) in the past. The Niue Meteorological Service (NiMS) was established in 1997 (the observations programme was administered by Niue Telecom before then). Niue's population is 1700 with net migration loss of 200 per year. The future of the NiMS is uncertain. There is strong private interest to provide services, which could be a threat to future viability of NiMS.

There are limited resources to meet ongoing costs. The Niue government position regarding aid is that it must be sustainable through the NiMS budget, and assistance may be required for ongoing costs from aid sources. NiMS has no forecasting capability. It relies on FMS for severe weather warnings, public forecasts, some aviation forecasts (aerodrome forecasts, areas forecasts, and low- and mid-level route forecasts) and marine forecasts; and on MetService of NZ for high level aviation route forecasts. There is one AWS (with human observed visual elements). Observations are taken by NiueTelecom outside working hours, when the NiMS Office is closed. A satellite imaging system provides low-resolution data. An EMWIN system provides access to a range of weather information. There are no upper air observations. Climate observations are extracted from AWS reports. CLICOM is used for climate data entry.

Weather data are sent to MetSerivce of NZ Ltd by e-mail for insertion into the GTS to save costs. Communication costs and reliability are significant concerns. The main users are the public, disaster management, environment, the media, marine, aviation, and limited tourism. Weather radar is desirable but unsustainable due to lack of ongoing support, including spares.

2.2.12
Northern Mariana Islands

The Northern Marianas is a self-governing commonwealth with covenant of free association with the United States. Citizens of CNMI are citizens of the USA (without the right to vote in US presidential elections). There is no meteorological office in the Northern Marianas.

The Northern Marianas meteorological programme is fully funded by the US government (Federal Program) through payments under the Marianas Covenant, signed in 1978. It has no forecasting capacity. The US NOAA NWS Forecast Office in Guam provides forecast and warning services for CNMI while the US NOAA NWS Aviation Weather Centre in Kansas City provides aviation weather information.

CNMI has a Supplemental Aviation Weather Observation Station (SAWOS) at Saipan, Rota, and Tinian airports. An ASOS is located at Saipan. There are no upper air reporting stations. The US Air Force's Doppler Weather radar provides coverage over the southern Mariana Islands.

The aeronautical telecommunications systems are old and need replacement. Surface weather observational coverage needs to be enhanced, possibly through more ASOSs. All surface and upper air data (including aviation reports) are archived locally and at the NCDC, Asheville, USA. Archived data is available on CD. Data from cooperative observing stations are sent to the US NWS Pacific Regional Headquarter Office, Honolulu, which forwards them to NCDC for archiving.

The main users of meteorological services are the general public, disaster management, government, aviation, tourism, water resources, coastal marine resources, and the media.

2.3.14 Palau

Palau is an independent country with free association status with the United States. RMI's observational programme is fully funded by the USA under the Compact of Free Association with the USA. It is operated in cooperation with the US NWS Pacific Region Headquarters, Honolulu.

Palau's Weather Service Office (PWSO) has a good complement of staff (total 11) with a range of requisite skills. The first Palauan meteorologist is undergoing forecaster training at WFO Guam, and should assume the position of Meteorologist-in-Charge by December 2000. The PWSO provides daily locally adaptive public and marine forecasts for Palau, based on guidance products provided by WFO, Guam. Severe weather warning services are provided by Guam WFO.

Surface observations are made at Koror and at Palau Airport. Observations include those for routine weather forecasting purposes, aviation services, climate purposes and those made by other organisations under cooperative arrangements. Upper air observations (including radiosonde) are made twice daily (additional during cyclones). All surface and upper air data (including aviation reports) are archived locally and at NCDC, Asheville, USA. Archived data is available on CD. Data from cooperative observing stations are sent to US NWS Pacific Regional Office, Honolulu, which forwards them to NCDC for archiving.

The main users are the public, disaster management, government, aviation, marine, water resources, and the media. Plans for improvement include additional aviation observations at rural airports; greater access to weather and climate by users; greater co-operation with the media; and the appointment of a Climate Change Coordinator for Palau.

2.2.14 Papua New Guinea

The Australian Bureau of Meteorology (ABM) administered meteorological operations in PNG until 1974. Currently the Papua New Guinea National Weather Service (PNGNWS) is a division of the Office of Civil Aviation. It does not enjoy the status of a separate major department and has limited control over its budget.

Institutional strengthening was identified in 1993 as a development need of the PNG NWS, but has not occurred. Under a modernisation programme, based upon the advice of the ABM 1994, the UK Met Office upgraded two existing wind-finding radars. The radars have not operated since 1995 due to budgetary pressures. An upper air programme was established at Madang, but was discontinued due to lack of maintenance. The surface observing programme has declined as equipment failed and was not replaced. A satellite imaging system provides low-resolution data. An EMWIN system provides alternative access to a range of weather information.

In 1998 the Office of Civil Aviation embarked on a massive refurbishment and restructuring programme with a corporatised efficient structure as the end-result. The programme is known as Balus. As part of this programme an extensive review to determine the Needs Analysis and Strategic Directions of the NMS was completed in 1999, which is the basis of the Needs Analysis for this project in respect of PNG. As a result of this review some urgent systems work is progressing to restore the NMS capability but much more extensive restoration is required to address what are very significant deficiencies within a NMS with regional forecasting responsibilities.

The PNG NWS has national responsibility for climate and for weather forecasting. There is only one professionally trained meteorologist in the Weather Forecasting Section. The primary role (80% of the work) of PNG NWS is the provision of aviation weather services (domestic and international). It is under-funded, run-down and unable to provide effective services.

Climate services, in which almost all available professionally trained meteorologists are involved, is reasonably well developed. CLICOM is used reasonably effectively. Government commitment is required for strengthening the PNG NWS.

The main problems identified were unreliable observations due to the lack of appropriate instrumentation, lack of proper observer training, unreliable communications, lack of forecaster training and confidence, and of forecasting and observational (satellite and radar) tools, user needs awareness (especially in aviation).

The main users of meteorological services are the general public, the media, aviation, marine, public, disaster management (severe weather, including drought), agriculture, forestry, mining and petroleum, power, water resources and tourism.

2.2.15 Samoa

The Apia Observatory has been fully funded by the Government of Samoa since 1989. Its name was changed to Samoa Meteorological Service Division (SMSD) in 1995.

There are two human-operated synoptic stations, six AWSs (used for climate reports also), six climate stations, and about 15 rainfall stations. Aviation reports are prepared at Faleolo Airport and Fagali Airport. The SMSD receives low-resolution satellite imagery. Faleolo Airport TAFs (Terminal Aerodrome Forecasts) are prepared by FMS. An EMWIN system provides alternative access to a range of weather information.

There is limited forecasting capability within the SMSD. Route forecasts are prepared by MetService of NZ and FMS. Two officers are involved in the preparation of forecasts and warnings-one is a university graduate with Assistant Forecaster training at the Australian Bureau of Meteorology (ABM), who also attends to information technology requirements of SMSD. New procedures for issuing severe weather warnings using the same terminologies for both American Samoa and Samoa were implemented recently to avoid confusion that had arisen in the past from conflicting warnings, issued from both meteorological offices. Guidance products (special advisories) from the RSMC (Nadi), Honolulu, ABM, and the US NWS Central Pacific Hurricane Center in Honolulu are used for the preparation of warnings in coordination and consultation with the Pago Pago WSO.

There have been substantial improvements and increased budget for the SMSD after cyclone Ofa and Val and with the establishment of the WMO Sub-regional Office for the South-West Pacific in Apia in 1997. The CLICOM system is operational now but has had problems (rectified through external assistance) in the past. No predictions were made by SMSD 1998 drought. It is an area that needs attention.

2.2.16 Solomon Islands

Some key senior officers of the Solomon Islands Meteorological Service (SIMS) were from the ABM (positions funded by the Australian government) until 1990, when the Service was fully localized. There is strong government recognition of the role of SIMS in disaster response and climate. SIMS is a well-managed small Meteorological Service. A Meteorology Act provides the legal framework for the activities of SIMS. Major public service wide restructuring in 1997 resulted in the reduction of some operational resources for SIMS. SIMS plans to derive some income through cost recovery charges to aviation and to other users.

The SIMS has limited forecasting capability, which needs strengthening. National public and marine forecasts are prepared and disseminated by SIMS, based on guidance products mainly from the Queensland Regional Forecast Office, Brisbane, and the RSMC, Nadi. National severe weather warnings are prepared by SIMS based on Tropical Cyclone Special Advisories from the Brisbane TCWC. Aviation forecast services are provided from external sources, but the SIMS plans to take over this role in the near future, in conjunction with improved services, and extension of the hours of operation of the SIMS Forecasting Centre to 24 hours.

There are seven human-operated synoptic observing stations, which are not adequate for spatial coverage for tropical cyclone warnings, and other services. SIMS plans to establish two more human-operated observing stations and a network of seven AWSs to supplement these stations. The upper air station at Honiara has had difficulty making continuous observations due to lack of operational resources. The hydrogen generator needs urgent replacement. A satellite imaging system provides low-resolution data. An EMWIN system provides access to additional guidance information and data.

Due to telecommunication difficulties, reports from outstations often do not get into the regional/international circuits. Recent improvements to communication arrangements are expected to improve the situation. However, collection of reports from outstations needs to be addressed. Frequent power cuts (back up power is not available at the Head Office) is a major problem.

SIMS has a well-developed Climate Section, CLICOM is fully operational, and a considerable amount of data has been archived. Climate applications and services need to be developed. SIMS plans to install weather surveillance/wind-finding radar at Henderson Airport, and build a new purpose-built building in Honiara.

2.2.17 Tokelau

Meteorological operations in Tokelau were heavily supported in the past by New Zealand, by direct assistance and through aid funds. Human-operated weather observations in the past were done by Tokelauan radio operators. Observations ceased when radio operators were made redundant in 1997. Currently the meteorological programme is essentially non-existent because of restructuring of the Tokelau Public Service. Government has plans to devolve the observational programme to the village level.

The Tokelau government position regarding aid is that it must be sustainable through the Tokelau Meteorology Programme, and assistance may be required for ongoing costs from aid sources. There are limited resources to meet ongoing costs.

There is no forecasting capacity. Tokelau relies on the FMS for severe weather warnings, and public forecasts. Surface observations are available only from the AWS at Nukunonu. Tokelau climate observations other than those extracted from the DCP have stopped, but are expected to recommence when the programme devolves to the village level. When the programme is reactivated, existing unattended meteorological instrumentation will need to be revived/upgraded, and communication links to Nukunonu re-established to enable transmission of reports to the Satellite DCP at Nukunonu. New staff will also need to be recruited. There is no upper air programme. In 1999 an EMWIN system was installed, but there are reception problems due to attenuation of radio signals by surrounding coconut palms.

Public forecasts and warnings are broadcast in Samoan from Apia on AM radio, and in English by New Zealand Radio International. CLICOM is operational on a Pentium computer. Climate data and services are provided using data archives held in New Zealand. The main users are disaster management, government, public, radio (from Apia and New Zealand), marine, and water resources.

2.2.18 Tonga

Meteorological operations in the past have been heavily supported (including past budgetary support) by New Zealand. The Tonga Meteorological Service (TOMS) provides a good service with limitations of old infrastructure and limited training. There are limited resources to meet ongoing costs. The Tongan government position regarding aid is that it must be sustainable through the TOMS budget, and assistance may be required for ongoing costs from aid sources

There is no forecasting capability. TOMS relies on FMS for severe weather warnings, public forecasts, some aviation forecasts (aerodrome forecasts, areas forecasts, and low- and mid-level route forecasts) and marine forecasts; and MetService of New Zealand Ltd for high level aviation route forecasts. There are seven surface human-operated stations, five operated by TOMS, and two by Tonga Telecom (these may need to be operated by TOMS in the future). TOMS plans to supplement these with an AWS. There is one pilot balloon station (balloons are currently provided by MetService of New Zealand Ltd, but this will be stopped). Hydrogen is shipped from Auckland. A hydrogen generator is recommended. A satellite imaging system provides low-resolution data. An EMWIN system provides access to additional guidance information and data.

All weather reports are sent to MetService of New Zealand Ltd by e-mail for insertion into Aeronautical Telecommunications System (AFTN)/GTS (same for return traffic). There are two additional climate stations and two rainfall stations. Synoptic weather stations also serve as climate stations.

Climate data is managed and archived using CLICOM which uses an outdated 386 PC that needs replacement. Data archive back-up facilities are doubtful. There is one full-time operator for CLICOM. Climate data archiving is slow. The TOMS staff also assist with the National Tidal Facility tide gauge. A weather radar is desirable but ongoing support is doubtful. Office buildings are old and highly prone to flooding and cyclone damage. The main users are the public, disaster management (cyclones and droughts), environment, aviation, marine, and possibly agriculture.

2.2.19
Tuvalu

Meteorological operations in Tuvalu in the past have been heavily supported by New Zealand (including budgetary support). The Tuvalu Meteorological Service (TUMS) provides a good service with limitations of a mix of old and new infrastructure and limited training. The provision of meteorological services is regulated by the Public Service General Administrative Orders. There are limited resources to meet ongoing costs. The Tuvalu government position regarding aid is that it must be sustainable through the TUMS budget, and assistance may be required for ongoing costs from aid sources.

There is no forecasting capability. TUMS relies on the FMS for severe weather warnings, public forecasts, some aviation forecasts (aerodrome forecasts, areas forecasts, and low- and mid-level route forecasts) and marine forecasts; and on MetService of New Zealand Ltd for high-level aviation route forecasts. The Honolulu Forecast Office provides a twice daily narrative synoptic discussion for Samoa, which includes Tuvalu.

There are four human-operated surface stations (TUMS plans to supplement these with an AWS). There is one upper air station (once daily wind finding and radiosonde) funded by the WWW and administered by MetService of New Zealand Ltd. The hydrogen generator is 20 years old and needs replacing. Synoptic weather stations also serve as climate stations. Reports are collected by telephone and HF radio and sent to MetService of New Zealand Ltd by e-mail for insertion into the GTS to save costs (the same is done for return traffic). A satellite imaging system provides low-resolution data. An EMWIN system provides alternative access to a range of weather information.

Climate data are managed and archived using CLICOM on a Pentium PC with good database backup facility. There is a part-time operator for CLICOM (the only person trained on CLICOM). Not all data is archived. The TUMS staff also assist with the National Tidal Facility tide gauge. A weather radar is desirable to support aviation and severe weather services. However national maintenance support is doubtful. Office buildings need to be repaired/refurbished. The primary users are the public, disaster management, natural resources and environment, aviation, marine and the media.

2.2.20
Vanuatu

Professional personnel from United Kingdom and France held key management positions in Port Vila, and guidance information from other advanced centres (e.g. Brisbane Cyclone Warning Centre). There is a high risk of failure of the cyclone warning system due to current low level of training and experience of forecasting staff. The airlines are not satisfied with aviation weather services provided.

The CLICOM system is operating currently, but there have been frequent breakdowns (fixed with external assistance) in the past. A substantial amount of data has been entered. There are no applications generated on CLICOM. Climate data is provided to a number of users. The main users of services are the public, disaster management, aviation, marine, fisheries, environment, media, agriculture, tourism, and forestry.

2.2.21
Wallis and Futuna

Wallis and Futuna is an overseas territory of France. Meteorological services are funded by the French National Meteorological Service, Meteo-France and managed by the “ Direction Interregionale de

Meteo-France en Nouvelle-Caledonie (DIRNC) ", the New-Caledonia Meteorological Service. There is a limited forecasting capability.

The observing network consists of two human-operated surface stations.

The Wallis Center receives EMWIN broadcasts from the GOES-West satellite including satellite pictures, and charts and various warning bulletins, inserted by the centres such as Nouméa and Nadi. The WAFS (World Area Forecast System) aeronautic data are accessed from GOES-West Broadcasts. A facsimile link also makes it possible to receive elaborate documents from Nouméa. A recent connection to the Internet network should allow the sending of files containing graphical information using the electronic mail facility. The Futuna station also receives the EMWIN broadcasts and the documents prepared in Nouméa by facsimile.

The personnel in Wallis and Futuna amount to 13. It has good technical capability and the staff are well trained.

2.3 USER NEEDS

2.3.1 Overview

Surveys of user needs were carried out through interviews with a number of major users in each country. Detailed information on user needs identified in the surveys is contained in the 21 national country reports prepared as part of this project. The surveys (summarised below for each country in Sections 2.3.2 to 2.3.22) showed that there are a number of users which have current or potential needs for a range of improved or additional weather and climate services. The nature of services is common to most countries, and may generally be categorised as follows: tropical cyclone warnings, climate services (including seasonal/interannual prediction), aviation weather services, marine weather services, and public weather forecasts (directly accessible to the public, or through the media).

While improved tropical cyclone warnings came out as a high priority continuing need in all countries, seasonal prediction and climate variability is another high priority emerging need for many users in all countries. Needs in other areas, while considered important by most countries, were assigned lower priority. Addressing needs in the two highest priority areas would, to a considerable extent, also take care of the needs in these other areas.

2.3.2 American Samoa

Tropical cyclone warnings

- Improved cyclone warnings; public education, awareness and training; provision of "crawls" on TV during cyclones.

Climate services

- More accurate, greater lead-time seasonal/interannual predictions; quarterly updates of ENSO events; awareness, education of users of climate information.

Aviation services

- Availability of weather observations from remote airfields; availability of aviation operational weather information on EMWIN.

Marine services

- More accurate and timely forecasts for coastal and offshore areas (out to 100 miles), especially for small boat operators and fishermen, but also for larger ships; three to five day extended forecasts; education and awareness of small boat operators regarding severe weather.

Media

- "Crawls" on TV during cyclones; weather forecasts during daily news.

Public weather services

- Public education and awareness; provision of "crawls" on TV during cyclones.

2.3.3 Cook Islands

Tropical cyclone warnings

- Faster exchange of information (disaster management); improved local interpretation of warnings and refinement of FMS output (disaster management).

Climate services

- Seasonal/interannual predictions for agriculture.

Aviation

- Improved Rarotonga aerodrome forecast; more accurate/detailed forecast for Northern Cook Islands.

Marine

- Improved local interpretation and refinement of Nadi output; sea surface temperatures in the future.

Public forecasts (including media)

- Improved local interpretation of forecasts; continued liaison over local weather presentation (TV); appropriate presentation aids (TV); improved weather package for Cook Island News (newspaper); bridge communications gap between the forecaster and user (Radio).

2.3.4 Fiji

Tropical cyclone warnings

- Greater accuracy and lead time in warnings; public education and awareness programmes (disaster management, tourism, public); provision of EMWIN system for tourism).

Flood warnings

- Flood warnings for the larger rivers.

Climate services

- Seasonal and interannual prediction- the provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry (disaster management, agriculture, water resources, forestry, fisheries); other climate applications.

Aviation weather services

- Improved services for aviation, especially domestic aviation operations.

Marine weather services

- Improvement in marine weather services including warnings, especially to meet the needs of small boat operators involved in the commercial and subsistence economy.

Public weather services

- Greater accuracy of public forecasts.

2.3.5 French Polynesia

Tropical cyclone warnings

- Greater ability to track cyclonic events (high resolution satellite reception, better forecasts from numerical models).
- Greater accuracy and lead time in warnings; public education and awareness programmes (disaster management, tourism, public).
- Faster exchange of information (disaster management); improved local self-explaining warnings (disaster management).

Flood and high precipitation rates warnings

- Adequate warnings for the high islands through the help of a weather radar.

Climate services

- Seasonal and interannual prediction- the provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry (disaster management, water resources, fisheries); other climate applications.

Aviation weather services

- Improved services for aviation, especially domestic aviation operations.

Marine weather services

- Improvement in marine weather services including warnings, especially to meet the needs of small boat operators involved in the commercial and subsistence economy.

Public weather services

- Greater accuracy of public forecasts.
- 3-5 day forecasts.
- "Visibility " of the Meteorological Service.

2.3.6 Guam

(Guam Weather Forecast Office products are used also by all other surrounding US-affiliated island states).

Tropical cyclone warnings

- Public awareness and education through the media on cyclones; greater use of the Internet for weather information.

Flooding (and water resources)

- Need for hydrological expertise at the WFO.

Climate services

- Public awareness and education through the media on droughts, and climate variability, climate change, etc; greater use of the Internet for weather information.

Public forecasts

- 3-5 day extended forecasts.

2.3.7 Kiribati

Tropical cyclone warnings

- Improved interpretation, local refinement and information input into warnings; assistance and guidance in developing the meteorological services; faster exchange of information.

Climate services

- Improved climate information including seasonal/interannual predictions; improved interpretation of information by meteorology staff.

Aviation services

- Improved briefing facilities at Bonriki Airport.

Marine services

- Improved interpretation, local refinement and information input into forecasts.

Public forecasts

- Improved interpretation, local refinement and information input into public forecasts.

2.3.8 Marshall Islands

Tropical cyclone warnings

- Public education and awareness; more accurate wind measurements using wind measuring equipment at outer islands, possibly at airfields; better communications with outer islands; weather radar to identify severe weather; more cooperative observing stations and AWSs; placement of a meteorologist at WSO Majuro.

Climate services

- More accurate, greater lead-time seasonal/interannual prediction for agriculture; climate variability expressed in simple laymen's terms; 1-5 day forecasts for agriculture.

Aviation services

- More accurate wind measurements using wind measuring equipment at outer islands possibly at airfields; better communications with outer islands; weather radar to identify severe weather; more cooperative observing stations and AWSs; better support for aviation users.

Marine services

- More accurate and timely forecasts for all areas; marine weather reports programme; marine weather familiarisation programme; an EMWIN system at the Transportation and Marine Department; a surf observation network to support surf advisories.

2.3.9
Federated States of Micronesia

Tropical cyclone warnings

- Better warning and other services through the establishment of a meteorologist position in FSM; more observations at remote sites to support severe weather warnings and aviation.

Climate services

- More and easily accessible weather information and forecasts including seasonal/interannual prediction; better designed weather products and educational programmes for users.

Aviation

- Measured wind speed and direction at all airports; training to certify all domestic weather services personnel; prompt communication of all weather reports to concerned aircraft.

Marine

- Wind, tide, current, and swell information from WSO for rescue operations; a marine weather-reporting programme for ships.

2.3.10
Nauru

The establishment of a National Meteorological Service is needed.

2.3.11
New Caledonia

Tropical cyclone warnings

- Greater ability to track cyclonic-related events (need for a weather radar in the south of Grande-Terre, better forecasts from numerical models).
- Greater accuracy and lead time in warnings; public education and awareness programmes (disaster management, tourism, public).

Flood warnings

- Flood warnings for the larger rivers.

Climate services

- Seasonal and interannual prediction- the provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry (disaster management, agriculture, water resources, forestry, fisheries); other climate applications.

Aviation weather services

- Improved services for aviation, especially domestic aviation operations.

Marine weather services

- Improvement in marine weather services including warnings, especially to meet the needs of small boat operators involved in the commercial and subsistence economy.

Public weather services

- Greater accuracy of public forecasts.
- “Visibility ” of the meteorological service.

2.3.12
Niue

Tropical cyclone warnings

- Faster exchange of information (disaster management); improved local interpretation of forecasts and warnings and refinement of the Nadi output (disaster management); training on EMWIN operation/products for the Disaster Management Unit; an EMWIN system and satellite DCP for the Telecom Office; a new EMWIN antenna and DCP for the Meteorological Office.

Climate Services

- Seasonal/interannual prediction for agriculture, disaster management, etc.

Aviation services

- Improve flight documentation to ICAO standards; improved/timely aviation reports (METARS Aviation Routine Weather Report)/SPECIS (Aviation Special Weather Reports)) to ICAO standards.

Marine Services

- Amplification of forecasts for local waters by local meteorology staff.

Public forecasts

- Bridge communications gap between the forecaster and user; weather package suitable for publication (Niue Island News).

2.3.13 Northern Mariana Islands

Tropical cyclone warnings

- Improved warnings through better observations; improved communication of warnings; greater involvement of users and partners in the review of progress and shared solutions; access to supplementary information during the lead-up to cyclone situations; public/business/government agency education and awareness programmes (including presentations by visiting meteorological personnel).

Climate Services

- Increased access to improved seasonal/interannual predictions; public awareness and education on seasonal predictions; impact of climate variability on local weather (especially typhoons), sea level and on critical coastal and marine resources; greater involvement of users and partners in the review of progress and development of shared solutions.

Aviation services

- Improved communications.

Public forecasts

- Three to five day forecasts; improved communication of forecasts; better press forecasts with the involvement of the press/media.

2.3.14 Palau

Tropical cyclone warnings

- Improved warnings through better observations e.g. at airfields in the outer islands; improved communication of warnings; greater involvement of users and partners in the review of progress and shared solutions; access to supplementary information in the lead up to cyclone-related situations; public/business/government agency education and awareness programmes.

Climate Services

- Increased access to improved seasonal/interannual prediction; public awareness and education on seasonal predictions; and impact of climate variability on local weather (especially typhoons), sea level, rainfall patterns and impact e.g. on water resources, and coastal and marine resources; greater involvement of users and partners in the review of progress and development of shared solutions.

Aviation services

- Improved communications.

Marine weather

- Improved forecasts through improved observations of weather and sea state, increased measurement of tides, and sea level.

Public forecasts

- Three to five day forecasts; improved communication of forecasts; better press forecasts with the involvement of the press/media.

2.3.15 Papua New Guinea

Tropical cyclone warnings

- More effective cyclone warnings, through improved local expertise (qualified and trained professional meteorologists), improved communications, more and better surface observations, high resolution satellite imagery, and weather radar to meet national and international responsibility; improved warning dissemination to users and remote communities; public awareness and education.

- forecast needs exist for frosts- PNG is the only PIC with this need.

Floods

- Improved forecasts of heavy prolonged rain.

Climate Services

- Improved seasonal/interannual predictions (including droughts)- for agriculture, forestry, water resources, power, disaster management, etc; development of specific climate applications to meet PNG needs, e.g. in agriculture.

Aviation services

- Substantial improvement in accuracy of forecasts (terminal conditions and route forecasts) and observations; information up to date and available when and where required; greater awareness on the part of weather officers of the impact of weather services on the economy and safety of operations; major need for improved communications; improved confidence on the part of aviation industry in weather information through improved services.

Marine weather

- More accurate forecasts through improved coastal observational networks, ship reports, better forecasting skills and tools.

Public weather services

- Improved forecasts for the tourist industry; improved forecasts of rainfall for the power industry; improved public awareness of value of weather services.

Special forecasts for industry

- There is some scope for special forecasts for industry (power industry, tourism, mining and petroleum).

2.3.16 Samoa

Tropical cyclone warnings

- Public education and awareness, translation of terminology on warnings; more effective cyclone warnings through improved local expertise (qualified and trained professional meteorologist).

Climate services

- Seasonal/interannual prediction; awareness/education on use of predictions; interpretation and use by industry, government, disaster management.

Aviation services

- Improved aviation weather services; better communications for aviation services; greater appreciation of the need for timeliness/accuracy of weather information on the part of NMS.

Marine services

- Greater accuracy/lead time in warnings for small boat operators; improved access to small boat operators operating in local waters to warnings; education and awareness of small boat operators.

Public forecasts

- More accurate regionally delineated forecasts; greater accuracy and extension to a few days; education/translation of weather terms.

2.3.17 Solomon Islands

Tropical cyclone warnings

- Greater accuracy and lead time; reduced false alarms, warnings to be on EMWIN; public education and awareness, translation of terminology on warnings.

Climate services

- Seasonal/interannual prediction; awareness/education on use of predictions; interpretation and use by industry, government, disaster management.

Flood warnings

- Flood warning systems for Gnalimbiu and Mbarode rivers.

Aviation services

- Improved aviation weather services; and better communications for aviation weather services; greater appreciation of the need for timeliness/ accuracy of weather information on the part of the NMS; aviation awareness.

Marine services

- Greater accuracy/lead time in warnings for small boat operators; improved access to small boat operators to warnings operating in local waters; education and awareness of small boat operators.

Public forecasts

- More accurate regionally delineated forecasts; greater accuracy and extension to a few days; weather maps and satellite imagery in newspaper; education/translation of weather terms.

Hazard data

- Resume reports on tropical cyclones/severe weather; consolidate documentation of hazard data for vulnerability analysis.

2.3.18 Tokelau

Meteorological Programme is pending re-establishment - Disaster management is the main concern.

General needs identified

- Improved cyclone warnings; improved communications between atolls.

2.3.19 Tonga

Tropical cyclone warnings

- Improve accuracy; improve warnings through local interpretation and input of information; bridge the gap between the technical warnings and forecasts; dedicated communications between Met Office and Radio Tonga. Develop TV presentation for the new TV station which is to be established; relocation the Tonga Meteorological Service to a place less vulnerable to flood and storm surge; improvement of and faster communication of information between parties.

Climate services

- Seasonal/interannual prediction.

Aviation services

- Relocation of the Meteorological Office at Fuamotu Airport to the new terminal building for easy access to flight documentation and briefing; improve accuracy of aviation forecasts for Tonga; more detailed forecasts for domestic operations, especially the northern groups.

Marine services

- Improve accuracy; bridge the gap between technical warnings and forecasts; dedicated communications between the Met Office and Radio Tonga; improve marine warnings and forecasts through local interpretation and input of information; provide sea surface temperature graphics.

Public forecasts

- Improve accuracy; bridge the gap between forecasts and the user; improve package supplied to media.

2.3.20 Tuvalu

Tropical cyclone warnings

- Improve accuracy; improve warnings through local interpretation and input of information; bridge the gap between the technical warnings and forecasts; upgrading and protection of Tuvalu Meteorological Service Head Office building from spring tides and storm surge; improvement of (including faster) communications and computing facilities; instruction on EMWIN operation and use; repair upper air accommodation buildings.

Climate services

- Seasonal/interannual prediction; improved climate data and information.

Aviation services

- Improve accuracy of aviation forecasts for Tuvalu; weather briefing facilities for a planned new national airline.

Marine services

- Improve accuracy; bridge the gap between the technical warnings and forecasts; improve marine warnings and forecasts through local interpretation and input of local information; provide sea surface temperature graphics.

Public forecasts

- Improve accuracy through local interpretation and information content input; bridge gap between forecasts and the user; improve the package supplied to media; develop presentation suitable for television.

2.3.21 Vanuatu

Tropical cyclone warnings

- Greater accuracy and lead time in warnings; public education and awareness programmes.

Climate services

- Seasonal and interannual prediction- the provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry (disaster management, agriculture, forestry, fisheries); other climate applications.

Aviation weather services

- Improved services for aviation in the interest of safety and economy of operations; improvement of telecommunications; greater awareness on the part of weather officers of the impact of weather services on the economy and safety of operations.

Marine weather services

- Improvement in marine weather services including warnings, especially to meet the needs of small boat operators involved in the commercial and subsistence economy.

Public weather services

- Greater accuracy of public forecasts.

Hazards data for vulnerability assessment

- Documentation of data on severe weather e.g. tropical cyclones and droughts.

2.3.22 Wallis and Futuna

Tropical cyclone warnings

- Greater accuracy and lead time in warnings; public education and awareness programmes (disaster management, tourism, public);
- Greater accuracy for high seas and storm surge warnings.

Climate services

- Seasonal and interannual prediction- the provision of products, information and advice related to seasonal and interannual variations of climate to the public and industry (disaster management, agriculture, water resources, fisheries); other climate applications.

Aviation weather services

- Improved services for aviation.

Marine weather services

- Improvement in marine weather services including warnings, especially to meet the needs of small boat operators involved in the commercial and subsistence economy.

Public weather services

- Greater accuracy of public forecasts.

PART 3 PROPOSED DEVELOPMENT PROJECTS

This section contains a brief description of priorities and areas of needs that have been highlighted from the perspective of users of weather and climate services and of NMSs of the twenty Pacific islands and Territories covered in this report. This is followed by proposed development projects aimed at further strengthening capacity in these countries to meet the needs and priorities identified.

The priorities and areas of need emerged from the findings of the analyses detailed in Section 2.1 and 2.2. The analyses revealed vastly different levels of development among the NMSs, and widely disparate resource allocation levels (Table 2). A number of factors, including those of historical nature, contributed to this situation. The analysis revealed that apart from Fiji, most independent Pacific island NMSs have not been able to fully carry out their roles and responsibilities in the period following the withdrawal of assistance by their former colonial partners. Localisation in most NMSs was not backed by appropriate resources, skills and expertise development programmes, resulting in a decline in the quality of weather and climate services. NMSs that continue to associate fully or partly with developed countries were found to be well equipped and provide better services. Based on these findings, the NMSs may be grouped into five categories as follows:

Category A These NMSs receive full funding from external sources and are relatively well equipped-American Samoa, Federated States of Micronesia, French Polynesia, Guam, New Caledonia, Northern Marianas, Marshall Islands, Palau and Wallis and Futuna.

Category B Fiji stands alone in this category. It has the most developed of fully nationally funded NMSs. It is also designated as a Regional Specialized Meteorological Centre (RMSC).

Category C Nationally funded with some forecasting capability but poor infrastructure-Papua New Guinea, Samoa, Solomon Islands and Vanuatu.

Category D Partly funded nationally and partly funded by external sources. These NMSs have minimum forecasting capability and rely fully on Fiji and New Zealand for provision of weather and climate services - Cook Islands, Kiribati, Tonga and Tuvalu.

Category E Partly funded nationally with external financial support, and with limited resources; their operations are minimal - Nauru, Niue, and Tokelau.

The analysis of the needs of users (detailed in Section 2.2) for weather and climate services and products identified the following five common themes:

- Severe weather warnings;
- Climate information and prediction services;
- Upgrade and strengthen observational networks;
- Upgrading telecommunication systems, and
- Infrastructure and institutional strengthening.

These five themes provide the basis for formulating the proposed development projects recommended in this report. While the need for improvement in aviation and marine weather services were also identified as common themes across the Pacific, these were not specifically singled out as additional broad themes for the purpose of developing separate development projects. However, it should be noted that severe weather warnings rely very heavily on aviation and marine observations, and that severe weather events impact very significantly on aviation and marine operations. Some sub-projects relating to aviation weather services have been included under the severe weather theme. Each theme includes some elements of capacity building and human resource development.

The international nature of meteorology, economies of scale, the relatively similar economic status of the PICs, and the commonality of areas to be addressed within the countries provide strong justification for packaging development assistance into regional projects, and the project team saw this as the appropriate mode of implementation. However, the level of upgrading needed in the various areas varies from

Table 2

Present status of National Meteorological Services of Pacific Island Countries and Territories

Country	Category	2000 Annual operating budget (estimate) US$000	Forecasting, climate services, technical maintenance and information technology capability (Number of skilled personnel)					All staff
			Professional Meteorologist	Support Forecaster	Climatologist	Engineer Technician	Infomation Technician	
American Samoa	A	660	2	5	0	1	0	8
Cook Islands	D	150	0	1	0	2	0	11
Northern Mariana Islands	A	10	0	0	0	0[a]	0	0
Federated States of Micronesia	A	2,199	3	25	0	3[a]	0	34
Fiji	B	1,500	14	4	2	2	3[e]	91
French Polynesia	A	5,700	12	12	4	6	7	112
Guam	A	2,000	12	6		1[b]	1	22
Kiribati	D	165 (150 –WWW)	0	1	0	0[g]	0	19
Marshall Islands	A	800	0	9	0	1[a]	0	10
Nauru	E	XX	0	0	0	0	0	5
New Caledonia	A	5,200	12	12	7	8	7	74
Niue	E	40	0	1	0	0[g]	0	3
Palau	A	820	1	8	0	1[a]	0	11
Papua New Guinea	C	821	2	2	5	3[f]	0	97
Samoa [c]	C	132		2	0	0	0	10
Solomon Islands	C	325	2	3	0	2	0	46
Tokelau	E	12	0	0	0	0[g]	0	0
Tonga[c]	D	160	0	1	0	0[g]	0	18
Tuvalu[d]	D	183 (+113-WWW)	0	1	0	0[g]	0	20
Vanuatu	C	270	1	3	0	2	1	29
Wallis and Futuna	A	See New Caledonia	1	2	0	0	0	13

A These countries also get technical maintenance support from the Sub-regional Maintenance Depot, Guam.

B Guam WFO has three additional technicians to provide support to US-affiliated states.

C One degree holder on staff, but without professional training.

D Two degree holders but without professional training.

E One of the three is an expatriate.

F The Office of Civil Aviation provides support for major engineering work.

G No in-house technician (or not fully trained), but support from other organisations (e.g. Telecoms) available, some times at low priority.

country to country. Therefore, while projects have been packaged on a regional basis, it is possible in many instances for sub-components of any of them to be implemented on their own without adversely affecting the overall regional project. For example in many instances, a project may be funded in one part (or country) of the region by one donor and in another by a different donor. Detailed information provided in country reports may be used in the preparation of project design documents, and will provide useful background information during project implementation. The recommended projects take account of on-going activities funded by donor countries in support of meteorology in the region. Any projects that might be implemented in support of the GCOS networks should be co-ordinated with projects recommended in this report.

The proposed development projects are categorised according to the five main priority areas identified by both users and NMSs as follows:

Project 1 STRENGTHENING OBSERVING SYSTEMS

1.1 Restore and upgrade the human-operated surface observational network.

1.2 Provision of Data Collection Platforms (DCP)/Automatic Weather Stations (AWS)

1.3 Marine meteorological data reporting, collection, dissemination, and training.

1.4 Basic meteorological observer training

1.5 Restore and upgrade the regional upper air observation network

1.6 Provision of high resolution satellite imaging systems

1.7 Lightning detection systems for Pacific Islands National Meteorological Services.

1.8 Pacific states radar network

1.9 Technical maintenance back up

Project 2 STRENGTHENING TELECOMMUNICATION NETWORKS

2.1 Provision of high frequency radio transceivers for the collection of weather reports from outstations.

2.2 Provision of Local Area Networks (LAN) for National Meteorological Services

2.3 Provision of Small Emergency Managers Weather Information Networks (EMWIN) receiving terminals

2.4 Regional Pacific Intranet (RPI)

Project 3 IMPROVE SEVERE WEATHER WARNINGS

3.1 Human resource development

3.1.1 Professional meteorological training

3.1.2 Training of support forecasters to assist the professional meteorologist in the provision of services especially related to severe weather phenomena.

3.1.3: Training in specialised tropical cyclone analysis, forecasting and warning

3.1.4 Training workshops and attachments in tropical cyclone forecasting and warning centres

3.1.5 Training of meteorological personnel on aviation awareness, and safety and economy sensitivity of aviation operations

3.1.6 Public education and awareness on severe weather (including tropical cyclones, drought, floods) and the role of climate variability

3.1.7 Awareness and education of small craft (boats) operators (including fishermen) regarding weather at sea, especially during cyclones, and the use of warnings

3.2 Storm surge prediction models

3.3 High resolution numerical weather forecasts for Pacific islands

Project 4 CLIMATE DATA MANAGEMENT, ANALYSIS AND APPLICATION

4.1 Climate analysis and applications

4.2 Climatology training

4.3 Pacific Regional Climate Bulletin

4.4 Expanding and enhancing the prudent use of climate predictions

Project 5 INSTITUTIONAL STRENGTHENING, INCLUDING INFRASTRUCTURE SUPPORT

5.1 SPREP Meteorology/Climatology Officer (MCO)

5.2 SPREP Meeting of Regional Meteorological Service Directors (RMSD)

5.3 Buildings and accommodation

While the first four regional projects address primarily technical and scientific aspects, Project 5 is aimed at the co-ordination of meteorological (including climatological) activities in the region, and providing overall management oversight support during the implementation of the projects.

Overview

Quality meteorological data is at the heart of all weather and climate services. Cyclone warnings, seasonal/inter-annual predictions, aviation services, marine services, and services to sectors such as agriculture, forestry, fisheries and tourism provided by NMSs, require accurate, timely, and quality data collected from surface and upper air networks, satellites, ships, aeroplanes, radar, buoys, etc. Each type of observation contributes in a unique and complementary way to the provision of all services, and to research.

Observations are required primarily to provide national services, but are also required by other countries within the region to forecast weather (including severe events) associated with major air mass movements over extensive areas. They are also needed for the production of numerical weather prediction computer guidance, and the preparation and the provision by advanced forecast centres of forecasts and warnings for regional and international use. They are needed regionally and globally for climate monitoring and the provision of climate services. Observations are inadequate in terms of spatial coverage, regularity, and accuracy to provide the required level of services by national and regional meteorological agencies. There is an urgent need to upgrade and restore existing equipment, and as necessary, procure and install new equipment and provide training and project management support to the following projects.

The overall objective of this project is to achieve improved, nationally and regionally integrated, and mutually complementary networks of observations to support the provision of various weather and climate services.

Projects 1.1 to 1.3 cover observations taken at specific locations on the surface of the earth; project 1.5, observations of the upper atmosphere obtained from instrumentation attached to balloons, etc; projects 1.6 to 1.8, those from space and ground-based remote sensing systems. Projects 1.4 and 1.9 are concerned with training and maintenance support.

Project 1.1 Restore and upgrade the human-operated surface observational network

Background

Observations from existing manual surface observing networks within the region are inadequate to meet the requirements of NMSs on all levels. The deficiencies in surface observing systems are due to the lack of appropriate equipment, training and quality control management (i.e. observations not taken or not taken on time, or not taken accurately), and on-going maintenance. The problem is compounded by the large gaps within the present networks. These gaps need to be narrowed by installing additional human-operated observing stations.

Project description

Specifically, source and supply standard surface meteorological instrumentation (Stevenson Screens, recording rain gauges, solar radiation measuring equipment, anemometers, etc, including spare parts) required to upgrade country networks to meet user needs for services of international standards. The project will ensure equipment provided under past programmes (e.g. the Pacific Meteorological Services Project (PMSP) completed in 1997) continue operating. The equipment will be procured through a central facility in SPREP or through a contractor. Equipment standards should be confined to WMO standards. A Project Co-ordinator will manage the implementation, and where necessary, arrange for further training of key technical staff.

Objective

To restore and upgrade human-operated surface observing networks in the region and to provide quality meteorological and climate data.

Location

All NMS's of Pacific Island Countries and Territories.

Duration

Five years.

Expected outcome

Operational equipment and human-operated weather stations restored and in full operation again; and installation of new human-operated surface observing stations in strategic locations to better understand the climatology of the region, and provide improved services.

Expected impacts

Increase in more accurate data from human-operated surface observing stations leading to better warnings and climate predictions for the Pacific islands, better understanding of the climatology of the region for planning purposes, and safe marine and aviation operations in particular.

Implementation

A meteorological technical specialist with experience in the region will be contracted to undertake maintenance of existing equipment and installation of new equipment. The specialist will be contracted to SPREP, which will manage funds allocated for the project. The funds for this project should be put under the SPREP Special Purpose Fund already set up for this purpose.

Risks and sustainability

No funding committed from development partners and individual governments. No commitments and support from local governments. The WMO Technical Cooperation Program could assist in this project.

Indicative budget

	US$750,000
Instrumentation and installation	700,000
Training	50,000
Total	750,000

Project 1.2 Provision of Data Collection Platforms (DCP)/Automatic Weather Stations (AWSs)

Background

A continual problem experienced by all Pacific island NMSs is the difficulty in the timely collection and distribution of surface observations. The analysis, as well as periodic surveys carried out by WMO highlighted this issue as a major problem which needs to be addressed. A major factor contributing to the belated transfer of data is poor or unserviceable telecommunication links from remote stations, particularly from outer islands. Unless observations are collected and put onto the GTS (Global Telecommunication Systems) promptly, they are of very little use. If the data is not received on time, then the efforts of individual observing stations are largely wasted. By using simple and relatively low cost satellite based transmission equipment, which has a proven record in the region, the collection and dissemination of data would be vastly improved.

Description of Project

The project seeks to identify simple and reliable equipment for use in these applications and to ensure its correct installation, use and maintenance. Three types of DCP equipment will be assessed and implemented using the GOES-WDCS system as the transmission medium with the following basic characteristics. Where access is not available through GOES-W, access through the Japanese GMS (Geostationary Meteorological Satellite)/ MTSAT (Multifunctional Transport Satellite) will be sought. This technology is successfully used worldwide to collect data from many different sensors. Systems envisaged include a simple keyboard entry, store and forward system to transmit manual observations, a combination of human-operated entry and automatic entry (where human-operated observations can be entered into the data stream for additional parameters not collected by a normal automatic weather station) and a fully automatic station capable of making standard observations of wind speed and direction, temperature, dew point/ relative humidity and atmospheric pressure. About 70 manual entry DCPs will be installed at remote stations.

Objective

The prime objective of this project is to ensure quick, reliable and accurate data transmission from meteorological observing stations in to the GTS. The distribution of the data to various analysis centres is crucial for the provision of better and improved services. The project also seeks to provide additional observation points from strategic remote areas where no observations are currently available. This will be particularly important in countries within the tropical cyclone belt.

Expected impacts

The major impact of this project will be to make a dramatic improvement in the reliability of meteorological data collection throughout the Pacific area. It will enable forecasters to use accurate and timely data to prepare forecasts, provide accurate and timely data input to models for developing longer term forecasts, and provide more accurate input to climate databases throughout the region. It will also provide early warnings of possible cyclone genesis in areas where synoptic data is currently unavailable. This in turn will contribute to the improved safety of life and property in those areas. The use of DCP technology will reduce the recurring costs of data collection.

Locations

All Pacific Islands Countries (PICs) and Territories.

Duration

2-3 years.

Expected impacts

The proposed project will provide for much improved data collection and distribution. It will provide collection points in strategic areas where they do not exist at present and will enhance the tropical cyclone warning system throughout the Pacific region. It will also result in reduced ongoing telecommunication costs.

Project implementation

It is envisaged that the project will be implemented in two parts. Due to the harsh environment and the need for appropriate reliable equipment, it is desirable that a survey be undertaken to identify the shortcomings, if any, of existing DCP installations and prepare a detailed design document which will set out the requirements in detail. Once a detailed design and procurement document is available, tenders would be called for the supply, delivery and installation of suitable equipment. The installation phase would see the delivery, installation and commissioning of the equipment using local meteorological staff as much as possible, or involving them as trainees or counterparts in the process, to give them the opportunity to become familiar with the equipment, its operation and maintenance.

Procurement

Procurement would be by international tender after a suitable tender document has been prepared. If it is possible under agency contracting procedures, it would be desirable that the person who prepares the initial contract documentation be appointed as the project manager to ensure continuity and sharing of local knowledge.

Management

As described in the above sections it will be desirable to appoint a project manager to oversee the project design and implementation.

Risk and sustainability

Appropriateness of equipment for harsh environment. Equipment failure resulting in non-transmission of information. Equipment may not be maintained regularly and appropriately and fail, and so information flow will fail. Equipment should be robust, accepting that value-for-money may involve purchase of more expensive equipment but which remains reliable in the long-term. Equipment should, as far as possible, be compatible throughout the region. NMS staff should be involved as counterparts during the installation and commissioning phase to improve understanding/familiarity with equipment.

Indicative budget

	US$3,160,000
Initial Project Design	100,000
Procurement and Installation	2,100,000
Civil Works	150,000
Spares	210,000
Training	200,000
Project Supervision	400,000

Project 1.3 Marine meteorological data reporting, collection, dissemination, and training

Project title

Provision of a Marine Meteorological Reporting Network for the collection and dissemination of marine meteorological reports from small boat operators, and expanded participation in the WMO Voluntary Observing Ships (VOS) Program for medium and large ships by Pacific island NMSs

Background

A major problem for regional forecasting centres and most NMSs with forecasting capability is the lack of meteorological reports over open waters of the Pacific. At present, there is a lack of VOS meteorological reports in many sections of the tropical Pacific. These reports provide critical data in support of operational meteorology to meet the needs of marine meteorological services, including those for the GMDSS, and those issued specifically for the marine communities, as well as global climate studies. The project will identify resources (i.e. marine meteorological observing equipment) needed for Pacific island NMSs to increase participation from vessels operating between the island nations. There is an even greater need to obtain marine meteorological reports from small craft operating within the region, particularly out from the shore to 150 km, in support of marine forecasts and warnings for near the shore and coastal waters.

Project description

This project proposes to train small and medium craft operators in the region, on how to take, record, and transmit marine weather reports to NMSs. It also proposes to establish marine radio station operators to collect marine weather reports and to disseminate marine forecasts and warnings to near shore craft operators. A similar network called the 'Caribbean Regional Meteorological Emergency Network (CARMEN)' is successfully operating at present in the Caribbean.

Objectives

To provide a simple and reliable marine weather report collection network in the region and within islands, particularly for those islands with vast exclusive economic zones (EEZ). The network will collect and disseminate real time marine weather reports from small and medium craft (boats) operators to the region's NMSs and regional forecast centres. The project further aims to increase the number of Pacific island registered ships participating in the WMO VOS Program. The project also aims to conduct seminars for recruiting and training marine boat operators to take and disseminate marine weather reports, including the provision of marine radios and marine meteorological equipment to facilitate report collection and dissemination.

Expected impacts

The provision of this equipment will contribute to the safety and well being of the marine community within PICs and Territories by providing the means to improve the coverage of marine weather reports and improve the accuracy of marine weather forecasts and warnings.

Locations

About 50 locations throughout the Pacific islands (about two coastal radio stations per country/territory).

Duration

Two to three years.

Expected outcome

Greatly improved receipt of marine meteorological reports to NMSs and regional forecast centres. This will result in improved marine forecasts and warnings to island communities, improved safety of life and property and enhancement of the critical marine transportation sector of island economies.

Project implementation

Schedule

The first phase of this project will be to write a detailed specification for the equipment required, identification of participating coastal radio station operators, and the identification of training resources and meteorological equipment needed for recruitment and training of boat operators.

At this stage there will also be a need to consider social/community participation aspects of the design, to engage and motivate stakeholders, including small-scale fishing boat operators. The services of a community development specialist/facilitator will be necessary for short-term implementation. Expressions of interest can then be obtained from prospective manufacturers. They will then be given the opportunity to competitively bid for the supply of the equipment and if they have the necessary resources, to provide installation and commissioning supervision.

It is desirable that the project manager should participate in both the design and installation/commissioning of the equipment, and plan/conduct marine workshops in major ports to recruit and train new boat operators on procedures for taking and transmitting marine meteorological reports. It is expected that the design/testing phase could take up to 12 months and that the installation of coastal radio stations, which would be identified by the Pacific island NMSs in partnership with their national marine agency, would then proceed in the next phase.

Installations should be carried out as much as possible by Pacific islands' Meteorological staff under the supervision of a contractor or the project manager. Adequate training in the use and maintenance of the equipment will be required. Because of the simple design, it is expected that operational training will be minimal.

Procurement

There are two phases to this project. The first phase involves the procurement of appropriate equipment. The second is the implementation phase, including adequate training in the operation and maintenance of the equipment. The supplier will be expected to manufacture suitable terminal equipment to meet the specifications laid down. The equipment at each coastal radio station will consist of two VHF and two HF radios, two antennas, mounts, power supplies, two PCs with modems, printers, printer supplies, scanners, and CD and CD write drives. The procurement will also include a supply of anemometers, barometers, and thermometers for use on boats and ships. Each coastal radio station will also receive a complete EMWIN system, to insure receipt of marine forecasts and warnings, and marine weather maps from regional centres, and verify that the reports collected were received by the Pacific island NMSs and disseminated. The prime requirement will be for simple and robust equipment that will operate satisfactorily in the tropical maritime environment prevailing in the Pacific islands. Care must be taken to ensure long operating life with minimal maintenance.

Management

It will be necessary to provide project oversight to ensure that the equipment provided meets the requirements of the project and that it is installed and operating satisfactorily. It will also be necessary to insure marine training workshops are conducted and reinforced, and NMS personnel are trained on installation and preventative maintenance for all marine radios and meteorological equipment, including a reliable supply of replacement instruments.

Risks and sustainability

As with any project being carried out in remote areas there are always a number of risks attached to this project. Risks will include lack of interest within the affected community, unless the benefits are explained clearly, failure of equipment and difficulty in ensuring maintenance and repairs, and loss/theft of equipment unless training in care and maintenance is adequate. With careful and adequate project design and implementation these risks can be minimised.

Indicative budget

	US$530,000
Design Phase	20,000
Manufacture and Testing	210,000
Installation and Commissioning	100,000
Training Workshops	100,000
Project Supervision	100,000
Total	530,000

Project 1.4 Basic meteorological observer training

Background

New recruits to a NMS whose jobs involve acquisition and processing of different kinds of weather data require training before operating independently. The training involves a basic knowledge of meteorology and methods and procedures for making observations in conformity with prescribed WMO standards, maintenance of basic instrumentation, and transmission of data. The nature and level of training required is not available within most Pacific Island Countries (PICs). The FMS will run the Basic Observer Training Course, which it has conducted in the past for its own recruits, as required for trainees from other PIC NMSs.

Description

High school graduates with good backgrounds in math/physics/computer basics who are new entrants to a Meteorological Service will be provided training at the Fiji Meteorological Service in Nadi. FMS will take five to ten trainees in to this course, depending on demand. It is proposed that five to ten trainees from PIC NMSs will be trained during alternate years in the next five years, starting in 2001. The project will benefit Cook Islands, Fiji, Kiribati, Niue, PNG, Palau, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, and Vanuatu, as required.

Objective

To improve and maintain weather-observing standards through the provision of appropriate training to weather observing personnel entering an NMS.

Location

Fiji

Duration

The training course is of about two months duration. The duration of the project will be five years.

Expected outcome

Availability of quality observations to meet the requirements for providing useful weather and climate services.

Expected impact

Social and economic benefits due to improved weather and climate services.

Estimated budget

US$110,000

Implementation

The project will be implemented through co-operative arrangements with the Fiji Meteorological Service, co-ordinated by SPREP/WMO.

Risks and sustainability

None identified.

Project 1.5 Restore and upgrade the regional upper air regional networks

Background

Upper air observations are essential for understanding atmospheric processes driving weather and climate. Data from upper air observations allow forecasters to assess the development and movement of weather systems. These observations are also very important in understanding changes in the regional climate (of the scale of climate variability and change). The observations are particularly important for the prediction of the development and movement (paths) of tropical cyclones. In the South Pacific region, upper air reports have declined significantly in the last 10 to 20 years. Many of the upper air stations with a long history of excellent records have been closed down. The upper air network in some critical areas has wide gaps in it, often resulting in a tropical cyclone slipping through the network, without any upper atmosphere information being available. There are two main reasons for this decline: a) lack of on-going funding for expensive radiosondes (electronic equipment released attached to balloons); and b) failure of hydrogen generating systems (for filling the balloons) due to age. The current hydrogen generators are also very dangerous to operate due to age, and are environmentally damaging.

Project description

The project will supplement about half the total cost for radiosondes over five years for countries with critical shortage of operational funds, procure and install new radiosounding ground systems (including GPS receivers) and modern hydrogen generators to replace failed systems as necessary (including the necessary maintenance training). Supplementary funding support for radiosondes is included in this project because of the crucial importance of upper air observations in particular for tropical cyclone warnings, aviation forecasts, and better definition of regional/global scale computer models for the benefit of the whole regional/global community. These models are also used jointly with global ocean models, to understand ocean-atmosphere interaction, and are being refined using the Pacific network of sea level gauges provided under a separate AusAID project. A Proton Energies system, an electrolytic hydrogen generator, which has no moving parts, and is virtually maintenance free, is recommended. The US NWS has installed a Proton Energies system and plans to replace existing generators at its Pacific Region upper air stations with the same model. The hydrogen generating systems supplied must meet any relevant regulations for each respective country since hydrogen is a highly dangerous, inflammable gas. Moreover, during the lifetime of project, it is expected that wind profilers will begin to offer a more cost effective alternative to the conventional systems.

Objectives

To provide regular, uninterrupted flow of upper air meteorological data with adequate spatial coverage to support the provision of high quality cyclone warnings, and weather and climate prediction for various purposes.

Location

Cook Islands (2), Fiji, Kiribati, Solomon Islands, Tonga, Tuvalu, Vanuatu, Papua New Guinea.

Duration

Five years

Expected outcome

Uninterrupted flow of upper air meteorological data with adequate spatial coverage contributing to improved weather services, in particular cyclone warnings, aviation weather services, and seasonal/climate prediction.

Expected impacts

Positive impact on social and economic development, through improved weather and climate services.

Project 1.6 Provision of high resolution satellite imaging systems

Background

Most Pacific island NMSs have access to three hourly low resolution (low detail) satellite images for tracking and forecasting and severe weather, but these are not suitable for detailed local analysis, and issuance of local forecasts and warnings due to the long time lapse between images and their low resolution. Some of this material is available from the Internet, but Internet services in the Pacific are unreliable, and this unreliability increases during periods of severe weather.

Project description

The project will supply, deliver and install High Resolution Satellite Image Receiving Equipment from the Global Meteorological Satellite (GMS) / Geo-stationary Observing Environmental Satellite (GOES) satellites to Pacific Island NMSs, including suitable display and interpretation software for satellite images. Prospective suppliers should indicate the levels of software available and their capability. The equipment must be suitable for operation in tropical maritime areas and withstand severe tropical storms. Emphasis must be placed on corrosion resistant constructions. Antennas should be capable of remaining operational in 60 mph sustained winds and withstand 120 mph wind gusts without damage. Simple, off-the-shelf, operating maintenance systems (e.g. Windows NT, etc.) are preferred.

Objectives

To provide NMSs with hourly high resolution satellite images and to assist NMSs in issuing high quality public, aviation and maritime forecasts and severe weather warnings. The project also aims to provide appropriate in-country training for the operation and maintenance of systems supplied, and for strengthening the capacities of NMSs to provide media-friendly weather information to the media.

Locations

American Samoa, Cook Islands, FSM, PNG, Palau, Marshall Islands, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Duration

Five years

Expected outcome

Provision of high-resolution satellite images to those Pacific island NMSs which have or are developing forecasting capabilities. Improve day-to-day and severe weather event forecasting for the general public, maritime and aviation users. Improved aviation terminal and route forecasts and maritime forecasts, resulting in safe aviation and marine operations.

Project implementation

The project is envisaged to span five years, implemented in the following phases;

Phase 1 Procurement of equipment,

Phase 2 Installation and commissioning

Phase 3 Training and on-going maintenance

Risks and sustainability

The main risks are likely to be inadequate commitments from partner countries resulting in insufficient funding for spare parts and on-going maintenance. This can be addressed by ensuring prior commitment to funding of parts and maintenance by partner countries, and ultimate replacement by charges to end-users of the information, or by inclusion in government budgets.

Indicative budget

	US$430,000
Phase 1	30,000
Phase 2	250,000
Phase 3	150,000
Total	430,000

It is envisaged that as far as possible, recurrent costs such as system maintenance, would be capitalised and funded through advance or progressive payments to the regional network maintenance centre. By this approach, the individual NMSs would not be liable for the network running costs. This phase will take about one to two years for completion, with most installations being completed by the end of year two and the project completed by year three.

Project 1.7 Lightning detection systems for Pacific islands National Meteorological Services

Background

Lightning detection systems are a vital tool in the detection and monitoring of severe thunderstorms. The NMSs of developed countries have made routine use of lightning detection systems since the early 1970s. Lightning detection systems are the primary tool in monitoring the onset of severe thunderstorms and providing short-term warning services in the 24 hour and shorter time scale. Most Pacific island NMSs and airports do not have reliable lightning detection systems to forewarn them of approaching thunderstorms within their areas of responsibilities. Thunderstorms are some of the most dangerous weather related hazards in the region. Many lives are lost and property destroyed each year due to thunderstorm related incidents worldwide.

Project description

This project involves the installation of lightning detection systems at meteorological offices and airports briefing offices. There are two lightning detection systems commonly in use today, one which relies on a network of detectors spread out over a large area. The latter comprises a rather complex system, requiring dedicated communication links from each detection unit to a central processor. The other uses a single local detection device, which gives good direction information but may be slightly less accurate in its distance measurement. Local detection systems have a useful range of up to 300 nautical miles (it is proposed to install the simple stand-alone units initially and develop a wider area regional network when suitable communication links are available to support this type of system). Given the vast distances between the islands, two to three regional networks are needed. A detailed design study will be required to build the most effective network. The project will have two phases: an initial phase to install single local lightning detection devices in some NMSs and a second design-and-construct phase to install network detectors at one, two or three network nodes, as determined necessary.

Objective

To provide local and regional lightning detection systems so that airports and meteorological offices can have prior warning of approaching storms by two means:

- Installation of local lightning detection systems and training in their use and maintenance to local NMS staff;
- Completion of a detailed feasibility-design study for the development of one to three (as necessary) regional networks of lightning detectors, and if feasible, the installation of these networks, provision of training and maintenance to NMS staff at the regional nodes, and in the interpretation of derived information to other NMS users.

To provide better aviation weather reports by highlighting areas of thunderstorms.

To improve safety of life and property by providing thunderstorm warnings.

Expected impacts

Improved severe thunderstorm warnings for users and better and improved aviation weather reports, leading to improved aviation safety.

Location

All Pacific Island NMSs which do not have lightning detection devices installed, and which have the capacity to use and maintain the devices. It is envisaged that about 45 stand alone units will be installed in Phase I, and that a feasibility-engineering design study will indicate that two or three regional networks will be required, and will identify the appropriate node locations.

Duration

Phase I
Procurement and installation of the stand-alone systems will be simple and the installation and training will be straight-forward. This could be completed in about one year.

Phase II
Development of the regional system, involving a feasibility-design and construct contract, will take longer, and its viability and success will very much depend on the availability of regional data links to be established under other projects proposed.

Expected outcome

Each Pacific island NMS will have access to improved storm warnings and this will lead to more accurate forecasts and warnings. Aviation safety will be improved.

PROJECT IMPLEMENTATION

Schedule

There are two phases to this proposed project. Phase I will be of 12 months duration, and Phase II will be of three years duration. The design study to be undertaken and the installation schedule for the regional network will depend very much on the prior availability of a regional communications system. After a suitable 'design and construct' contractor is selected, installation and commissioning should proceed under the supervision of the contractor and project manager.

Procurement

At this time there is only one major manufacturer/ supplier of suitable equipment for the stand- alone systems, so procurement will be straightforward for the lightning detection equipment to be provided in Phase I. As this equipment is PC based, suitable computers will be required. It should be possible to share these computers with other applications, or to use existing computers. It will be necessary to use similar PCs to those already in use in each country to ensure effective maintenance and repair. The regional system to be developed as Phase II would be subject to an international tendering process and the selected contractor would oversee the installation of the equipment by local meteorological staff. Because of the regional nature of these systems the control and processing equipment for each network should be located at a centre where there is adequate expertise in networking and maintenance of a regional communications network. Any location with insufficient staff and resources would have been eliminated in the feasibility-design stage as an unsuitable location for a regional node.

Management: To ensure that the stand-alone systems are installed correctly it will be necessary that any supplier is able to provide overall supervision and training during the installation phase. Local meteorological staff in most locations could do the actual installations. For the regional networks to be developed as Phase II, it will be necessary for an experienced engineer to be contracted to carry out the design-and-construct of the networks, including a survey of likely locations and infrastructure available to determine the appropriate number, location and complexity of the networks. During the installation stage there will not be a large amount of technical equipment required on each site and so installation will be straight forward. The project manager will undertake overall coordination of installations and commissioning tests.

Risks and sustainability

Phase I

As the stand-alone systems are simple and easy to set up and use there is little risk that this part of the project will not be successful. The hardware is relatively robust and it will be installed in meteorological offices where the operating environment is such that its care and maintenance can be assured.

Phase II

The regional system will need dedicated communications links, which should be in existence as a prerequisite for this phase to proceed, and will be dependent on prior agreed regional cooperation and coordination. Good project design and management will also be essential to ensure the success of the second part of the project. In many areas the lightning detection networks are installed, operated and maintained by private organisations and the data is made available to interested parties for a suitable fee. While this approach seems to work in more developed areas it may not be the best approach for the Pacific islands. A detailed engineering feasibility and design study will be needed to identify the best approach for the regional networks. Provided reliable equipment is correctly installed the ongoing operating and maintenance costs of these systems should be minimal.

Indicative budget

US$ 670,000

Stand-alone Systems

Equipment	100,000
Installation costs	10,000
Spare parts	10,000
Project Supervision	50,000
Total estimated Sub Project Costs	170,000

Regional Systems

System design	100,000
Supply and delivery of equipment	250,000
Installation Supervision	75,000
Spares	25,000
Project Supervision	50,000
Total estimated Sub Project Costs	500,000

Background

Weather Surveillance Radars (WSR) are widely used by most cyclone prone countries to monitor tropical cyclones and other severe weather in densely populated coastal areas or islands. In the region, Fiji and New Caledonia currently have radars. French Polynesia has concrete plans to install one or two radars. While satellite imagery provides valuable broad scale snapshot information on cyclones and other severe weather over extensive areas at intervals of about an hour, radar provides frequent up to the minute detailed information on cyclones as they approach a population centre. Radars provide the most effective available technology for monitoring cyclones within a range of about 500 kilometres.

Information derived from a radar in one country (e.g. Solomon Islands) will be invaluable for a country "downstream" e.g. Vanuatu (and subsequently to New Caledonia/Fiji, if a cyclone heads towards those countries). Radars provide additional benefits in terms of providing support to flood forecasting and aviation weather services when located within a range of airports. In some instances, the upper air wind-finding function can be combined into a dual-purpose radar, but this involves compromises in functionality. This joint functionality should be considered in the design, as a cost saving measure.

Radars are very expensive and highly complex equipment, requiring very significant resources in terms of ongoing operating costs and technical maintenance capability. Therefore sustainability will present a major problem for small, poorly resourced NMSs. In view of these factors, they are justifiable only for locations where the population/infrastructure density is high, the frequency of severe cyclones is high (at least an average of one severe/very severe cyclone about every two years) and where NMSs have the expertise to interpret the data, the resources to meet ongoing costs and a past record of reasonable maintenance capability on similarly complex equipment. The absence of these requirements will render expensive equipment useless. Only a few locations (possibly four) in the region (Southern Hemisphere, excluding the French Territories) currently have some likelihood of meeting these requirements. Possibilities are Papua New Guinea, Solomon Islands, Vanuatu, and Samoa. These locations, provided the respective governments accept responsibility for ongoing operating costs, will be considered for the first phase of the project. Subject to the success of this phase, other locations will be considered in a second phase.

Project description

The project involves the installation, initially, of about four weather radars in selected Pacific island states, where it is judged that the radars will offer significant benefits and are likely to be capable of being maintained using in-country resources. The project will entail a detailed network design, procurement and implementation, and establishment of ongoing support, staffing and logistic arrangements.

Objectives

To support the provision of severe weather forecasting and warning services for the general community, particularly for tropical cyclones; and to improve aviation weather services, particularly relating to severe weather, thunderstorms and tropical cyclones.

Locations

As indicated above, the locations considered potentially suitable are Papua New Guinea, Samoa,Solomon Islands, Vanuatu . These locations are suggested subject to confirmation of requirement through a detailed project design and feasibility study.

Duration

The project implementation phase is expected to take three to four years from initial approval. The useful life of the system is expected to be at least 15 years.

Expected outcomes

- Improved warning services to local communities for severe weather and tropical cyclones.
- Improved safety and services to aviation through early warning and monitoring of severe weather.
- Advancement to understanding of the climatology of the Pacific through research projects drawing upon archived data built up from the network over time.
- Strengthening of cooperation between states in the exchange of radar data particularly during severe weather events.

Project implementation

The project is envisaged to span three to four years, implemented in the following phases:

Phase 1

Network design and feasibility study to identify radar locations and siting options. This phase will also evaluate options of radar technology and recommend relevant technical features. In addition, support and maintenance requirements will be investigated and recommendations developed. This phase may take one year.

Phase 2

Implementation. This phase will involve the procurement and installation of the radar systems through open tendering. In addition, it is envisaged that a separate project management contract will be let to a system integrator, to carry out the detailed tasks of coordinating all aspects of the project including specification, procurement, testing, and ancillary infrastructure including, power, access, communications, land acquisitions, local authority liaison and so on. This phase will take about three years for completion. Training and building capacity among local staff will be a vital aspect of the project. This will be addressed by making maximum use of local personnel in the implementation work.

Risks and sustainability

Risks

The main risks and difficulties may be:

1 Project magnitude associated with geographic extent of Pacific area and diversity of countries. This will mean that the project coordination and management will be a large and complex task and great care will be required in selecting a project integrator with the necessary, organisational skills, technical experience and political credentials.

2 Development of skills among local staff to ensure that systems will be maintained and operated effectively for their working life. Emphasis on this aspect in the implementation contract will be essential.

Sustainability and support

This will be a key issue and will need to be carefully assessed on a case by case basis for each country. Maximum use should be made of local personnel during all phases of the project to transfer as far as possible, the skills necessary to support the system for its economic lifetime. It is likely that this will finish up as a mix to various extents, of local staff and vendor contract support. It will also be necessary to develop radar data interpretation and forecasting skills among local meteorological staff. This issue may be addressed with the cooperation and assistance of major NMS's in the region Australia, New Zealand and the USA.

Estimated budget

Overall budget is estimated to be **$US10,200,000** apportioned to the two phases as follows.

Phase 1	200,000
Phase 2	$US10,000,000

Background

Specialised meteorological maintenance services are generally not available in the Pacific islands. In the past, many countries relied on the former New Zealand Meteorological Services (now MetService New Zealand Ltd.) and other advanced NMSs through bilateral or multilateral development assistance for such services. Changes in the policies of these development partners saw technical assistance discontinued. At the 1998 SPREP Meeting of RMSD in Honolulu, the 26 Directors recommended the establishment of the SPREP Special Purpose Fund (Trust Fund). The idea is to attract funding from external sources to support on-going maintenance of equipment and to fill gaps left by New Zealand and other countries. The need to maintain a technical back-up maintenance programme is urgent.

Project description

The project seeks to provide specialist maintenance, maintenance advice and calibration services including the necessary spare parts not available locally. The project will also seek to procure better deals with manufacturers of meteorological equipment through bulk purchase agreements of consumable items (radiosondes, balloons, etc). The project will also provide advice on requirements for monitoring and maintenance, including those required for all stations throughout the region. The project will also encourage annual inspection visits as requested by countries and promote the development of technical maintenance skills within countries.

Objectives

To provide external specialist and back up services required to maintain weather and climate monitoring to WMO specified calibration standards as well as securing funding for the Special Purpose Fund.

Expected impacts

Continuous full operations of observing stations throughout the region and procurement of advantageous purchase deals with manufacturers of meteorological equipment through the negotiation of bulk purchases on behalf of the countries.

Location

All SPREP Pacific island members in Categories B, C, D, E.

Duration

Total support time of six months per year, over five years but with expectation of longer term support beyond this period.

Expected outcome

Secure cost-effective purchase agreements with manufacturers of meteorological equipment and continuous operation of observing networks.

Project implementation

Technical specialists will be recruited by SPREP under contract. SPREP/WMO will manage the contracts and disbursement of the funds.

Risks and sustainability

Development partners do not have the funds to contribute to the SPREP Special Purpose Fund. Recipient countries do not provide on-going support. SPREP is already undertaking this task with financial contributions from new development partners.

Indicative budget

US$500,000

Overview

The means of timely collection of raw and processed meteorological (including climate) data and products (including those in graphical form) are a necessary prerequisite for the provision of all weather and climate services. In the case specifically of severe weather warnings and aviation services, delays and inaccuracy can result in serious consequences. The value of weather data deteriorates rapidly with time. Modern communications technology has made possible the rapid exchange of high quality, high volume graphical information in developed countries. In many PIC NMSs telecommunication systems are outdated, fragile, and subject to frequent failures, resulting in unacceptable breaks in the transfer of data and products. To meet the requirements of severe weather, it is necessary to provide robust systems that can withstand the harsh tropical conditions, with appropriate back-up systems as necessary. This project addresses these concerns.

Project 2.1 Provision of high frequency radio transceivers for the collection of weather reports from outstations

Background

Many countries use transceivers to collect weather observations and reports from outer stations at a central NMS location. In some countries, these are old and difficult to maintain, resulting in frequent and lengthy interruptions in the collection of weather reports, especially in times of stormy weather. The transceivers also provide backup to other available means of communication (including of warnings), and are the only means for the relay of administrative messages to isolated weather stations. Without effective communication systems, forecasts and warning systems, however accurate, are worthless, as warnings and advice cannot be passed on to affected communities.

Project description

The project involves the procurement and installation of high frequency radio transceivers to replace existing systems, including the aerial system, solar power supplies, and an adequate supply of spare parts. Procurement will be done regionally (for ease of purchase, cost effectiveness and to assist NMS mutual support networks) and implementation will be the responsibility of individual NMSs. An estimated 45 systems will be required.

Objective

To improve the communication and collection of weather reports from outstations and to provide better severe weather warnings and advice to outlying stations/communities.

Location

Cook Islands, Fiji, Kiribati, Papua New Guinea, Tuvalu and Solomon Islands. (Kiribati and Tuvalu to receive only solar power supplies and aerial systems)

Expected outcome

Regular uninterrupted availability of essential weather reports at the national collection centres for NMS use and for regional and global dissemination.

Expected impacts

Improved weather and climate services for the economic and social benefit of the region.

Implementation

Complete systems will be bulk purchased and implementation will be co-ordinated by SPREP/WMO.

Risks and sustainability

Risks

SPREP should ensure that all recipients can install and test the equipment, and provide support for this if individual NMSs cannot undertake the installation.

Sustainability

The systems will be sustainable if NMS users are familiar with installation and maintenance protocols, if problem identification manuals are available at all locations, and if there is a regularly replenished store of standard spare parts in each location. SPREP should coordinate the provision of manuals and spare parts.

Indicative budget

US$1.2 million

Project 2.2 Provision of Local Area Networks (LAN) for National Meteorological Services

Background

There is an increasing demand for up to date weather services and products from users. The provision of fax and voice "on demand" services is one way of effectively delivering these services and products to end-users. Most NMS's would benefit by having an office local area network so that all data, including satellite images are readily available throughout the office. In some instances this could be extended to aviation briefing offices and other specialised offices. A basic LAN within each NMS will facilitate interchange and exchange of data between divisions and staff. For external users, the provision of a web site will assist in rapid dissemination of data to end-users. Adequate training in the operation, use and maintenance of the installed system will ensure its sustainability and continued operation.

Objectives

To provide a simple and efficient interconnection between various data sources and users of meteorological data, enabling meteorological staff to have ready access to all data available and to develop expertise within NMSs to construct and maintain their own web pages.

Project description

The project entails the establishment of LAN for those NMSs which do not yet have access to networks. The LAN would allow each country's NMSs to have reliable and high capacity access to data and office as well as to the Internet. This will also assist these NMSs by providing quick access to vast range of scientific and information resources available on the web, as well as access to services and weather products of advanced NMSs and research organisations. In addition, it will facilitate exchange of information, data, forecasts and warnings within NMSs in the region and outside it.

Location

The project covers all Pacific islands NMSs. Some proposed locations may have the basic elements already in place to provide the proposed improvements. In these cases, additional training may be required, or some additional components may be needed. It is proposed that an initial survey be conducted to determine the exact needs of each service by a suitably qualified IT specialist who is conversant with the meteorological needs of the region.

Expected outcomes

Improved forecast and warning services to local communities, aviation, agriculture and marine sectors through timely access to regional data and information sources; advancement in the understanding of the climatology of the Pacific by improving and facilitating exchange of scientific data and research collaboration; strengthened cooperation between states through ease of communication and mutual assistance, particularly during severe weather events; mitigation of the risk of small Pacific nations becoming 'information poor' as information technology continues to advance in the developed world; improved interface between the NMSs and users and greater accessibility to data, warnings and forecasts, and improved communications within NMSs to enable them to provide better services to end-users.

Project implementation

The project is envisaged to span four years, implemented in the following phases:

Phase 1

Network design and feasibility study, to determine the local requirements, regulatory constraints and site-specific factors. The study should also include a cost-benefit analysis, an analysis of the estimated cost of operating the system, especially the internet facility, and the ability of the concerned NMS or government department to pay for the ongoing operation of the facility – even with space segment lease arrangements funded regionally. From this study, a network design would evolve, from which procurement specification would be prepared. This phase may take six months. The first stage would be to carry out a detailed survey of the present status and expected future requirements. The survey should be carried out by an IT specialist familiar with the needs of NMSs. A detailed design and implementation plan would then be prepared for each country and the supply and installation of suitable equipment be implemented together with in-country training.

Phase 2

This phase will involve the procurement and installation of the VSAT network through open tendering. The contractor selected would be required to provide, install, commission and maintain the network for its operational life. It would be desirable for installation of the supplied equipment to be carried out by the NMS staff, under supervision of the designated contractor, where these staff are available, so that they have a good appreciation of the equipment and methods used in providing the networks.

Phase 3

This phase will take about one to two years for completion, with most installations being completed by the end of year two and the project completed by year three. As far as possible, consideration should be given to procuring as much equipment as possible from within the countries, provided reliable suppliers are available. This would ensure local expertise, spares parts and backup maintenance support are available. It is envisaged that as far as possible, recurrent costs, such as space segment lease costs and system maintenance, would be capitalised and funded through advance or progressive payments to the network contractor. Using this approach, individual NMSs would not be liable for the network running costs.

The project will be managed by a person with suitable expertise in the IT field, who is familiar with the requirements of the NMS's. It should be possible to utilise local suppliers as much as possible with meteorological staff working closely with the installation team.

Risks and sustainability

With any high technology equipment there is the risk that ongoing operation and maintenance will be a problem. Given adequate opportunity for local staff to participate fully in the installation and commissioning of the systems, and with adequate training this risk should be reduced considerably. It is imperative that simple and appropriate technology is used, which will require minimum maintenance and use an operating system that the majority of users are already familiar with. Installation should be carried out professionally to ensure integrity of the cabling and equipment. Adequate training must be provided. By using locally available resources and materials wherever possible, on-going maintenance problems will be kept to a minimum. Transport and other installation costs could also be substantially reduced.

Indicative budget

US$700,000

Phase 1	
Initial Survey	250,000
Phase 2	
Equipment and installation	250,000
Phase 3	
Spares, Training and on-going maintenance	200,000

Project 2.3 Provision of small Emergency Managers Weather Information Network (EMWIN) receiving terminals

Background

A major problem in most Pacific islands is the inability to quickly inform remote communities of severe weather and other warnings. Over the last few years there have been many instances of little or no warnings of impending natural disasters being received in remote communities. This has caused considerable loss of property and sometimes of lives - impacts which may have been prevented or reduced, had adequate and timely warnings been received.

Project description

A key element of the analysis project is to develop and enhance the provision of warnings and other information to NMSs and users. Warnings are not of much use if they are not delivered to the wider population in areas likely to be affected. It is now possible to provide a low cost reliable data transmission via the US NWS EMWIN service, which can deliver these messages to the remotest communities quickly and accurately and alert them to possible dangers. This project is to provide a number of small and simple EMWIN terminals to remote communities throughout the Pacific islands to enable them to reliably receive weather forecasts, severe weather and tsunami warnings.

Objectives

To provide a simple and reliable warning reception system throughout areas which have limited or no access to normal distribution services and to ensure prompt receipt of warning messages in remote communities.

Expected impacts

The provision of this equipment will contribute to the safety and well-being of island communities by providing them with early warnings of approaching severe weather and other phenomena.

Locations

About 100 locations throughout the region.

Duration

It is expected that this project will take two to three years to complete.

Expected outcome

Greatly improved delivery of warnings to island communities, improved safety of life and property and greater feeling of security and well-being.

PROJECT IMPLEMENTATION

Schedule

The first phase of this project will be to write a detailed specification of the equipment required. The production of this tender document will be undertaken by SPREP/WMO in Apia. Expressions of interest can then be sought from prospective manufacturers who will be given the opportunity to bid competitively for the supply of the equipment and (possibly through a joint venture) to provide installation and commissioning supervision. It is desirable that the project manager participate in both the design, installation and commissioning of the equipment. It is expected that the design/testing phase could take up to 12 months and that the installations would then proceed in the next phase. Installations should be carried out as much as possible by Pacific NMS staff under the supervision of a contractor or the project manager. Adequate training in the use and maintenance of the equipment will be required. Because of the simple design, it is expected that operational training will be minimal.

Procurement

There are two parts to this project. Firstly to procure, install and commission suitable signal equipment, and subsequently to provide adequate training in its operation and maintenance. The primary signal source will be from the US NWS GOES EMWIN data stream. The supplier will be expected to manufacture suitable terminal equipment to meet the specifications laid down in the SPREP/WMO tender document. The terminal equipment will consist of a small diameter satellite receiving system capable of operating on solar power. It will consist of a small antenna, down converter, signal processing module and thermal paper printer. It will also have an audible alarm device, which will be activated when predetermined warnings are received. The prime requirement will be for a simple and robust terminal that will operate satisfactorily in the tropical maritime environment prevailing in the Pacific islands. Care must be taken to ensure long operating life with minimal maintenance. It would be desirable that the equipment be supplied as a pre-packaged kit of components, which can be easily assembled on site with a minimum of work and expertise. It will be necessary for all potential suppliers to demonstrate that they (possibly in a joint venture partnership with another agent) can provide supervision of the installation and commissioning phase to ensure that the equipment is installed and operating correctly. After the equipment is installed it will be essential to provide training in operation and maintenance. Training may be provided by the supply and installation contractor, and the provision of training could be included in that contract, or training may be provided under contract to SPREP/WMO through an agency familiar with the use and maintenance of the equipment, such as US NOAA. Initial discussions with potential suppliers could confirm which method of providing training would be most effective.

Management

It will be necessary to provide project oversight to ensure that the equipment provided meets the requirements of the project and that it is installed and operating satisfactorily. It is envisaged that a part time project manager will be required.

Risks and sustainability

As with any project being carried out in remote areas there are a number of risks attached to this project. With careful and adequate project design and implementation these risks can be minimised. A prime area to focus on will be reliable construction of the equipment. Due care must be taken to acquire materials that will withstand the harsh tropical environment for a long period of time. To ensure maximum reliability most installations will need to be solar powered. Long life equipment must be used in the power supplies. Provided that adequate care is taken in the design and installation phases, and by the project manager in the inspection of the installations, the project will be successful. The project engineer will need to carefully oversee the design and implementation of the project and a suitably qualified and experienced manager will be essential.

Indicative budget

US$650,000

Design Phase	150,000
Manufacture and Testing	300,000
Installation and Commissioning	100,000
Project Supervision	100,000
Total	**650,000**

Background

Communications links to most Pacific NMSs are based on low speed Aeronautical Fixed Telecommunications Network links supplemented by special purpose systems such as satellite based EMWIN and the geo-stationary satellite Data Collection Service (DCS). While these systems serve their specific purpose well, they do not offer a simple but versatile communication capability to enable NMSs easy access to neighbouring countries, the WMO GTS or the global Internet. This project seeks to fulfil this need.

Project description

The project entails an 'intranet' for the Pacific states, implemented through a satellite based Very Small Aperture Terminal (VSAT) network. The Regional Pacific Intranet (RPI) would allow each Pacific NMS to have reliable and high capacity access to the Internet. This would allow access to the vast range of scientific and information resources as well as access to services and NWP output of leading centres. In addition, it will facilitate exchange of information, and routine forecasts and warnings among the Pacific islands.

Objectives

To provide a facility which will enable efficient communications between Pacific NMSs, a high capacity connection to the global Internet, and improve the operation of real time exchange of meteorological data and enhance the Global Telecommunications System (GTS) in the Pacific.

Locations

All Pacific Island NMSs. This amounts to approximately 21 countries or territories, subject to refinement of numbers after a detailed project design study.

Duration

The project is expected to have a duration of four years for implementation and an overall minimum lifetime of 10 years.

Expected outcomes

Improved forecast and warning services to local communities, aviation, agriculture and marine sectors, through timely access to regional data and information sources; advancement of the understanding of the climatology of the Pacific by improving and facilitating exchange of scientific data and research collaborations; strengthened cooperation between states through ease of communication and mutual assistance, particularly during severe weather events; and mitigation of the risk of small Pacific states becoming 'information poor' as information technology continues to advance in the developed world.

Project implementation

The project is envisaged to span four years, implemented in the following phases:

Phase 1

Network feasibility and design study, to determine local requirements, regulatory constraints and site-specific factors which might limit the effective operation of such a facility. From this study, a network design would evolve, from which procurement specification would be prepared. This phase may take six months.

Phase 2

Implementation. This phase will involve the procurement and installation of the VSAT network through open tendering. The contractor selected would be required to provide, install, commission and maintain the network for its operational life. It is envisaged that as far as possible, recurrent costs, such as space segment lease costs and system maintenance, would be capitalised and funded through advance or progressive payments to the network contractor on a regional network basis. With this approach, individual NMSs would not be liable for network running costs. This phase will take about one to two years for completion, with most installations being completed by the end of year two and the project completed by year three.

Risks and sustainability

Risks

The main risks and difficulties may be the project magnitude associated with geographic extent of areas and diversity of countries. This will mean that project coordination and management will be a large and complex task and great care will be required in selecting a contractor with the necessary organisational skills, technical experience and political/ institutional credentials. Possible difficulties with the telecommunications regularity regime in each country, which may impede approval for establishing communication networks independent of the national telecommunications carrier. This risk may be addressed by emphasising the benefits flowing back to the country through improved services, combined with assurances that the system will be used only for bona fide meteorological purposes (although the difficulty of policing this assurance must be acknowledged). Alternatively an agreement may be reached by convening a series of in-country inter-agency workshops, to consider the national implications of the NMS having access to such a facility.

Sustainability and support

VSAT systems are a very reliable and mature technology. The best maintenance strategy would be to contract with the system vendor to provide maintenance services for the life of the network, as part of the purchase cost. In this way, the users of the system could treat it as a 'black box' and need not become involved with its internal working or support. This type of arrangement is normal, even in developed countries, because the specialised nature of the VSAT equipment usually does not lend itself to user maintenance.

Indicative budget

US$3,600,000

The total budget is estimated at US$3.6m apportioned as follows:

Phase 1	100,000
Phase 2	3,500,000

(includes capital and recurrent costs for eight years capitalised)

Overview

Almost all countries rated improvement in the formulation and distribution of severe weather warnings as their highest priority need. The general weather analysis and interpretative skills within NMSs, specifically in areas such as cyclone warnings, need strengthening. As an example, the capacity of NMSs essential to provide national and local content in warnings, including appropriate tools and technology for the interpretation of warnings or advisory messages from the Regional Specialized Meteorological Center (RSMC) and other advanced centres, was identified as a major need. Forecasters need specific training in these areas. Even within the Nadi RMSC, the current level of specialist tropical cyclone expertise and experience is limited and needs strengthening. Public awareness and education in understanding warnings issued by NMSs was also identified as a major need. The projects in this section aim to address these needs. The goal is to enhance the capacity of NMSs in the specific area of analysis and interpretation of data and information relating to severe weather events, preparation of warnings, and improvement of the understanding and awareness of tropical cyclone and other warnings by users. The analysis and interpretative skills acquired by staff from these projects will also be useful in analysing climate records and sea level data, and providing appropriate advice to users. Severe weather warning can also be improved by enabling Pacific NMSs to benefit from enhancements in numerical models currently under development in advanced centres. This project has three main component projects, some which are divided into sub-components.

Projects 3.1.1 to 3.1.7 (grouped under Project 3.1) address capacity building and human resource development. Projects 3.2 and 3.3 are concerned with technological tools.

Project 3.1.1 Professional meteorological training

Background

Many NMSs do not prepare cyclone warnings and forecasts. All Pacific NMSs depend heavily on various forms of advisory and guidance information from one or more centres (e.g. Nadi, Brisbane, Honolulu, Melbourne and Wellington). Many PIC NMSs do not have personnel with the requisite meteorological background in weather analysis and interpretative skills to blend local/national information e.g. geography, cultural nuances, traditional local behaviour, etc., with this advisory information, to prepare tailored warnings and other information for effective use by local communities and special users in their countries.

Project description

A degree-holder (graduate) in math's/physics/computer science either currently a NMS, or recruited from outside, from each NMS with responsibility for national cyclone warnings, provision of information on climate variability, climate change and services to aviation will be provided with training as a meteorologist. The Australian Bureau of Meteorology Training Centre is one such venue for the training, which is not available in universities. The project will benefit American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Kiribati, Marshall Islands, New Caledonia, Niue, Northern Mariana Islands, PNG, Palau, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna, as required.

Objective

To have in each NMS at least one professional meteorologist, as required by the NMS. This officer will provide technical and scientific leadership particularly on tropical cyclones, and climate related issues.

Locations

Australia, New Zealand and USA.

Duration

The duration of the training course will be about one year. The project will be of five years duration, since recruitment of such officers with the required basic qualifications takes time, and training institutions are not equipped to take more that two or three trainees at a time.

Expected outcome

Availability of capacity to provide scientific/technical leadership on matters related to tropical cyclones, climate change and climate variability, including outreach to the users.

Expected impacts

Reduced social and economic disruption due to improved warnings.

Implementation

The project will be implemented through the award of a contract to a suitable training provider.

Risks and sustainability

Lack of national personnel with appropriate qualifications to undergo training; and loss of trained meteorological personnel. Graduates for this training should be bonded to the NMS recruiting them, probably for a double-equivalent time (i.e. two years) after their return, and the PIC government concerned should ensure that there is budgetary support to continue their employment in the NMS.

Indicative budget

US$250,000

Project 3.1.2
Training of support forecasters to assist the professional meteorologist in the provision of services especially related to severe weather phenomena

Background

While the meteorologist (Project 3.1.1) will provide professional leadership, the support role required for the provision of services can be provided by existing officers of NMSs with the appropriate background. One or two (more in the case of larger NMSs) officers with such training are needed in each NMS.

Description

The Assistant Forecaster Course provided by the Australian Bureau of Meteorology (ABM) offered in alternate years is the only known course in the region suitable for this purpose. The project is to be implemented over five years since the training institution is not equipped to take more than seven trainees at a time. The course will be conducted during the second and fourth years of the first five-year span. The project will benefit American Samoa, Cook Islands, and Federated States of Micronesia, Fiji, French Polynesia. Kiribati, Marshall Islands, New Caledonia, Niue, Northern Mariana Islands, PNG, Palau, Samoa, Solomon Islands, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis and Futuna, as required.

Objective

To have in each NMS personnel with support forecaster skills and knowledge related to the provision of various services.

Location

Melbourne

Duration

Five Years. The course is of eight months duration. The project will be implemented over five years since the training institutions is not equipped to take more than seven trainees at a time, and NMSs will find it difficult to have too many members of the staff away for eight months at the same time.

Expected outcome

Availability of capacity to provide interpretative and user support and related skills on matters related to tropical cyclones, climate change and climate variability, including outreach to the users.

Expected impacts

Reduced social and economic disruption due to improved warnings.

Implementation

The project will be implemented through the award of a contract to a suitable training manager, with training provided through ABM Melbourne.

Risks and sustainability

There is a low risk of loss of trained personnel, as these jobs are rewarding and interesting for technically skilled or semi-skilled people with a relatively low range of options in countries with high levels of unemployment.

Indicative budget

US$240,000

Project 3.1.3
Training in specialised tropical cyclone analysis, forecasting and warning

Background

Analysis and interpretation of raw and semi-processed meteorological data relating specifically to tropical cyclones, the diagnosis of the cyclone's structure and prediction of its future behaviour require highly specialised skills and knowledge. These skills are essential for NMSs with responsibility for the preparation of cyclone warnings, and are not currently available or not available to the requisite level in some NMSs. Even in NMSs which do not operate regional forecasting centres, there is a need for these skills, to provide warnings with the input of relevant local knowledge.

Project description

The University of Florida, in cooperation with the US National Weather Service Hurricane Warning Centre in Miami Florida offers a three-month specialised training course in tropical cyclone forecasting and warning. The course is targeted to existing meteorologists with some general forecasting experience. The NMSs of the following countries, which currently have or will have in the next five years, professionally trained meteorologists with at least one year of forecasting experience, will benefit from this training: American Samoa, Federated States of Micronesia, Fiji, Marshall Islands, New Caledonia, Northern Mariana Islands, Palau, Papua New Guinea, Solomon Islands and Samoa.

Objective

To have each NMS responsible for the preparation of warnings, specialised tropical cyclone analysis and forecasting skills. This officer will provide technical and scientific leadership particularly on tropical cyclones, and climate related issues.

Location

Miami, Florida, USA

Expected outcome

Availability of special tropical cyclone analysis and warning preparation skills in NMSs with national warning preparation responsibility.

Expected impacts

Reduced social and economic disruption in PICs due to improved warnings.

Implementation

By arrangement with the World Meteorological Organization or contract with the supplier.

Risks and sustainability

Non-availability of professional meteorologists in the NMSs concerned (in which case the country must be able to access and interpret information from regional cyclone warning centres) and loss of trained meteorological staff. The risks can be addressed by using a bonding arrangement for staff attending specialised training courses, and by ensuring national work opportunities and regional support networks make NMS jobs attractive to trained graduates.

Indicative budget

US$150,000 ($15,000 for each of the 10 countries)

Project 3.1.4
Training workshops and attachments to tropical cyclone forecasting and warning centres

Background

Tropical cyclone forecasters in the Pacific need to upgrade their skills and knowledge and learn new technology to keep up to date with most recent developments. This project involves a number of workshops and attachments to advanced cyclone warning centres. For the purpose of this project, the countries in the region are grouped as follows:

Group 1
American Samoa, Fiji, French Polynesia, New Caledonia, which have adequately developed forecasting capability.

Group 2
PNG, Samoa, Solomon Islands, Vanuatu, which have basic forecasting capability.

Group 3
Remaining countries of the region that have no forecasting capability

Project description

The project will consist of a series of workshops undertaken in various centres in the region and work attachments for forecasters from Group 1 and 2 countries to regional cyclone warning centres (Fiji, Brisbane, Honolulu, Wellington, La Reunion).

Objectives

The proposed project will enable centres to update skills in the analysis of data and preparation of warning messages about severe weather events such as tropical cyclones, heavy rain, damaging heavy swells and storm surge.

Location

All Pacific island SPREP members.

Duration

Five years

Expected outcomes

Improved warning services for severe weather and tropical cyclones to local communities, and improved safety of aviation and marine operations.

Project implementation

Workshops
Training workshop on tropical cyclone forecasting in the first, third, and fifth year; and Training workshop on sea and swell forecasting in the second and fourth year.

Attachments
Training attachment from Group 3 to RSMC Nadi: three per year for two weeks duration each.

Training attachment from Group 2 to RSMC Nadi and/or TCWC Brisbane: two per year for two weeks duration each.

Training attachment from Group 1 to TCWC Brisbane and/or Honolulu and/or La Réunion centres: two per year for two weeks duration each.

Training attachment within Group 1: two per year for one week duration each.

Attachment of developed country experts to NMSs: two per year for one month each.

Indicative budget

	US$604,000
Workshops 20 persons (80,000 + 20,000) x 5 years	$500,000
one person from each country for each workshop + consultancy, fees, contingencies	
Attachments of trainees to training centres: (4000 x 16)	$64,000
Attachments of experts to NMSs: (20,000 x 2)	$40,000

Project 3.1.5
Training of meteorological personnel on aviation awareness, and safety and economy sensitivity of aviation operations

Background

Aviation operations are very sensitive to weather (especially severe weather) in terms of both safety and economy of operations. Aviation weather services are the main revenue earners in some NMSs. Provision of meaningful weather services to aviation needs a significantly different approach compared to that needed for other purposes. In particular, the time scales involved in decisions that significantly affect flight operations are very short, i.e. a few hours. Sudden changes in weather at the destination or en-route, if not conveyed to an aircraft in flight on time, or not taken in to account in pre-flight planning can have a very significant negative effect on the cost of operations and on safety. This effect can be vastly more than the actual cost of providing the service. It is even further enhanced in the Pacific region where often the long distances between suitable airports must be considered, should a diversion be necessary, and the need to carry excess fuel for contingency diversions has a major economic impact on aviation services. The economic impact of weather services on airlines (and indirectly the country and its economy), both from a positive and negative perspective, can be disproportionately large.

There are three components that require consideration. The first and fundamental component is the supply of accurate and timely aviation weather observations, and the maintenance of an observing "watch". The second component is the provision of briefing material to aircrew so that flight planning can be completed and optimised. The first two components affect all PICs. The third component is the provision of accurate aerodrome forecasts by the forecasting office that has the responsibility for the specific aerodromes, and the continual review of the forecast at those aerodromes. This only affects Fiji, Papua New Guinea, Solomon Islands and Vanuatu. All components interact and are important. However, the third component is critical, since flight planning and the aerodrome forecast ultimately dictate the resultant fuel requirements.

There is a strong identified need in many countries to inculcate among meteorological officers involved in aviation weather services, an attitude of continuous vigilance and responsiveness, through an understanding of the importance of timely and accurate weather services for aviation. There is also evidence that this importance, from an aviation technical perspective, is little understood.

Objective

To improve the quality of weather services affecting the safety and economy of aviation operations through enhanced user focus and responsiveness.

Description

The project involves the conduct of training workshops in the region for meteorological personnel directly involved in the provision of weather services to aviation. Resource persons involved in the workshop will be required to be specialists in aviation weather services. They will demonstrate to the participants, through practical examples, the implications for both safety and economy, of weather services to aviation operations, through the use of hypothetical or real scenarios.

Where possible a train-the-trainer approach will be taken in the selection of participants. The workshop will establish a mechanism for in-country transfer of knowledge within NMSs through seminars, workshops, etc, and material for this will be supplied to the participants.

To maximise the benefits, to reflect the different requirements of the participants and to enable the workshops to be concentrated, the workshops should be conducted at two levels. A basic workshop is required for those staff involved in observing and aviation briefing. A more advanced workshop, or a follow-on workshop session covering forecast related issues is required for all aviation forecasters.

A subsequent review of the changes which have been effected by the PICs as a result of each workshop is required, with an assessment of effectiveness (and a report on lessons learned) to be completed by the training provider.

Location

All SPREP Pacific island members

Duration

There will be three region-wide one-week workshops evenly spanned over a period of five years for each of the two levels specified. An alternative format would be for three workshops, each with a larger group of attendees in the first one-week general session, to be followed immediately by an advanced workshop for three to five days, involving forecasters.

Expected outcome

Safer and more economical air travel through improved aviation weather services.

Expected impacts

Economic and social benefit to the Pacific islands.

Implementation

The project will be implemented through the award of a contract to a suitable provider and coordinated by SPREP/WMO. The project will be monitored through a report/reports to the project coordinator on progress in country on the training and impact on weather services, three to six months following each workshop.

Risks and sustainability

There is a low risk of loss of trained personnel at this level. All workshops should be held at a location away from the place of work of any participants, so they are not distracted from the proceedings by the demands of their normal work.

Indicative budget

US$120,000

Project 3.1.6
Public education and awareness on severe weather (including tropical cyclones, drought, floods) and the role of climate variability

Background

Warnings on cyclones and advice on droughts need to be understood and acted upon by the user, especially the public, for them to be effective. This requires understanding by the public of the nature of cyclones and their behaviour, and the specific actions to be taken and when they are to be taken to minimise loss of life and damage. Clearly understandable translation of warnings into the local language and the use of symbols, signs, and signals where necessary to convey the message are an important part of the warning system. Bridging the distance between the warning message and the end user effectively needs close coordination between the national disaster organisation, the NMS, other government departments, the media, community leaders, and non-government organisations (e.g. the Red Cross Society). Effectiveness of response to warnings issued by NMSs can be enhanced by the involvement of community leaders. While the machinery for this process is in place in most countries, it needs strengthening.

Climate variability associated with the El-Niño/La-Niña and other longer period climatic controls has begun to feature very significantly in the lives of the Pacific people. Climate variability and possibly climate change is now beginning to be held responsible for extreme departures from normal climate. The public education/awareness programme will include climate variability.

Meteorologists, as generators of warnings and advice on droughts and the onset/cessation of the El-Niño/La-Niña phases, have a crucial role to play in the process.

Project description

The project will have the following components:

- Preparation and production of pamphlets, booklets, and information on other media, containing educational/awareness material at the appropriate level on cyclones, drought, floods, and climate variability, translations of technical terms, the warnings system, etc., and dissemination of these to community leaders, schools and the general public;

- Conduct of in-country joint workshops by meteorologists, and disaster management personnel and involving concerned community leaders, NGOs, the media, and disaster focal points in government departments, to facilitate the effective implementation of disaster management plans in operational situations.

Objective

To educate the public and raise institutional and public awareness regarding cyclones, floods, and storm surges, so that agencies and individuals or communities may make decisions and take appropriate actions to minimise loss of life and property.

Location

All SPREP Pacific island members.

Duration

One-week workshops for public officials, school principals, disaster coordination personnel, NGOs and personnel from similar agencies, and media personnel involved in weather forecast transmission, conducted twice over a five-year period in each PIC.

Expected outcome

A public informed and educated to be able to make decisions and take appropriate and timely action to minimise loss of life and damage to property.

Implementation

This project will be implemented through contract and coordinated closely with the public awareness and education project relating to climate services (Project four).

Risks and sustainability

Inadequate commitment on the part of parties concerned in coordinated implementation of the project, and subsequent follow-up. Pre-workshop discussions will be necessary, involving representatives of the agencies involved.

Indicative budget

US$500,000 (US$100,000 per workshop)

Project 3.1.7
Awareness and education of small craft (boats) operators (including fishermen) regarding weather at sea, especially during cyclones, and the use of warnings

Background

Numerous boats including fishing vessels operate in the extensive national waters of PICs. There are numerous occasions when these boats disappear at sea and lives are lost. Governments are obliged to spend considerable resources in search and rescue operations. Often boat operators do not have adequate understanding of severe weather, including cyclones, and how to use information contained in forecasts and warnings to plan their trips and avoid being caught at sea in bad weather.

Project description

National workshops will be conducted for small boat owners, co-ordinated by the national disaster organisation and involving the NMS, the Marine Department, and experienced mariners. All PICs will benefit from the project. The project will be co-ordinated centrally in the region, but implemented nationally and jointly by the national disaster organisation, the NMSs and the Marine Department.

Objective

To upgrade the education and awareness of small boat operators regarding weather conditions during cyclones and the use of weather information to plan their trips effectively to avoid being caught in bad weather at sea.

Locations

All SPREP Pacific island members.

Duration

One-week workshops, conducted in two series over a five-year period in each PIC, separated by two years.

Outcome

A small-boat operating community, well informed regarding dangerous weather at sea and the use of warnings, and using weather information including warnings effectively to enhance safety of life at sea.

Expected impacts

Reduced loss of life at sea and cost to the government and country through reduced search and rescue costs.

Risks and sustainability

The major risk will be lack of motivation for the people most affected to attend the workshops. It will be necessary for workshop facilitators to visit the countries concerned prior to the workshops, to meet with fisherman's' associations, boat owners associations, and to deliver messages through community notice-systems, including village church notices, radio public information broadcasts and other media outlets. In each instance the benefits to the local boat operators must be stressed.

Indicative budget

US$500,000

Background

The impact of storm surges generated by cyclones as they approach a coastal area/island is one of the most damaging aspects of tropical cyclones. Past tropical cyclones, such as Ofa and Val in Samoa, showed that storm surges caused much more damage than high winds. Almost all islands have population and economic development activities concentrated along coastal areas. This proposal aims to bring together experts to develop storm surge models relevant to the Pacific region and islands. National Aeronastical Space Academy (NASA), Commonwealth, Scientific, and Industrial Research Organisation (CSIRO) and others have already developed models for forecasting storm surge for coastal regions and islands. For examples, CSIRO , Australia, has just completed a study on the 'Impact of Sea Level Rise and Storm Surges on Coastal Resorts around the Cairns region, while NASA has already prepared detailed storm surge models for Hawaii. These experiences can be adapted for each of the Pacific islands.

Project description

The project involves bringing together about 40 experts from various organisations and institutions for a five day workshop to share their experiences on storm surge model development which may be applicable and adapted for the Pacific region. The workshop will develop project proposals for developing storm surge model at specific priority locations for donor considerations,

Objective

To develop storm surge models appropriate for the Pacific islands and the region.

Duration

Five days

Location

Samoa, Australia or Honolulu (depends on offer by host organisations)

Expected outcome

Storm Surge models developed and used by all Pacific Islands.

Expected impacts

Better warnings to the public of approaching storm surge and the improved prediction of return periods of storm surges based on cyclone climatology.

Project implementation

SPREP and WMO, in collaboration with the South Pacific Geoscience Commission (SOPAC), CSIRO and NASA.

Risks and Sustainability

No risks.

Indicative budget

US$120,000

Background

Severe weather warnings required by many Pacific island NMSs rely upon the outputs of global atmospheric numerical forecast models developed and operated by advanced centres eg in UK, France, USA, and Australia. Although these are useful at present (the only models used at present), this reliance on global models has many drawbacks. Firstly, the PICs do not have access to the highest resolution real-time products issued by these centres. Secondly, these global models perform poorly in forecasting small-scale phenomena. Past experience shows that a relatively high number of false warning messages of severe weather events have been issued by the Pacific Island NMSs, and a number of severe weather events went undetected by these global models.

Project description

A few advanced centres are currently developing the next-generation numerical models which provide very fine details of weather patterns. Forecasts issued by these new fine-mesh models would provide Pacific island NMSs the capability to be much more effective in predicting harmful weather also during non-cyclonic situations, such as heavy rain, sudden high winds or damaging heavy swell. On the other hand, advanced centres would benefit from assessments and feedback on the models carried out by the staff of Pacific island NMSs.

Procurement

The project will involve convincing advanced centre(s) to accept the principle of this cooperation; and the

- Installation of the necessary equipment (workstation, high speed telecom line.) to acquire the high-resolution data and adapt them locally;
- Use of telecommunications systems to provide feedback from the PICs to the numerical model developers, through interactive communications, on the outcomes of pilot experiments; and
- Research by the modellers to assess objectively the quality of a forecast – through interactive use of the telecommunications systems.

Objectivies

The proposed project would allow Pacific island NMSs to gain access, within limited geographical domains of their concern, to be very accurate small scale weather forecasts issued by the advanced centres, and to adapt these forecasts to meet their local needs and responsibilities. Further, the Pacific island NMS forecasting centres would be required to regularly evaluate and give feedback on the performance of enhanced fine mesh numerical model outputs of advanced centres.

Duration

A period of 10 years seems necessary given the current state of knowledge and development of models to obtain routine, operational and reliable weather forecasts for a number of Pacific islands.

Location

All PICs having weather forecasting capabilities would potentially benefit from this project. For the other PICs, RSMC Nadi would provide interpretations of these high resolution numerical forecast outputs and use them in the preparation of warnings or guidance products. Advanced centres which could participate in this project are those which have the capability and are interested in the project.

Expected outcome

The number of inadequate warnings and of non-detection of severe weather events would be reduced significantly.

Project implementation

Phase 1
Establishment of the framework (choice of the participating advanced centres, choice of the PICs able to collaborate, methodology definition) (one year)

Phase 2
Purchase and installation of equipment (work station, leased line.) (six months)

Phase 3
initial experimental phase (one single geographical domain, one single non real-time meteorological situation per month) (two years)

Phase 4
Assessment of pilot results

Phase 5
Normal experimental phase (many geographical domains, real-time meteorological situations) (five

years)

Phase 6
Final assessment and conclusions.

Risks and sustainability

Risks
The main risk is likely to be the difficulty of having PICs and advanced centres working together for a long period of time. This would require significant resources and careful logistical planning.

Sustainability and support
This will be a key issue and will need to be carefully assessed on a case by case basis for each participating country. Development of skills among local staff would be necessary to ensure that cooperation with advanced centres is maintained.

Indicative budget

US$120,000

Overview

In view of concerns about climate change and variability, availability of useful seasonal and interannual climate prediction emerged as the most prominent, high priority need, especially in the agriculture, forestry, fisheries, disaster management and energy sectors. Most users saw a strong need for more regular updates and accurate predictions of the El-Niño/La-Niña phases and associated weather and climate extremes (e.g. probability of tropical cyclone occurrence). Provision of the more traditional climate data and services continues to be an important function of Pacific island NMSs. Recent advances in this area of science provides strong motivation to address this need. Unlike cyclone warnings, this is a relatively new field, and one that needs development for the Pacific NMSs from a fairly basic threshold. Seasonal and climate prediction needs relatively good quality data in summarised form as a prerequisite. This project proposes to address climate data management, preparation of seasonal/interannual predictions and their interpretation and use.

Project 4.1 Climate analysis and applications

Background

Availability of climate data, information and services was identified as one of the key needs of users in number of sectors including forestry, fisheries, agriculture disaster management, tourism, and construction, etc.This project aims to provide basic training courses on common applications of climate data, such as analysis and extraction of deciles, extreme winds, climate outlooks, calculation of soil moisture, etc., and the provision of necessary tools for trainees to be able to interpret and analyse historic climate records of their own countries.

Project description

The project provides for the continuation of training courses at appropriate advanced climate centres with the assistance of WMO, under the Climate Information and Prediction Services Project (CLIPS). Trainees should be from the climate divisions of Pacific islands NMSs.

Objective

To develop the capability to apply climate data and knowledge to improve planning and operational decisions in agriculture, forestry, water resources, fisheries, engineering and the environment.

Location

Roving in-country workshops or attachment to advanced climate centres like NIWA (National Institute for Water and Atmospheric Research), etc.

Duration

One month training per year, over three years.

Expected outcome

Improve climate predictions and understanding of the climatology of the region and countries, particularly in relation to the ENSO phenomenon.

Project implementation

Bureau of Meteorology Climate Centre, NIWA, SPREP and WMO.

Risks and sustainability

The main risk is the lack of committed funding, which this proposal is seeking to address.

Indicative budget

US$100,000

Background

Climate information and prediction services was identified as one of the key priority needs of users, particularly in the forestry, fisheries and agriculture sectors, and for disaster management. Most users wanted to see more regular updates and accurate predictions of the El-Niño/La-Niña and associated weather and climate extremes (e.g. probability of tropical cyclones occurrence). Despite this high priority need, there are very few qualified climatologists in the region. This project aims at developing university level knowledge and skills in climatology, develop the capability to carry out climatological analysis, and interpret these to users and policy makers.

Project description

Interest in hosting this programme was expressed by the University of the South Pacific, as a part of the Pacific Islands Climate Change Diploma Course, initiated under the PICCAP programme.

Objective

To develop university level knowledge and skills in climatology.

Location

USP

Duration

Three years.

Expected outcome

More qualified climatologists in the region.

Project implementation

USP, SPREP and WMO.

Risk and sustainability

The main risk is the lack of committed funding, which this proposal is seeking to address.

Indicative budget

US$250,000

Background

In 1996, SPREP commissioned a feasibility study to look at ways of developing a Regional Climate Bulletin. The idea for a regional bulletin came out of the third SPREP Meeting of RMSD in 1995. The study concluded that there was urgent need to establish a regional climate bulletin to disseminate climate information and predictions to all people in the region. At present, only a quarterly newsletter produced by the Pacific ENSO Application Centre (PEAC) in Honolulu, Hawaii is serving as a source of climate predictions. This newsletter only covers US affiliated countries and territories. A detailed proposal for a regional bulletin came out of the 1996 feasibility study. SPREP submitted this detailed proposal to various donors and as of this year, the Italian government has agreed to provide limited funds to kick-start the bulletin.

Project description

A regional climate bulletin catering for the needs of all SPREP Pacific island members will be produced. Ideally, it could be hosted on a web page. However, hard copies still need to be produced and circulated.

Objective

To develop a regional climate bulletin serving the needs of PICs.

Location

SPREP Web page, or Fiji Meteorological Service, PEAC.

Duration

Three years.

Expected outcome

Timely and wider dissemination of climate information and predictions.

Project implementation

SPREP/WMO jointly with Pacific island NMSs and advanced climate centres.

Risk and sustainability

The main risk is the lack of committed funding, which this proposal is seeking to address.

Indicative budget

US$300,000

Background

The capacity to predict seasonal to interannual rainfall and other climate anomalies (largely based on the El-Niño Southern Oscillation/La-Niña phenomena) in the Pacific region emerged as a high priority for SPREP members. Experience has shown that statistical predictions can work well for the coming season (zero to three months) whereas forecasts from climate models become more useful at longer lead times. Unfortunately statistical predictions are not made for or by all members, nor is the web-based information from climate models readily available for members who do not have web access and there is little guidance on how this broader picture relates to specific locations within the region. While both statistical and climate model forecasts together can provide the basis for a very useful climate prediction service in all member countries, there are a range of issues that need to be addressed in producing a successful system. This project proposes a system which is best developed employing a joint/community strategy with each of the NMSs playing a pivotal role in their region.

Recently the Australian Bureau of Meteorology (through its National Climate Centre) in conjunction with the Fiji Meteorological Service used AusAID funds to develop a PC-based stand-alone statistical prediction scheme for seasonal rainfall in Fiji. A comprehensive assessment of the skill of the scheme was also produced. The Fiji Meteorological Service is now using this scheme operationally in their monthly climate outlook.

The only on-going input required for this scheme is the latest monthly value of the Southern Oscillation Index or SOI - a readily available, single number. This scheme therefore provides an extremely simple but highly useful starting point and potential back bone for seasonal forecasting operations, especially in countries with limited staff resources and/or experience in interpreting output from more complicated systems.

The project proposes similar schemes for other countries in the region, giving them the capacity to perform seasonal forecasts or at least to have access to forecasts specifically tailored to their regions/countries. During the first few months statistical schemes have demonstrable skill in the region (as has been the experience in Australia, Fiji, US and French affiliates) and very likely have skills in the those countries in the region which do not currently have a capacity in this area.

While there is work being done in assessing the accuracy of climate predictions from climate models in other parts of the world, there is currently no initiative specifically focused on downscaling (ie refining and directing) information from coupled atmosphere-ocean models, to seasonal to interannual forecasts in our region on a near real-time basis for use by NMSs.

Another obstacle to the widespread and prudent use of seasonal to interannual forecasts in our region is that their availability and potential usefulness is not widely appreciated by the general public. There is therefore a strong need for education and training in a wide range of issues both within our NMSs and amongst the broader community. The production of a new climate prediction service is of limited value if it is not used in decision making by governments and industry in the region, or if the results are not used properly, due to an imperfect understanding of the advice provided.

Project description

The project is therefore aimed at:

- developing systems to downscale forecast information from coupled atmosphere-ocean general circulation models for our region;
- increasing the capacity of NMSs in the region to produce their own outlooks using in-house, stand-alone systems and to integrate this with the information from the coupled atmosphere-ocean models to produce a coherent whole;
- raising the awareness of the new products amongst the wider community as they become available;
- liaising with potential users (individual users, government agencies, and a range of industries) to ascertain what information and what formats will be of most use to them, to develop dissemination strategies, increase awareness of their probabilistic nature, and to assist in the incorporation of the forecasts into decision-making.

These aims are to be achieved as follows:

1 Training workshops

Approximately two weeks duration in the region possibly in Fiji ideally prior to a two day climate outlook forum) after the statistical schemes have been developed) in 2001/2002, with the participation of lecturers from SPREP member nations and other centres around the world. This is aimed at training participants on how to use the schemes developed and on accessing and interpreting material from centres around the world and on devising an actual outlook for the region. Specifically it will aim to:

- raise appreciation of factors affecting climate on large-scale and on a regional/national scale;
- enhance ability of NMSs to interpret forecasts from centres around the world and incorporate information into NMS outlook statements;
- develop capacity to make statistical forecasts using the proposed scheme;
- ability to access and understand additional information from overseas on an ongoing basis;
- an appreciation of the relative skill of the various methods to ensure that consensus forecasts are on as objective a footing as possible; build an informal self-support network in the region to support the more formal structure (see below);
- increase understanding of the basis for statistical and numerical prediction;
- building links with users - demystifying the forecasts, tailoring forecasts;
- increase appreciation of psychological and sociological pitfalls that can be associated with subjective consensus forecasting; and
- provide an operational climate outlook for subsequent dissemination

Cost: $40,000 per workshop

2 Professional Officer

To build schemes, document and verify schemes, and provide supporting explanatory reference material. Roving training work, education, implementation and liaise as required ($150,000).

3 Support

For longer term training, the attachment of key staff at centres where the method is well established (e.g. Fiji). ($30, 000)

4 A trainer/technician

Perhaps based in Fiji, Australia or at SPREP to follow up on trainees, to answer any further queries, to ensure the smooth running of systems for 12 months or longer, and explain and assist with implementation of new services as they become available ($50,000).

5 The use of consistent PCs

Standardising PCs in all centres would be an advantage for follow up, so that centres can exchange information on the smooth running of packages ($30,000).

6 Person to assist with collation and dissemination (See project 4.3)

The collator would work in the region making full use of existing channels and modern methods where possible but ensuring that all participating nations receive timely information.

7 A person to develop and implement a marketing strategy

To gauge what products are most needed and in what format and by what channels, to promote services as they are developed, to provide advice on promotion and media liaison, and to assist with ongoing improvement of systems ($60,000).

8 Two post-doctoral fellows

To investigate the feasibility, and if feasible, develop real-time systems to downscale forecasts from coupled atmosphere ocean models and to develop an objective consensus system incorporating climate forecasts from more than one system to enhance accuracy ($260,000).

Objective

To enhance the ability of NMSs in the region to produce, interpret, disseminate and explain climate prediction information using modern techniques, to raise the awareness of the availability and potential usefulness of the information, to enhance the ability of potential users to incorporate the predictions into their decision making.

Location

Australian Bureau of Meteorology, SPREP, Fiji Meteorological Service, and NMSs throughout the

Duration

Three years.

Expected outcome

Increased ability of companies, government agencies and individuals to factor climate prediction information into their decision making which will assist in the better management of activities (e.g. government, business, health, agriculture) related to climate variability in the region.

Project implementation

Australian Bureau of Meteorology, SPREP, Fiji Meteorological Service.

Risks and sustainability

It has been assumed that the observational data needed to develop prediction schemes (both stand-alone and downscaled) are made available by the individual NMSs. All of the initiatives are aimed at capacity building in the individual centres, and to provide systems that will be of use for extended periods beyond the project life-time within the various NMSs.

Indicative budget

US$620,000

PROJECT 5 INSTITUTIONAL STRENGTHENING, INCLUDING INFRASTRUCTURE SUPPORT

Overview

The Pacific island NMSs have recently assumed a strong collective posture in spearheading a co-ordinated approach to the planning and development of meteorology (including climate) at the regional level under the leadership of SPREP. Particularly due to the regional nature of meteorology and climate, and SPREP's very successful leadership, this approach has resulted in a number of very positive initiatives. Two very significant initiatives are the SPREP Meeting of Regional Directors, and this needs analysis project. It is essential for the development of meteorology in the region that the momentum of these initiatives not be lost. In particular, the implementation of projects recommended in this report needs continued strong SPREP involvement in the co-ordinator/facilitator role. In addition to addressing this matter, the project addresses the essential need for appropriate cyclone resistant accommodation for NMSs and their essential facilities.

Background

In 1993, SPREP recruited the first Meteorology/Climatology Officer (MCO) under funding from the Commonwealth Secretariat. Funding for the position ran out after the Commonwealth Secretariat funds were used up in 1996. Since then, an officer substantively assigned fully to the US Department of Energy (DOE) Atmospheric Radiation Measurement (ARM) programme has been carrying out the task of coordinating activities of NMSs within SPREP on a part-time basis. This has placed enormous pressure on that particular officer. US DOE ARM programme has proposed that their officer should be put fulltime under that programme leaving NMSs without support in SPREP. This project proposes that a full time meteorologist should be recruited to coordinate regional meteorological activities within SPREP, in cooperation with the WMO Sub-regional Office in Apia. Due to the need for regional cooperation on matters relating weather, climate variability, and climate change, there is strong need for a full-time position in SPREP. Most Pacific islands will continue to need external assistance from SPREP on matters relating to regional and international cooperation, in view of their current lack of capacity or resources.

Project description

The project provides for the continuation of the SPREP MCO. Its role is to coordinate meteorological activities in the region jointly with WMO**.**

Objective

To provide full time support to NMSs of PICs.

Location

SPREP Secretariat, Apia, and Samoa.

Duration

Six years. (A three year contract initially to be renewed upon mutual agreement and contingent on satisfactory performance).

Expected outcome

Improved coordination and collaboration amongst NMSs.

Assist with formulation/coordination of specific projects to strengthen NMSs in the region.

Assist in facilitating the training of meteorological/climatological personnel in specific areas pertaining to their work.

Project implementation

SPREP Secretariat.

Risks and sustainability

SPREP has no funding allocated for this position, but can support the position if donor funds are made available. The main risk is the unavailability of suitably qualified and experienced staff from within the region who may be interested in the position. The position demands a qualified meteorologist who is dynamic, flexible and willing to travel extensively throughout the region.

Indicative budget

US$360,000
US $ 60,000 per year
(salary plus additional costs)
Total US$360,000 over six years

Project 5.2 SPREP meeting of Regional Meteorological Service Directors (RMSD)

Background

Since 1993, SPREP has organised the annual meetings of Regional Meteorological Service Directors (RSMD). The first four meetings were held in Vanuatu (93), Samoa (94) Fiji (95), and Samoa (97), and were sponsored by New Zealand, Commonwealth Secretariat and other donors. These meetings had guaranteed funding. However, funding for the subsequent meetings in Honolulu (98), Tahiti (99) and Samoa (2000) were obtained from various donors through the efforts of SPREP. This project aims to secure a firm funding commitment for this meeting over the next four years.

Project description

The project provides for the continuation of the SPREP Meeting of RSMD in the next four years. Based on past experience, this meeting has resulted in vast improvements of coordination and collaboration amongst NMSs of the SPREP region. The development of the Strategic Action Plan for the Development of Meteorology in the Pacific, 2000–2009, provision of EMWIN systems to Pacific island Countries, the PMSNAP project, and many other development assistance to NMSs would not have been possible without the RMSD forum. Having the meeting back to back with a workshop on a specific topic is a great model which has worked very well in the past. This resulted in minimising costs, and reducing the time that Directors and meteorological staff spend away from their offices.

Objectives

To provide a continuing forum for the coordination and planning of meteorological and climatological activities in the region, and the conduct of specific training workshops on various topics as per past practice.

Location

Various, within the PICs. Attendance by all SPREP members.

Duration

Five days (Two day workshop, followed by three day meeting).

Expected outcome

Improved coordination and collaboration amongst NMSs. Planning the development of NMSs and formulation of specific projects, and the provision of training to meteorological personnel in specific areas pertaining to their work.

Project implementation

SPREP and WMO to organise.

Risks and sustainability

The main risks are the lack of committed funding, which this proposal is seeking to address.

Indicative budget

US$320,000
$80,000 per meeting
Total $320,000 over four years

Background

The PMSNAP missions identified a number of sub-standard offices and facilities in some of the key NMSs. Samoa, Tonga and Tuvalu were singled out in particular, as having needs for new offices and/or renovations of their present offices. NMSs of Vanuatu and the Solomon Islands require their NMS building to be replaced. Some of the buildings, where critical facilities of these NMSs are located, are not cyclone resistant or are exposed to flooding, ocean waves and swell.

Project description

The project calls for the extension and/or renovation of existing buildings where practicable. The construction of new buildings and possible relocation is recommended for Samoa, Tonga, and Tuvalu. The new offices will be fitted with new furniture and have appropriate office space and environment to meet the growing demands placed on the NMSs.

Objectives

To provide NMSs which currently have inadequate accommodation with cyclone resistant accommodation that can withstand wind and tidal impacts (see country reports in annexes).

Location

Kiribati, Samoa, Solomon Islands, Tuvalu, Tonga, and Vanuatu.

Duration

Project will be completed within a three-year time frame.

Expected outcome

Adequate and appropriate accommodation for the NMSs concerned.

Project implementation

The PICs concerned.

Risks and sustainability

The main risk is the lack of support from national governments concerned to make publicly owned land available on which to construct (or reconstruct) offices.

Indicative budget

US$6m dollars
US$1m dollars per country

This synthesis report closely meets the requirements of the Scope of Services (Annex 1). It identifies severe weather warnings and climate services (including seasonal/interannual prediction) as the two region-wide highest priority areas of need, where investment in upgrading the capacity of NMSs would have the greatest returns in terms of economic and social benefits. Upgrading in these areas would have beneficial flow-on effects on the provision of weather services to aviation, marine interests, to the general public on a routine basis, and on climate services.

It is also clear that most PICs do not have the minimum and necessary pre-requisite support structures for providing these services i.e. adequate and functional weather and climate observation networks, concomitant telecommunications, and a minimum level of human and other resources. It is clear that if the decline in these which has occurred over the last two or three decades is not addressed urgently, the situation will deteriorate where the region and the countries will have great difficulty in providing essential services such as credible cyclone warnings. Further, they will find it impossible to address the issues of climate change and variability. The report therefore identifies the necessary support structures that need to be upgraded, i.e. weather and climate observation networks, and national and regional telecommunications. The report also identifies key factors required for continued co-ordination of regional planning, and implementation of weather and climate activities in the region.

To rectify the situation the report recommends, for implementation through development assistance, five regional projects (with sub-projects) under the following themes: observational networks, communications, severe weather warnings, climate services (including seasonal/interannual prediction), and institutional strengthening and infrastructure. In many instances sub-projects under the major projects may be beneficially implemented independently of other sub-projects, and without loss of effect on other projects or subprojects.

One major constraint faced by most countries in the region is that often they do not have the resources to provide ongoing support and operating expenses for projects that require these, especially those involving complex equipment. This is a major challenge, both for donors and for aid recipients.

ANNEXES

Annex 1 Scope of services: The Pacific Meteorological Services Needs Analysis Project

1 Project

Description

This project involves an analysis of needs of National Meteorological Services (NMS) of Pacific Island Countries to ensure they meet national, regional and international obligations, particularly in weather services, climate change and variability, international cooperation and national development needs. The project will also develop a set of coordinated activities, which could be picked up by donor agencies to develop NMSs in the region. The Sixth SPREP Meeting of Regional Meteorological Service Directors (RMSD) held in Tahiti in July 1999 identified this project as high priority.

1.1 Duration

SPREP shall commence the agreed activities outlined on 10 January 2000, and complete them by 31 May 2000.

1.2 Location

The analysis shall look at NMS in the following countries: American Samoa, Cook Islands, Federated States of Micronesia, Fiji, French Polynesia, Guam, Kiribati, Marshall Islands, Nauru, New Caledonia, Niue, Northern Mariana Islands, Palau, Samoa, Solomon Islands, Tokelau, Tonga Tuvalu, Vanuatu and Wallis and Futuna.

1.3 Goal

The overall goal of the Needs Analysis Project is to identify strategies for the improvement of NMSs across the Pacific.

1.4 Objectives

The main objectives of the Needs Analysis Project are:

- To identify the national, regional and international obligations relevant to meteorological services in the Pacific island Countries participating in the analysis
- To determine the capacity of each service to meet these needs
- To present a range of options for projects suitable for donor agencies to undertake in order to address the needs identified.

2 Project Outputs

2.1 Project Outputs

- A single report identifying the national, regional and international obligations relevant to meteorological services in the countries specified above and assessing the capacity of each service to meet these needs.
- The report shall also detail an integrated range of projects concepts which address these needs, in a format which would give donor agencies sufficient information to determine the resources, approximate costs, duration, location, risks, sustainability, objectives and expected impact of each project.
- Presentation of the results at the seventh SPREP meeting of RMSD in 2000.

ANNEX 2 The Pacific Meteorological Services Needs Analysis Project (PMSNAP) team

The members of the PMSNAP team were:

Ram Krishna (Team leader), Supervisor, International Affairs (former Director of the Fiji Meteorological Service), Bureau of Meteorology, Melbourne, Australia.

Robert R Brook (Adviser), Assistant Director (Observations and Engineering), Bureau of Meteorology, Melbourne, Australia, Chairman of the WMO Regional Association V Working Group on Planning and Implementation of the WWW.

Mike Hassett (Telecommunication Expert), Superintendent, Telecommunications, Bureau of Meteorology, Melbourne, Australia.

Scott Power (Expert on Seasonal Climate Prediction), Bureau of Meteorology, Melbourne, Australia.

Edward Young (US NOAA NWS Expert), Deputy Director, US National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Pacific Region, Honolulu, Hawaii.

Karl Turner (US NOAA NWS Expert), Chief, US National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Pacific Region, Honolulu, Hawaii.

Eileen Shea (Consultant), East West Center, Honolulu, Hawaii.

Jacki Pilon (Meteo France Expert), Director, Meteo France, Tahiti, French Polynesia.

Tony Veitch (MetService NZ Ltd Expert), Manager, International Division, Meteorological Service of New Zealand Limited, Wellington, New Zealand.

Garry Clarke (Met Service NZ Ltd Expert), Technical Manager, International Affairs Division, Meteorological Service of New Zealand Limited, Wellington, New Zealand.

Rajendra Prasad (Pacific Expert), Director, Fiji Meteorological Service, Nadi, Fiji.

Henry Taiki (WMO Expert), Program Officer, WMO Sub-regional office for the South-west Pacific, Apia, Samoa.

Marjorie E Sullivan (AusAID consultant), AusAID, Canberra, Australia.

Joanne Laurence (AusAID adviser), AusAID, Canberra, Australia.

Colin Schulz (SPREP Telecommunication Expert), Nambour, Australia.

Penehuro F Lefale (SPREP Expert and Co-ordinator of Project), SPREP, Apia, Samoa.

	Planning meetings and organisation
31 December 1999	Memorandum of Understanding signed between AusAID and SPREP
16 January	Disbursement of funds to SPREP by AusAID to start the project
30 to 31 January	First Planning Meeting of the PMSNAP hosted by Meteorological Service of New Zealand Limited, Wellington, New Zealand
28–29 March	Second Planning Meeting of the PMSNAP hosted by SPREP and the Cook Islands Meteorological Service, Rarotonga, Cook Islands
27–28 April	Third and Final Planning Meeting of the PMSNAP hosted by the Bureau of Meteorology, Melbourne, Australia
	Fact finding mission
16 August–22 October 1999	Needs Analysis and Strategic Directions – Balus Programme (Luana, Veitch, Quayle, Gabi, Kekedo) – AusAid sponsored
2–7 February 2000	Port Moresby: Further consultations with PNG NWS staff (Lefale)
9–10 February	Pago Pago: Undertake American Samoa needs analysis (Turner, Lefale)
11–13 February	Apia: Undertake Samoa needs analysis (Turner, Taiki, Lefale)
13–15 February	Suva/Nadi: Discussions with regional and international organisations and undertake Fiji needs analysis (Krishna, Young, Prasad, Taiki, Lefale)
17–21 February	Port Vila/Honiara: Discussions with NMSs and users in Vanuatu and Solomon Islands (Krishna)
21 February–5 March	Niue: Discussions with Meteorological Office and users in Niue (Clarke)
7–9 March	Nukualofa: Discussions with NMS and users in Tonga (Clarke)
16–20 March	Funafuti: Discussions with NMS and users in Tuvalu (Clarke)
21–23 March	Tarawa: Discussions with NMS and users in Kiribati (Clarke)
3–7 April	Rarotonga; Pacific Islands Conference on Climate Change, Climate Variability and Sea level Rise, Rarotonga, Cook Islands. Conference attended by all members of the PMSNAP Team.
27 March–7 April	Undertake Nauru needs analysis (Lefale). Undertake Cook Islands needs analysis (Clarke, Veitch)
11–13 April	Nuku’alofa: Undertake Tonga needs analysis (Clarke, Lefale)
16–26 May	Geneva: Fifty Second WMO Executive Council. Council attended by Lefale and Prasad. Discuss regional synthesis report.
	Report preparation
1–15 May	Melbourne: Krishna and Lefale prepare first draft of the regional synthesis report (Pacific Meteorological Service; Meeting the Challenges)
16 May	Canberra: Krishna presents draft report to AusAID officials prior to finalising the document
17–25 May	Geneva: Lefale discusses draft with WMO staff.
27 May	Three-hour telephone conference organised by the US NWS Pacific Region Office, Honolulu to discuss changes to report (Clarke, Krishna, Pilon, Schulz, Turner, Young)
5 June	Draft synthesis report transmitted to Mr G Miles, SPREP (R Krishna)

ANNEX 4 LIST OF ORGANISATIONS AND INDIVIDUALS CONSULTED

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Mr A Sene Junior
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American Samoa Telecommunications Authority

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Mr P Bailey
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Mr A Malae
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Mr M T Solomona
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Mr F T. Pola
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American Samoa Environmental Protection Agency (ASEPA)

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Cook Islands Meteorological Service

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Ms J Matenga
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Mr T Pitt
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Cook Islands Television

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Mr A Kaloumaira
Disaster/Mitigation Adviser
South Pacific Geo-science Commission

Fiji ENSO Workshop panel discussion, 23 February 2000, Forum Secretariat, Common Room A

Team members P Lefale, E Young, R Krishna, and R Prasad attended this panel discussion, organised by SOPAC/SPDRP2/UNEP on Strategies for operations and preparedness to the 1997/1998 ENSO in Fiji.

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KCNM AM and KZMI FM Radio

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Wewak

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NWS Station Supervisor and meteorological observers

Provincial Disaster Coordinator

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ANNEX 5.1 References and bibliography

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Vanuatu Meteorological Service Strategic Development Plan (2000-2009) (R Krishna, Australian Bureau of Meteorology) – (A joint project of ABM, VMS, and WMO), 1999.

Project 1	Strengthening observing systems	Indicative budget (US$000)
1.1	Restore and upgrade the human-operated surface observational network.	750.00
1.2	Provision of Data Collection Platforms (DCP)/Automatic Weather Stations (AWS)	3,160.00
1.3	Marine meteorological data reporting, collection, dissemination, and training	530.00
1.4	Basic meteorological observer training	110.00
1.5	Restore and upgrade the regional upper air observation network	2,600.00
1.6	Provision of high resolution satellite imaging systems	430.00
1.7	Lightning detection systems for Pacific Islands National Meteorological Services	670.00
1.8	Pacific states radar network	10,200.00
1.9	Technical maintenance back up	500.00

Project 2	Strengthening telecommunication networks	Indicative budget (US$000)
2.1	Provision of high frequency radio transceivers for the collection of weather reports from outstations	1,200.00
2.2	Provision of Local Area Networks (LAN) for National Meteorological Services	700.00
2.3	Provision of Small EMWIN (Emergency Managers Weather Information Network) receiving terminals	650.00
2.4	Regional Pacific Intranet (RPI)	3,600.00

Project 3	Improve severe weather warnings	Indicative budget (US$000)
3.1	Human resources development	
3.1.1	Professional meteorological training	250.00
3.1.2	Training of support forecasters to assist the professional meteorologist	240.00
3.1.3	Training in specialised tropical cyclone analysis, forecasting and warning	150.00
3.1.4	Training workshops and attachments in tropical cyclone forecasting and warning centres	600.00
3.1.5	Training of meteorological personnel on aviation awareness, and safety and economy sensitivity of aviation operations	120.00
3.1.6	Public education and awareness on severe weather (including tropical cyclones, drought, floods) and the role of climate variability	500.00

3.1.7	Awareness and education of small craft (boats) operators	500.00
3.2	Storm surge prediction models	120.00
3.3	High resolution numerical weather forecasts for Pacific islands	120.00

Project 4	**Cimate Data Management, Analysis and Application**	**Indicative budget (US$000)**
4.1	Climate analyses and applications	100.00
4.2	Climatology training	250.00
4.3	Pacific Regional Climate Bulletin	300.00
4.4	Expanding and enhancing the prudent use of climate predictions	620.00

Project 5	**Institutional Strengthening, Including Infrastructure Support**	**Indicative budget (US$000)**
5.1	SPREP Meteorology/Climatology Officer (MCO)	360.00
5.2	SPREP Meeting of Regional Meteorological Service Directors (RMSD)	320.00
5.3	Buildings and accommodation	6,000.00
	Total	**35,650.00**

ANNEX 5.3 List of acronyms

ABM	Australian Bureau of Meteorology
AusAID	Australian Agency for International Development
AFTN	Aeronautical Fixed Telecommunications Network
AWS	Automatic Weather Station
BMTC	Bureau of Meteorology Training Centre
CLICOM	CLImate COMputing
COP/ UNFCCC	Conference of Parties to the UNFCCC
EMWIN	Emergency Managers Weather Information Network
ENSO	El-Niño/La-Niña Southern Oscillation
ESCAP	Economic and Social Commission for Asia and the Pacific (UN)
FMS	Fiji Meteorological Service
GCOS	Global Climate Observing System
GTS	Global Telecommunication System
GUAN	*Global Upper Air Network*
METAR	Aviation Routine Weather Report
NCDC	US National Climate Data Center
NIWA	National Institute of Atmospheric and Water Resources
NMS	National Meteorological Service
NWS	National Weather Service
PIC	Pacific Island Country
PMSNAP	Pacific Meteorological Services Needs Analysis Project
RMSD	Meeting of Regional Meteorological Services Directors
SOPAC	South Pacific Applied Geoscience Commission
SPECI	Aviation Special Weather Report
SDMP	Strategic Action Plan for the Development of Meteorology in the South Pacific
TAF	Terminal Aerodrome Forecast
RSMC	Regional Specialized Meteorological Center
UNFCCC	United Nations Framework Convention on Climate Change
UNEP	United Nations Environment Program
UNESCO	United Nations Educational Scientific and Cultural Organization
USP	University of the South Pacific
WMO	World Meteorological Organization
WSR	Weather Surveillance Radar
WWW	World Weather Watch

This study has been made possible through the efforts, within a relatively short time frame, of the highly dedicated members of the project team (Annex 3), their widely varied technical, scientific and management skills; and their willingness to work on the project while carrying out their normally assigned functions within their organisations. It could not have been undertaken without the significant resource inputs of the Australian Agency for International Development; the Australian Bureau of Meteorology; the East West Centre, Hawaii; the Fiji Meteorological Service, Meteo France, French Polynesia; the Meteorological Service of New Zealand Limited; the South Pacific Regional Environment Programme; the US DOE ARM Project; the US National Oceanic and Atmospheric Administration (NOAA) National Weather Service, Pacific Region, Hawaii; the World Meteorological Organisation; and the National Meteorological Services of SPREP member countries. The extensive information gathered for the study has been made possible through the co-operation of the numerous individuals and organisations listed in Annex 5. The personal interest in the project and the encouragement provided by Dr Zillman, Director, Australian Bureau of Meteorology and President of the World Meteorological Organisations also merits acknowledgement.