Reviewing Weather and Climate Services in the Pacific

Report prepared for the Secretariat of the Pacific Regional Environment Programme (SPREP), by a review team of: Bruce Chapman (team leader), Atunaisa Kaloumaira, Bikenibeu Paeniu, and Robert Brook: April 2010

Cover picture by Atunaisa Kaloumaira: Fiji, South-West Kadavu Island coastline

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Acronyms used

CROP	Council of Regional Organisations in the Pacific
ENSO	El Niño–Southern Oscillation
FMS	Fiji Meteorological Service
GTS	Global Telecommunications System
HYCOS	Hydrological Cycle Observing System
NMS	National Meteorological Service
PICs	Pacific Island Countries
PICTs	Pacific Island Countries and Territories
PI-GOOS	Pacific Islands Global Ocean Observing System
RA V	Regional Association V (Roman five: South-west Pacific) of the WMO
RMSD	Regional Meteorological Services Directors
RSMC	Regional Specialized Meteorological Centre
SOPAC	Pacific Islands Applied Geoscience Commission
SPC	Secretariat of the Pacific Community
SPREP	Secretariat of the Pacific Regional Environment Programme
WMO	World Meteorological Organization

Executive Summary

A team of consultants conducted a review of Pacific Regional Meteorological Services as commissioned by the Secretariat of the Pacific Regional Environment Programme (SPREP) in November 2009. This was in response to a directive from Pacific Islands Forum Leaders. Over the period November 2009–April 2010, the team reviewed relevant documentation, consulted with SPREP member countries and other organisations, and considered feedback on a draft report before presenting its final report and recommendations.

The team reviewed the strengths and weaknesses in the current arrangements, and identified key areas for improvement in relation to:

i. regional coordination and support
ii. strengthening National Meteorological Services (NMSs)
iii. institutional arrangements to support the delivery of specialised services by the Fiji Meteorological Service (FMS)

The review team assessed a range of options for addressing these issues and developed recommendation that address priority issues. With respect to regional coordination, the team recommends new investment in a dedicated Regional Desk to provide support at regional as well as national level. To strengthen National Meteorological Services, the team recommends actions that promote the support and effectiveness at national level. For delivery of specialised services, the team recommends a set of actions that build on the current arrangements

The recommendations below offer practical, cost-effective means for enhancing meteorological services to the region.

Recommendations

Regional Coordination and Support

Regional Desk

Recommendation 1: That a Regional Desk for Pacific National Meteorological Services (NMSs) be established as described in section 9.2.

Donor / Aid Policies: Surety of Continuing Support

Recommendation 2: That key development partners review their donor/support policies to provide surety of ongoing support for Pacific Island NMSs given their critical role in the safety, security and sustainable development of Pacific Island Countries and Territories (PICTs).

Donor / Development Partner Forum

Recommendation 3: That a donor/development partner forum be scheduled in association with the meetings of Regional Meteorological Services Directors (RMSD), to align donor investment with regional needs and promote donor coordination.

Strengthening National Meteorological Services

Raising the Profile of National Meteorological Services

Recommendation 4: That Pacific Island Governments assign greater importance to the work of NMSs by mainstreaming them into their respective overall policy and decision-making processes; as well as according NMSs greater share in the allocation of budgetary resources.

Integration and Linkages

Recommendation 5: That development partners support NMSs' contribution in the development and implementation of national action plans being developed by PICTs, so that the work of the NMSs and other linked fields (such as hydrology, disaster risk reduction and climate change) can be integrated.

Regional Specialised Meteorological Services

Constitution of Fiji Meteorological Service — RSMC Nadi

Recommendation 6: That the FMS be constituted as a stand-alone entity of the Fiji Government as described in section 9.1

Fiji Government support to Fiji Meteorological Service

Recommendation 7: That the Fiji Government maintain its commitment to provide resources that enable FMS to fulfil its role as RSMC Nadi, in association with development partners.

Development Partner Support to Fiji Meteorological Service

Recommendation 8: That development partners continue to provide support to FMS through its transition and under its new organisational structure.

Pacific Islands Forum Leaders — Call for Annual Report on Meteorological Capacity

Recommendation 9: That Pacific Island Forum Leaders call SPREP initially to provide a 2010 interim report on the FMS restructuring progress and subsequently call for an annual report from the Pacific Desk (as per Recommendation 1) focussing on the sustainable delivery of meteorological services including the capacity of FMS to meet its RSMC commitments over the approaching cyclone season.

Fiji Meteorological Service — Specifying Services to Other PICTs

Recommendation 10: That FMS develop bilateral agreements with other national meteorological services to which it provides services.

1 Introduction

Weather and climate issues have been of increasing interest and concern for Pacific Island Countries and Territories (PICTs) over recent years. This reflects the vulnerability of Pacific islands to extreme weather events and to other potential disasters that have weather-related components.

Pacific Island Countries (PICs) are also becoming increasing alarmed about the impacts of global climate change, in terms of weather and climate variability and associated effects such as sea-level rise.

At the same time, the science and technology of weather forecasting and climate prediction has been moving ahead rapidly.

These factors have led to a growing concern about the capacity of PICs to maintain appropriate capability for serving their national and regional needs.

In 2008, Pacific Island Forum Leaders, in their annual communiqué:

> …called on SPREP to urgently carry out a comprehensive review of regional meteorological services, reporting intersessionally to Leaders as soon as practicable on all options, including building on existing arrangements and consideration of other service providers.

The issue had been brought to Pacific Island Leaders' attention by Small Island States within the Pacific Islands Forum. Leaders' interest reflected ongoing concern over two linked issues:

i. the sustainability of services that are provided to Small Island States by the Fiji Meteorological Service (in part, operating as Regional Specialised Meteorological Centre Nadi)
ii. the capacity of national weather and climate services to provide an appropriate level of service across the Pacific islands region.

Both issues have been the subject of previous investigations and reports, notably:

- the Report of the World Meteorological Organization Fact-Finding Mission in 2007
- a background paper prepared by the Australian Bureau of Meteorology (R Krishna) for the Pacific Islands Forum Secretariat in March 2008
- an independent Report prepared by Australian Marine Science and Technology Limited (AMSAT) for the Pacific Islands Forum Secretariat in May 2008.

These three reports[1] focussed largely on technical aspects of weather and climate services, with some consideration of institutional issues.

[1] Full titles are provided in Annex 2

2 Review Process and Methodology

This review team was commissioned by SPREP in November 2009, to provide recommendations to Forum Leaders on options:

> …for the provision of viable and effective regional meteorological and climatological services, including regional specialised meteorological and climatological services to all Pacific Island Countries and Territories as provided by the specialised RSMC Nadi, Fiji Meteorological Service (FMS), and other regional service providers.

The review team met with National Meteorological Service Directors and staff in four Pacific Island Countries (Fiji, Kiribati, Samoa and Vanuatu) during November and December 2009. Contributions from National Meteorological Services in other Pacific Island Countries and Territories were solicited through a survey questionnaire circulated in January 2010. Members of the team also met with officials in Australia, New Zealand and the USA.

The team submitted a draft report to SPREP in January 2010: this was circulated to SPREP member countries and other stakeholders for comment. After consideration of feedback received (including discussions with senior officials of the Fiji Government), the team concluded its report in April 2010.

The full Terms of Reference and Review Methodology are attached as Annex 1.

This report is not about the science and practice of meteorology and climatology, but focuses on the funding and institutional arrangements for effective delivery of these services. The Annexes contain technical detail relevant to the report's conclusions.

3 Weather and Climate in the Pacific Islands Region

The Pacific is the world's largest ocean, and is now recognised as a major driver of global weather and climate systems. Particularly important is the El Niño–Southern Oscillation (ENSO), a quasi-periodic climate pattern that occurs across the tropical Pacific with a roughly five-year cycle. ENSO is associated with floods, droughts and other weather disturbances in many regions of the world, which vary with each event. Developing countries that depend upon agriculture and fishing, particularly those of the Pacific Ocean, are the most affected by ENSO.

Pacific Island Countries and Territories are among the smallest (in terms of land area, population and economic wealth) and most vulnerable in the world. Their vulnerability stems from their exposure to multiple natural hazards. Among the most destructive of these are extreme weather and climate events: cyclones, floods, storm surges and droughts.

The extent of damage from other hazards (such as an earthquake, a tsunami and a volcanic eruption) is also strongly influenced by the weather that preceded and accompanied them. For example: ash falls in Savo Island (Solomon Islands) were influenced by wind direction; landslides in the highlands of Papua New Guinea, along the highways of Palau and in central Viti Levu in Fiji were triggered by periods of intense rainfall. In general, higher risk of seismic liquefaction is present when vulnerable soils are saturated due to high groundwater level.

The effective and efficient provision of humanitarian response, relief and recovery activities immediately post-disaster is equally subject to weather and climate conditions.

The World Bank noted[2] in 2006 that:

> Pacific Island countries rank among the most vulnerable in the world to natural disasters. Since 1950, natural disasters have directly affected more than 3.4 million people and led to more than 1700 reported deaths in the region (outside of Papua New Guinea).
>
> Cyclones accounted for 76 percent of reported disasters from 1950 to 2004, followed by earthquakes, droughts and floods.
>
> Total reported cost of disasters in the 1990s alone is estimated at US$2.8 billion (over a 10-year period: this represents an average cost of US$280 million per year in the Pacific Islands Region).

It is also recognised that Pacific Island Countries are among the most vulnerable to the adverse effects of climate change; particularly sea level rise, potential ocean acidification, and the security of food.

The economic and social costs, and frequency of adverse events, mean that Pacific Island Countries have a compelling interest in understanding weather and climate: so that they can prepare and protect themselves (disaster management) as well as reduce future risks. PICs are also in a unique position to contribute to global understanding of weather and climate through collecting meteorological data (observations) and sharing their knowledge.

[2] World Bank 2006: Not if but When: Adapting to Natural Hazards in the Pacific Islands Region – A Policy Note.

4 Role of Meteorological Services

Virtually every nation in the world has a National Meteorological Service. Typically the functions of an NMS include: taking weather observations; providing and communicating weather forecasts and warnings; supplying meteorological information; publishing meteorological reports and data bulletins; promoting the use of meteorological information; research in the scientific field of meteorology; furnishing advice on meteorological matters; and cooperation with other NMSs.

These functions are usually funded by governments (either directly or through contracts) in recognition of their character as public goods, provided in the public interest. Particular services may include: support to navigation, shipping and civil aviation; assisting persons and authorities engaged in primary production, industry, trade and commerce; specialised needs such as those of defence forces.

To undertake this role, a Director of an NMS usually has certain powers: to establish meteorological offices and observing stations; to arrange within government, or with any authority or person, to take and record meteorological observations and transmit meteorological reports and information; and to arrange for the training of persons in meteorology. The NMS often also includes, or works closely with, a National Hydrological Service. In some countries the weather and climate service functions are performed in separate organisations.

Meteorological Services can play a major role in reducing the adverse economic, social and environmental impacts of weather in Pacific island communities. At the same time, their work underpins sustainable development through support to sectors such as agriculture, tourism and energy. They do this by providing timely warnings and information on impending severe events, and insights into longer-term weather and climate patterns. Their direct contribution is complemented by partnerships with other government and regional agencies that are concerned with related areas such as: disaster risk reduction and disaster management, hydrology, oceanography and seismic science, as well as communication media, community groups and civil society. Annex 3 provides further information on the linkages between meteorological services and disaster risk reduction, as well as basic data on PICs.

5 Trends in Weather and Climate Services

Meteorology and climatology are rapidly changing fields. Advances in computing power in particular have enabled increasingly sophisticated models and predictive tools to be developed.

The review team considers the following trends relevant over the next decade:

- Rapidly changing technology means that continual investment is needed in computer hardware and software, and in information technology systems.
- To align with changes in technology, practitioners need to maintain up-to-date skills to handle and interpret the information presented.
- Increasingly strict standards are being applied to ensure that skilled staff and quality management systems are in place, especially for critical services such as those required for the aviation sector.
- Global telecommunications tools, such as the internet, are making it easier for the public to gain access to weather and climate information.
- This increased connectivity has opened up a market for independent providers to offer weather and climate services to the public or specific clients groups. At times this makes it difficult to distinguish between forecasts provided by authoritative sources and those that are less rigorous or more in the nature of commentary.
- An increasing range of weather and climate 'products' can be developed for the benefit of specific audiences or sectors (tourism, agriculture, energy, etc). As people come to recognise the usefulness of such products, their expectations are raised; they expect NMSs to provide additional material and services beyond the traditional weather forecasts.
- There is increasing concern about security issues. In relation to weather and climate, this ranges from an interest in the general security of people in their communities, through food security (particularly in the context of climate and agriculture), to personal security (such as in aviation services), and the longer term need for adaptation to climate change.
- There is increasing awareness of global climate and climate change, not just as a technical issue, but also as a matter of wide public policy interest. Pacific Island Countries have been at the forefront of the global debate on

the adverse effects of climate change and climate variability, and on policies and action to address adaptation and mitigation.

- There is growing acceptance that weather and climate services need to be linked with other areas of government such as hydrology, disaster management and risk reduction, in order to maximise the effectiveness of systems such early warning and communications.
- There is a move towards pooling of resources among National Meteorological Services so that specific services develop areas of specialisation that serve a wider region (for example EUMETNET, the Network of European Meteorological Services).

6 Regional Overview — Meteorological Services

The overall arrangement and capacity of meteorological services in the Pacific islands region has been thoroughly documented in previous reports (in particular Krishna's 2008 report to the Bureau of Meteorology). A brief description of their roles and functions in the region follows.

6.1 National Meteorological Services

All Pacific Island Countries and Territories have a National Meteorological Services. The organisational arrangements include: state-owned enterprises, statutory agencies and branches of government departments. In New Caledonia and French Polynesia, they are part of Meteo France (the French NMS); in American Samoa they are part of the US National Weather Service. In Micronesia, the NMSs of the Federated States of Micronesia, Palau and the Marshall Islands are closely affiliated with the US National Weather Service, as part of a compact of free association.

Funding for these services varies widely; they can be partly or fully funded from the national budget, supplemented by external funds and technical support from countries that have had traditional links with the NMS, or from international programmes (such as PI-GCOS , the Pacific Island Global Climate Observing System) or from development assistance. Some NMSs receive a small income from fees for service activities (see Annex 4).

6.2 Regional Specialized Meteorological Services

For the purpose of this review, a key institution is RSMC Nadi, designated by the World Meteorological Organization (WMO) as a Regional Specialized Meteorological Centre (RSMC); its activity specialisation is in tropical cyclones. The RSMC is operated by the Fiji Meteorological Service. Under its RSMC designation, a key requirement is its operation 24 hours a day for seven days a week during the cyclone season.

Other offices in the broader Pacific islands region with WMO 'RSMC' designation include those based in Wellington and Darwin. (Annex 5 provides information on the WMO and its designation of specialised centres.)

6.3 World Meteorological Organization (WMO)

The World Meteorological Organization is a specialised agency of the United Nations. It is the UN system's authoritative voice for meteorology (weather and climate), operational hydrology and related geophysical sciences.

WMO has a membership of 189 Member States and Territories. WMO promotes cooperation in the establishment of networks for making meteorological, climatological, hydrological and geophysical observations, as well as the exchange, processing and standardisation of related data, and assists technology transfer, training and research. WMO also fosters collaboration between the National Meteorological and Hydrological Services of its members; and furthers the application of meteorology to public weather services, agriculture, aviation, shipping, the environment, water issues and the mitigation of impacts from natural disasters.

WMO facilitates the free and unrestricted exchange of data and information, products and services in real time, or near-real time, on matters relating to safety and security of society, economic welfare and the protection of the environment. It contributes to policy formulation in these areas, both at national and at international levels.

The WMO provides global and regional forums to address policy and technical issues. Most Pacific Island Countries are members of WMO; they participate actively in the work of WMO Regional Association V (Roman five, South-west Pacific); usually referred to as RA V.

6.4 Development Partners

National Meteorological Services in the Pacific islands region were, in general, established by colonial governments. These governments (France, United States of America, Australia, New Zealand, United Kingdom) maintain some level of association and support. In some cases of these governments continue to provide most of the services (e.g. France, to New Caledonia and French Polynesia). In other cases Pacific Island Country governments have taken over primary responsibility for National Meteorological Services post-independence.

In addition, development partners such as Japan, the European Union, and United Nations agencies continue to provide (often project-based) support for training and infrastructure. Annex 6 provides examples of outside support for meteorological (weather and climate) services in the region.

6.5 Regional Meteorological Service Directors (RMSD)

Directors of Meteorological Services have met annually since the mid 1990s. The meeting is open to representatives of meteorological services from the region as well as developed countries with Pacific linkages, and development partners. Recently the Directors decided to meet every second year instead of annually. Background information on RMSD is provided in Annex 7.

During the last decade, SPREP has provided a level of secretarial support. Funding (for travel and direct costs) has come from a variety of sources including WMO, Australia, the USA, and in the 1990s from the Commonwealth Secretariat.

6.6 Council of Regional Organisations in the Pacific (CROP) Agencies

SPREP: In addition to the support provided to RMSD, SPREP provides support for the Pacific Islands component of the Global Climate Observing System (PI-GCOS) funded by the US Government. SPREP also has the regional mandate among CROP agencies for policy and technical work in relation to climate change. This includes responsibility for the Pacific Islands Framework for Climate Change.

SOPAC has the regional mandate among CROP agencies in relation to disaster risk reduction and disaster management. The agency has expertise in hydrology and employs staff specifically focussed on Pacific Islands Global Ocean Observing System (PI-GOOS) and Pacific HYCOS (a component of the World Hydrological Cycle Observing System (HYCOS). In addition, SOPAC has technical staff that can assist with maintenance of meteorological equipment.

In line with recent Pacific Islands Forum Leaders' decisions, SOPAC's functions are in the process of being devolved to the Secretariat of the Pacific Community (SPC) and SPREP (in particular PI-GOOS).

7 Assessment of Strengths and Weaknesses

The review team acknowledges the service provided by meteorological service staff operating in the Pacific Islands, often with basic equipment, modest budgetary support and little recognition within government. In the face of enormous challenges, these staff continue to provide service within their means and play their part in regional and global weather and climate monitoring systems.

Against that background the team provides the following assessment.

7.1 National Meteorological Services

The 'Needs analysis for the strengthening of Pacific Islands Meteorological Services'[3] published in 2001 classified the capacity of National Meteorological 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, Wallis and Futuna.
>
> **Category B** Fiji stands alone in this category. It has the most developed of fully nationally funded National Meteorological Services. It is also designated as a Regional Specialized Meteorological Centre by WMO.
>
> **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.

[3] SPREP 2001. Needs analysis for the strengthening of Pacific Islands Meteorological Services: meeting the challenges. Apia, Samoa

As part of this review a questionnaire was circulated to Pacific island MNS seeking information on current capacity and a range of other matters. A description of the questionnaire along with a summary of results is provided in Annex 4.

The review team found that overall the categorisation above still applies. However, several Category C countries have increased their capacity significantly in the last decade: notably Vanuatu, Papua New Guinea and Samoa.

Areas for Improvement

As indicated above, the capacity of NMSs (in terms of staff skills and infrastructure investment) varies widely across the region. A number of gaps and weaknesses have been identified:

- Poor telecommunications infrastructure in some countries delays transfer of data into the WMO Global Telecommunications System (GTS) and other international networks. This restricts the effectiveness of GTS implementation and creates uncertainty about delivery and receipt of telecommunications.
- In-country telecommunications are crucial for providing information (including warnings) to end-users. At national level there may be insufficient funds to pay for reliable internet connection, or the NMS is not assigned priority access.
- Low visibility and status of NMS within national government; NMSs struggle to compete for resources for equipment, infrastructure, skilled staff and training.
- Some NMSs have inadequate or poorly enunciated statutory authority for their role and functions.
- Access to equipment, maintenance and training is poor or inconsistent. Training is often at the convenience of providers rather than aligned with needs of Pacific Island Countries.
- Meteorological observation networks are inadequate, both in number of sites and quality management of data.

- Provision of observational data is inconsistent, e.g. due to telecommunication difficulties (timeliness), equipment problems or staff availability.
- There is a lack of professional support in NMSs with small numbers of staff; and a lack of professional development and career opportunities.
- Linkages with other relevant departments in-country (disaster management, hydrology, etc) are not always effective and meaningful.
- Where services are supplied from outside, there is a lack of formal agreement to specify services; formal opportunities for dialogue on the nature or quality of services are absent or limited. This in turn creates uncertainty about what happens if the service is not provided as expected. Clear specification of services would provide certainty for all parties and provide a baseline for NMSs to assess the cost and effectiveness of alternative providers, should they wish.

The review team considers that the need for strengthening National Meteorological Services fall into several key areas: national needs and resources; national linkages, and telecommunications. These are here reviewed in more detail.

i. National Needs and Resources

It is necessary to ensure that NMSs have sufficient resources to meet their national needs. The review team considers that, at a minimum, the government needs to retain the ability to interpret weather and climate information, and to act as a source of independent policy advice on weather and climate issues (even if forecasting and other services are provided from outside). The level of services required will differ according to national circumstances, and should be determined at a national level.

For some NMSs, national requirements are well understood and resourced already. Other NMSs need to be better recognised in the national planning and budgetary processes ('mainstreaming').

For NMSs that receive services from Fiji Meteorological Services, it is particularly useful to have a clear sense of what services, capacity and resources can

realistically be funded at national level. This information can provide a baseline for a specification of services required from FMS. Such information can also be used for assessing the cost-effectiveness of alternative providers of an equivalent service.

ii. National Linkages

There is a further need to strengthen the linkages at national level between NMSs and closely aligned activities such as hydrology, disaster risk reduction and disaster management.

iii. Telecommunications

Telecommunications infrastructure and capacity across the region has been identified as a critical issue for some countries. The review team is aware of the regional Digital Strategy being developed through the Pacific Island Forum Secretariat, and considers that the needs of NMSs should be taken into account in this process.

7.2 RSMC Nadi — Fiji Meteorological Service

RSMC Nadi has emerged from a phase of potentially critical staff and capacity shortages in 2007, to be in a position to reach full staff complement in the near future (2010). Annex 8 shows the history of Fiji Government investment in the Fiji Meteorological Services over the last 10 years. This shows a trend of increased operational funding over the 10-year period, and a step increase in capital funding since 2004. Recent (2009) capital expenditure on IT equipment (hardware and software) by the Fiji Government stands these aspects in good stead for the medium term.

FMS operates from a purpose-built facility well suited to its function. The institution is recognised both within and outside Fiji as crucial for the region, and attracts considerable support from development partners.

Services provided to the region, including at national level as required, extend beyond meteorological services. An example is tsunami warning, based on FMS's technical/communication networks and experience with early warning systems.

The service is increasingly valued within Fiji for the strengths of its communication capability; and for the value it adds to the work of other government agencies and sectors of the community.

The review team met with senior officials of the Fiji Government who conveyed that government's ongoing commitment to FMS and its capability to operate as a designated Regional Specialised Meteorological Service (Annex 9 lists persons consulted by the team).

Fiji officials indicated that they recognised some of the restrictions associated with the service operating as part of a government department; they reaffirmed the government's intention to develop an alternative institutional structure for FMS, to provide greater flexibility.

Nevertheless some concerns have been expressed to the review team about the long-term stability of the RSMC given its past track record, particularly in relation to human resources. The team acknowledges these concerns as discussed below.

Areas for Improvement

i. Retention of Experienced Staff

The most pressing difficulty for FMS and RSMC Nadi is its limited ability to retain and recruit skilled staff. This ongoing issue was identified when FMS Nadi first gained RSMC status, and has been raised continually in recent years.

Many qualified forecasters leave to seek what they see as better opportunities offshore. Figures provided by FMS indicate that in the 20 years to 2007, the Service has lost 40 meteorologists, most of whom have secured similar jobs overseas[4].

It is well recognised that good, experienced cyclone forecasters have highly transferrable skills.

[4] At prevailing staff levels, this represents a complete turnover of forecasting staff approximately every five years.

Qualified, experienced forecasting staff are much higher paid in Australia or New Zealand than in Fiji. Annex 11 includes indicative base remuneration levels for senior forecasters (or equivalent) in Fiji, Australia and New Zealand, along with a regional (CROP scale) comparison.

The base salary rate for a senior forecaster in Australia is about five times that paid in Fiji. The actual difference is significantly greater, as certain additional allowances (such as for working in shifts) are available in Australia and New Zealand. The Australian Bureau of Meteorology and the Meteorological Service of New Zealand Ltd both declare a firm policy of not offering positions to those in the employ of the Fiji Metrological Service; though it is a matter of record that ex-FMS staff have gained employment with these agencies and elsewhere.

Under current conditions for FMS, and given the higher salaries offered elsewhere, the review team considers it inevitable that FMS will face continual loss of experienced staff, and their replacement with fresh graduates from meteorology training. Episodes when clusters of experienced staff leave at the same time, creating shortages as seen in 2007, are also likely.

ii. Delivery of Services

The continual loss of experienced staff has given rise to concerns about the delivery of services by FMS.

RSMC — Cyclone Forecasting and Other Critical Services

The WMO Fact Finding Mission of 2007 was instigated because of WMO Congress concern over possible

> …interruption of tropical cyclone warning services in the Pacific as well as general services, especially aviation weather services, currently provided by RSMC Nadi.[5]

Capacity has now lifted but staff, many of whom who are still in the process of gaining practical experience, risk being overstretched. This risk is particularly high when multiple cyclones occur in close succession (or simultaneously).

[5] WMO 2007: Abridged Final Report With Resolutions, Fifteenth World Meteorological Congress, Geneva 2007; WMO-No 1026

An associated issue is that the WMO process of designation involves a thorough assessment of capacity at the time designation is sought or granted, but involves no routine monitoring of capacity subsequently. The review team has been advised that WMO would only formally reassess the situation if concern was raised by other WMO members. The team sees the lack of a monitoring (or self-assessment) system as being an important gap. The team considers that an appropriate monitoring mechanism should be instituted within the Pacific so that any issues can be addressed within the region, rather than being raised at a WMO Congress.

Services Provided to Other PICs

The review team has heard concerns expressed about the quality of daily forecast services provided by FMS to neighbouring Small Island States. The concern was that forecasts appeared to be too general, not specific to the target location. It was reported to the team that some receiving countries were looking to other web-based services for information in preference to (or to supplement) that provided by FMS. This in part reflects the advances in technology world-wide. In the past, access to specialised services and products from advanced meteorological services was the domain of very advanced National Weather Services; now these can be obtained easily via the internet. Seeking supplementary information is not a concern in itself, but it relies on the receiving service having the capacity to discern the quality of service on offer through the internet, and to gauge its accuracy and level of authority. This example indicates that FMS needs to carefully guard its own reputation for authoritative work.

iii. Institutional Setting for Fiji Meteorological Services

The review team considers that the two issues discussed above are, to a significant degree, associated with the current institutional setting for FMS.

The Fiji Meteorological Service is established as part of the core Fiji public service. It is therefore subject to the terms and conditions of employment set out by the Public Service Commission. The Commission sets down salary scales and other factors that affect recruitment, remuneration and conditions of staff. As noted above, the salary scales for professional forecasters are much less than they might

earn elsewhere. Several other issues that also impact on the way FMS currently operates include:

- limits on the ability of the director to make decisions on the operation of the organisation (including appointment of staff)
- lack of flexibility about use of resources
- the need to support wider government objectives that are not always aligned with efficient running of an NMS.

7.3 WMO

The World Meteorological Organization has allocated specific resources to the Pacific region by establishing a Sub-Regional Office for RA V in Apia, and has targeted support for the region (for example in the area of training, Annex 10).

WMO's RA V meetings and activities provide an opportunity for representatives of Pacific Island Countries to contribute to the wider operations of the WMO — an area in which PIC representatives are increasingly active. The 'Tropical Cyclone Operational Plan for the South Pacific and Southeast Indian Ocean' documents roles, responsibilities and contingency arrangements for handling tropical cyclones in the region.

Areas for Improvement

The review team was advised that, of all the WMO administrative regions, the level of take-up for various types of support provided by WMO is lowest in RA V (the region which includes PICs). So RA V is receiving less support in terms of training and other areas, even though it is a region of high need. More could probably be done to mobilise support for the region through the various means provided by WMO.

Arrangements for monitoring RSMC capacity, once designations are made, also lack clarity.

7.4 Regional Meteorological Services Directors (RMSD)

RMSD has provided a forum for discussing technical and operational issues for nearly two decades (Annex 7). The directors' collective aim (set out in their vision and mission) is:

> ...for all meteorological services in the Pacific region being able to provide all appropriate meteorological services to their nations.

RMSD has been instrumental in developing key documents (Strategic Action Plan and Needs Analysis) and gaining resources for NMSs in the region.

It has also succeeded to some extent in raising the profile of NMSs and their work through providing reports to the SPREP governing body —ultimately drawing Meteorological Services Directors' concerns to the attention of Pacific Forum Leaders.

Areas for Improvement

In recent years there has been no consistent source of funding to support RMSD meetings. This has had negative flow-on effects in terms of secretarial support (drafting papers, preparing agenda, arranging logistics) and follow-up on meeting agreements and resolutions. The lack of resources also contributed to RMSD changing from an annual meeting to one held every two years. The intention has been for Directors meeting informally in the corridors of WMO RA V meetings in alternate years.

The RMSD agenda has been a mixture of open discussion, country reports and outside presentations (for example; from international/regional agencies and universities).

RMSD has lacked a clear mandate, focus, and line of reporting. Reporting has typically been through the annual SPREP meeting, but this has not always been a comfortable relationship: meteorological services do not generally report through Ministers for the Environment.

The review team sees a need for improving the RMSD arrangements: sustainable funding must be established to support the regional role of RMSD — including coordination, development and resource mobilisation.

7.5 Development Partners

Development partners have played, and continue to play, an enormous role in the establishment and ongoing operation of National Meteorological Services in the region.

NMSs of developed countries such as Australia, New Zealand and the USA provide direct support to Pacific island meteorological services. This comes in a variety of forms including: technical advice, training, secondment of staff, and supply and maintenance of equipment.

Development and aid agencies provide mainly project-based support for infrastructure, training, and capacity building.

While acknowledging the support provided, the review team sees the need to improve the delivery of such support in several ways:

- coordinating between agencies at national level, especially between technical agencies and aid/development agencies
- coordinating between different donor agencies in key areas such as training
- providing for greater flexibility in the delivery of development support, including the provision for longer-term (or ongoing) commitments of support for certain agencies or programmes.

8 Key Issues

The review team has identified three major areas with opportunities for improving the quality and sustainability of National Meteorological Services for the Pacific islands region.

8.1 RSMC Nadi — Fiji Meteorological Service

The review team's assessment indicates that the Fiji Meteorological Service, as host to RSMC Nadi, has faced challenges in recruiting and retaining skilled and experienced staff; and in staying up-to-date with technology and equipment.

FMS provides additional services (aviation and maritime) for the region, and provides national services (meteorology and tsunami warning) and support for some Small Island States.

Increasingly, there are also calls on FMS skills and expertise within Fiji—such as supporting national networks for early warning and disaster management (and disaster risk reduction); hydrology and seismic science; and climate information and prediction.

Some of the difficulties faced by FMS have to do with its institutional structure, while others reflect the history of the organisation and its relationship with neighbouring National Meteorological Services.

8.2 Regional Support and Coordination

The review team sees the need for a stronger regional mechanism to provide a:

- forum for addressing regional issues for meteorological services
- clear line of reporting for meteorological service directors
- mechanism for channelling support to develop capacity in Pacific island NMSs

- coordination role both for the meteorological services themselves and for development partners—particularly to provide for a coordinated regional approach to:
  - training
  - purchase and maintenance of equipment
  - capacity building
- vehicle for sustainable financing and resource mobilisation.

8.3 Strengthening National Meteorological Services

Some NMSs need to raise the profile of meteorology within their government system. Some also need a clear sense of their national role and how this fits in the wider regional picture. The expectations of service from FMS and the potential consideration of other providers also need clarification.

9 Analysis of Institutional Options

The two key issues highlighted in sections 8.1 and 8.2 may be addressed through a range of institutional changes or options as discussed below.

9.1 RSMC Nadi—Fiji Meteorological Services

A primary focus for concern has been the delivery of cyclone forecasting along with aviation and marine services delivered by RSMC Nadi.

Cyclone forecasting is integral to the RSMC role of Fiji Meteorological Services, while the other services are not. This distinction is relevant when assessing the institutional options for best delivery of these services, and considering other service providers. The review team had to make some assumptions about which of the following services might potentially be delivered by another service provider:

i. tropical cyclone warnings

ii. other regional services (aviation, maritime)

iii. public weather forecast and warning services to other PICs

iv. national services for Fiji.

The review team has approached this analysis within the following broad scenario:

- A Fiji Meteorological Service must be maintained for delivering, at least, national meteorology needs.
- Other Small Island State National Meteorological Services will need ongoing support from FMS (and elsewhere). They may develop their own capacity to prepare national forecasts in future, but not to an equivalent level as FMS.
- Cyclone, aviation and maritime services have potential to be provided from FMS or elsewhere.

With this scenario in mind, the review team offers options for improved delivery of services, after identifying the following high-level criteria.

High-Level Criteria for Assessment	
Effectiveness	Does it address the core issue: skills and resources to support delivery of services
Simplicity	Clear roles and functions
Sustainability	Funding; human resources
Accountability	Clear accountability to an appropriate body
Flexibility	Can it adapt to future change
Smooth transition	Avoid major disruption to services or institutions

The team then used these criteria to assess the merits of six alternative options:

Option 1: Status quo

Option 2: Restructure as stand-alone government entity

Option 3: Delivery of services by another Pacific Island National Meteorological Service

Option 4: Regional agency – Fiji Government partnership

Option 5: Full delivery through a regional agency

Option 6: Australia / New Zealand / France / United States of America

These options were developed from a combination of sources, including suggestions made to the team in the course of its consultations. The assessment is provided in Annex 11.

On balance, the review team considers that Option 2 provides the most straightforward and potentially cost-effective way of providing specialised regional services. Option 2 builds on existing structures and skills, and has the ongoing support of the Fiji Government; all other options involve greater costs, greater uncertainty in relation to funding, and additional transitional hurdles. However, the success of such a change depends on several factors in terms of design, implementation and ongoing access to resources.

The review team stresses that any option (including the preferred option) that incorporates a lift in the salary and conditions above the current FSM rates, will involve higher staff costs in some areas along with changes in work practices. The continuing commitment and support of the Fiji Government and development partners is therefore crucial to sustainability of this service.

In terms of institutional design, we suggest the following as elements for the success and sustainability of a restructured agency created under this option:

i. A Governing Board to be appointed by the Government; membership to include another Pacific Island Country representing the wider regional interest in weather services provided by FMS.
ii. The Board to have the ability to set terms and conditions of employment appropriate to recruit and retain suitably skilled and experienced staff.
iii. The Chief Executive Officer to have responsibility for day-to-day operation of services including hiring and firing of staff.
iv. The agency to have the authority to enter agreements with other agencies outside the Fiji Government, including other National Meteorological Services and development partners.
v. The agency to have the ability to charge fees for certain services.
vi. The agency to continue to operate from its existing sites and with existing assets/infrastructure.

The review team's view is that the restructuring should take place soon, to ensure that the anticipated benefits will result. The team notes a recent development in this regard; that the Fiji Government has re-appointed the FMS Director, with, as we understand, directions to pursue the restructuring process.

9.2 Regional Mechanism

As noted above, the team considers there is a strong case for strengthening the arrangements for regional coordination.

Using the same set of high-level criteria for assessment as in section 9.1 above, we assessed several options for delivering this regional role:

Option A: Work solely through WMO

Option B: RMSD (with secretarial support)

Option C: Meteorology Standing Committee under a Regional Agency

Option D: Dedicated Desk to support Pacific National Meteorological Services

Option E: A Pacific Meteorological Office (modelled after the Caribbean Meteorological Office).

On the basis of its assessment (Annex 12), the review team supports the establishment of a 'Regional Desk for Pacific National Meteorological Services' (Option D) to be housed in one of the CROP agencies. The Regional Desk would need to be funded specifically for the purpose, to avoid the host agency being asked to deliver this function at the expense of other mandated priorities.

The Regional Desk would initially be staffed by a Coordinator, additional technical staff being recruited over time. It is envisaged that the desk would form the nucleus of the regional coordination structure, ultimately having a very extensive remit in this activity. Its focus will be mainly on coordination, resource mobilisation and provision of regional support to the FMS and NMSs of all PICTs. One element of its work would be to provide secretariat support to the RMSD. An indicative list of key activities for the Regional Desk includes:

- in consultation with the FMS, establish a framework describing the range of assistance FMS may require from a regional backstopping mechanism that would enhance and sustain the delivery of meteorological services to other PICTs
- in consultation with regional NMSs and others, establish country needs and requirements
- coordinate regional training programs in consultation with training providers (see Annex 9), Development Assistance Agencies, NMSs, WMO and other relevant bodies
- develop a schedule of meetings or workshops targeting specific areas; this could include the concept of a Ministerial level meeting as appropriate
- in consultation with NMSs, and giving particular weight to the contemporary situation with respect to regional support provided by the FMS, arrange for the placement of appropriately qualified staff in FSM and RSMC Nadi. This will ensure the operation of regional services as well as the development of staff experience and capacity—that may be eventually transferred to other National Meteorological Services in the region

- mobilise resources to address the needs at regional level and for National Meteorological Services
- develop a coordination process for maintaining facilities and infrastructure needed to support meteorological activities (such as observing, telecommunications and IT systems) that are beyond the resources of individual NMSs (particularly the smaller ones). If appropriate and cost effective, this could include direct support from the Pacific Desk.

10 Conclusion and Recommendations

The analysis presented in this report and its annexes has identified a number of areas for improvement in the delivery of meteorological services. The review team has assessed a range of options for addressing these areas, and developed what it considers to be practical, pragmatic responses that build on the existing strengths in the region. The foundation is laid for increased investment, by proposing clearer specification of services and longer-term assurance about future resources in partnership with donor partners.

The recommendations presented below are designed to address the key issues identified during the conduct of the review. They are set out in three categories; Regional Coordination and Support, Strengthening National Meteorological Services, and Specialised Meteorological Services. Each recommendation addresses particular aspects identified in the preceding discussion, as explained in the 'rationale' statement that follows each one.

The key is Recommendation 1 that proposes the establishment of a Regional Desk. This recommendation provides for a permanent support mechanism for regional coordination, and also a vehicle for future development of national and regional projects to enhance delivery of services.

Regional Coordination and Support

10.1 Regional Desk

Recommendation 1: That a Regional Desk for Pacific National Meteorological Services be established as described in section 9.2.

Rationale: There is a clear need for a regional mechanism with clear goals and an appropriate level funding and secretarial/institutional support. The review team considers that the Regional Desk offers a positive vision for the future of NMSs in the region; at modest cost it provides a permanent focus for NMSs from a regional perspective and provides sufficient resources (in terms of dedicated staff) to mobilise further resources through project development and donor liaison.

10.2 Donor / Aid Policies: Surety of Continuing Support

Recommendation 2: That key development partners review their donor/support policies to provide surety of ongoing support for Pacific island NMSs, given their critical role in the safety, security and sustainable development of Pacific Island Countries and Territories.

Rationale: Short-term and project-based support is helpful but does not allow receiving agencies (such as National Meteorological Services) to plan ahead with confidence. The review team supports increased flexibility in donor policies to allow for longer-term commitments of support where appropriate. The team understands that donor policies are being reviewed under the Cairns Compact on Strengthening Development Coordination in the Pacific, and submits this recommendation for consideration in that process.

10.3 Donor / Development Partner Forum

Recommendation 3: That a donor/development partner forum be scheduled in association with the annual meeting of Regional Meteorological Services Directors, to align donor investment with regional needs and promote donor coordination.

Rationale: The review team sees the clear need to align and coordinate donor support; a dedicated Donor Forum would be an effective way to address meteorological services and other closely linked fields. The Forum could include development partners along with United Nations and regional agencies.

Strengthening National Meteorological Services

10.4 Raising the Profile of National Meteorological Services

Recommendation 4: That Pacific Island Governments assign greater importance to the work of NMSs by mainstreaming them into their respective overall policy and decision-making processes; as well as according NMSs greater share in the allocation of budgetary resources.

Rationale: The status quo in most PICs is that NMSs have been ranked very low in the overall national policy frameworks. Some are simply the 'unseen arm' of

governments, and are often among the first sectors suffering from budgetary cuts. Some PICs are not even certain where to house NMSs within the government system; they have retained colonial practice when regarded more as having a communication mandate. The current trend is that several countries have seen the merits of placing their NMS within the Offices of the President and Prime Minister; there they could become more proactive and useful to their overall national development. Nonetheless, NMSs need to be revamped and integrated into the top-priority national policy frameworks.

10.5 Integration and Linkages

Recommendation 5: That development partners support NMSs' contribution in the development and implementation of national action plans being developed by PICs so that the work of the NMS and other linked fields (such as hydrology, disaster risk reduction and climate change) can be integrated.

Rationale: The review team considers that more donor support should be provided at a national level amongst PICs: to raise the profile and increase the effectiveness of NMSs, and to enhance linkages with other agencies and end-users of weather and climate services. PICs are taking control at national levels to better integrate climate change and disaster risk reduction activities; this is done through related national plan initiatives that focusing on mainstreaming into national development planning.

Regional Specialised Meteorological Services

10.6 Constitution of Fiji Meteorological Service / RSMC Nadi

Recommendation 6: That the FMS be constituted as a stand-alone entity of the Fiji Government as described in section 9.1

Rationale: The review team considers that the proposal of the Fiji Government, to re-establish FMS—RSMC Nadi as a stand-alone entity of government, represents a practical option for an improved institutional structure. This is subject to the institution receiving secure ongoing financial support from the Fiji Government and development partners; and technical support from NMSs in developed

countries of the broader Pacific region (Australia Bureau of Meteorology, National Meteorological Service of New Zealand Ltd, Meteo-France, US National Weather Service).

10.7 Fiji Government Support to Fiji Meteorological Service

Recommendation 7: That the Fiji Government maintain its commitment to provide resources that enable FMS to fulfil its role as RSMC Nadi, in association with development partners.

Rationale: the continued support of the Fiji Government is crucial to the ongoing sustainability of specialised and other meteorological services provided to Pacific Island Countries by FMS.

10.8 Development Partner Support to Fiji Meteorological Service

Recommendation 8: That development partners continue to provide support to FMS through its transition and under its new organisational structure.

Rationale: FMS in its regional role has always been based on a partnership between the Fiji Government and development partners; particularly the National Meteorological (or Weather) Services of Australia, New Zealand and the USA. The continued support of development partners is necessary for the ongoing sustainability of specialised and other meteorological services that FMS provides to Pacific Island Countries. In the short term, this should include support for the transition to a new organisational structure (which may benefit from specialised expertise in areas such as accounting or change management).

10.9 Pacific Islands Forum Leaders — Call for Annual Report on Meteorological Capacity

Recommendation 9: That Pacific Island Forum Leaders call SPREP initially to provide a 2010 interim report on the FMS restructuring progress and subsequently call for an annual report from the Pacific Desk (as per Recommendation 1) focussing on the sustainable delivery of meteorological services including the capacity of FMS to meet its RSMC commitments over the approaching cyclone season.

Rationale: This recommendation provides a mechanism for Forum Leaders to monitor progress by the Fiji Government on its commitment to restructure FMS and in ensuing years FMS capacity to deliver these critical services and for the Forum Leaders to put in train action to remedy the situation if necessary. Without this the only monitoring mechanism is through WMO which is cumbersome, does not provide for an immediate response, and means the issue is handled in a global forum away from the Pacific Islands region. The report could also usefully include a review of the previous cyclone season as is done in the Caribbean Meteorological Organization.

10.10 Fiji Meteorological Service — Specifying Services to Other Pacific Island Countries and Territories

Recommendation 10: That FMS develop bilateral agreements with other national meteorological services to which it provides services.

Rationale: The review team has identified a significant gap with respect to services provided by the Fiji Meteorological Service, in that the provision of services to other Pacific Island Meteorological Services is based large on informal arrangements and history. This situation should be clarified to the benefit of all parties. In particular, documenting what each party undertakes to do/deliver provides a basis for planning by all parties (e.g. timeframes for investment and future human resource/skill needs). It also opens the opportunity for NMSs to consider the comparative merits of alternative providers.

11 Next Steps

If these above recommendations are accepted, the review team proposes the following as immediate steps towards implementation.

Pacific Desk

i. There needs to be an early decision on which organisation will host the Pacific Desk, so progress towards its establishment can be made.
ii. Once the host organisation is identified, it should develop a full project proposal for funding the Desk. The review team suggests that project development funding should be provided for this phase, to avoid burdening the host agency with additional tasks without additional resources.
iii. In parallel with (ii.) above, seed funding should be provided for the early recruitment of a Desk Coordinator who can initiate the work of the Desk as soon as is feasible.

Specialised Regional Services

iv. To ensure that Forum Leaders have up-to-date information, the review team proposes that SPREP be asked to provide a report on the status of the Fiji Meteorological Service restructuring process (refer also Recommendation 9).
v. The report from SPREP (in iv. Above) will provide a basis for identifying any appropriate specific support to Fiji Meteorological Service that may support the transition.
vi. Development partners are encouraged to positively consider any support that will assist the process and assure the success of the restructured organisation.

12 Acknowledgements

The review team wishes to acknowledge the contribution of all those consulted during the course of this review. Special thanks are due to officials of countries visited by the team, who gave willingly of their time, and in several cases went to great lengths to set up meetings at short notice.

Dean Solofa of SPREP worked tirelessly throughout the review period to ensure that logistical arrangements were in place and all practical support was provided to the team: we are most grateful.

Annex 1: Terms of Reference and Review Methodology

Part 1: Terms of Reference

The Terms of Reference for the Review are provided below. The timeline set out in sections 5 and 7 is as initially agreed; the schedule was amended several times during the Review as explained in Part 2 of this Annex.

TERMS OF REFERENCE

Review of Pacific Meteorological and Climatological Services
Draft Terms of Reference

1. Background

Pacific Island Forum Leaders 2008 Communiqué: "called on SPREP to urgently carry out a comprehensive review of regional meteorological services, reporting intersessionally to Leaders as soon as practicable on all options, including building on existing arrangements and consideration of other service providers".

The 19th SPREP Meeting added: “agree that SPREP immediately commence planning for this urgent review, and as a first step bring together representatives of interested members to provide policy oversight including the development of terms of reference for the review."

This urgent review is separate from the planned review and renewal of the Strategic Action Plan for the Development of Meteorology in the Pacific Region 2000- 2009.

2. Objective

Provide Forum Island Leaders urgently with clear, prioritized, and costed options and recommendations for the provision of viable and effective regional meteorological and climatological services, including regional specialized meteorological and climatological services to all Pacific Island Countries and Territories[6] as provided by the specialized RSMC Nadi, Fiji Meteorological Service (FMS), and other regional service providers. To develop these options, a review shall be undertaken that will also include a consideration of building upon existing arrangements[7] and a consideration of other service providers.

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[6] Pacific Island Countries and Territories currently receiving Pacific regional support from the Fiji Meteorological Services includes American Samoa, the Cook Islands, French Polynesia, Kiribati, Nauru, New Caledonia, Niue, Samoa, Tokelau, Tonga, Tuvalu, Vanuatu, and Wallis & Futuna, as well as Fiji itself. This includes aviation, marine, public daily weather forecasting, and RSMC Nadi cyclone forecasting,.

[7] As decided at the 19th SPREP Meeting regarding strengthening meteorological and climatological services in the region, the Meteorology and Climatology Officer (MCO) position at SPREP since the mid-1990s must be filled and supported. The MCO should work with a robust meteorological body (such as a proposed Pacific Meteorological Council noted at the 19th SPREP Meeting) in the region to guide these critical activities in the

3. Tasks

i Conduct a thorough desk examination of previous reviews, including the 2007 WMO-led mission to the Fiji Meteorological Service, and the 2007-8 review of sustainable meteorological and climatological services from a directive by SIS Leaders carried out by the Pacific Islands Forum Secretariat, SPREP, SOPAC and other agencies in the region.

ii Consult with SPREP, the World Meteorological Organization, and PIF member government representatives and all other major stakeholders including Fiji Meteorological Service and recipient governments, regional agencies, donors, weather agencies in Australia, New Zealand, the USA, Meteo-France.

iii Consult with the WMO for advice and assistance on regional and national service costing process.

iv Clearly identify the strengths and weaknesses of the current arrangements in servicing regional meteorological and climatological needs, notably for regional specialised meteorological and climatological services.

v Develop a priority list of options for developing a viable and effective regional service with cost-benefit analyses including determination of net cost and criteria of cost, service effectiveness, and financial and human resource sustainability. Financial sustainability should include feasibility of cost-recovery models for provision of commercial service functions as well as identification of services considered 'public good'. In addition, assess each option according to its impact on building on the strengths and/or addressing the weaknesses of the current arrangement.

vi Establish the position of the Fiji authorities with regard to ongoing effective support of regional meteorological and climatological services from Fiji.

4. Outputs

i Draft work plan developed by the Review Team to be submitted to SPREP for consideration and approval by 13th November, 2009.

ii First progress report to be submitted to SPREP for consideration 27th November, 2009.

iii Draft final report to be submitted to Policy Oversight Group for consideration by 18th December, 2009.

5. Consultancy Deliverables and Reporting Schedule of the Review

The deliverables of the Review are as below with accompanying timeline estimate based upon an initial event marking the initiation of the Review work by the Review

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region, and in this regard the relationship between SPREP and WMO office in Apia must be strengthened and better defined for effective and efficient support to the Member States

Team. This Review start point shall be marked by the week of the mobilization of the Review Team initiation (November 2nd).

1) **Work Plan:** A work plan draft is to be developed by the Review Team and submitted to SPREP two weeks from the Review start point.
2) **Progress Reports:** The Review Team shall work together to produce a progress report during the course of the review work.
    a. A first progress report of the Review Team is to be submitted to SPREP for consideration four weeks from the Review start point on November 30th.
3) **Final Report:** The Final Report of the Review Team shall be prepared for initial review and consideration of SPREP.
    a. A first draft of the Final Report is to be submitted to SPREP for consideration 7 weeks after the Review start point on December 20th.
    b. A Final report to be submitted to SPREP for consideration and approval 12 weeks after the Review start point on January 31st.

6. Methodology

The team will take the following approach in carrying out the tasks outlined above:

- Consult with SPREP, the WMO and Pacific Forum member governments and other relevant stakeholders in developing the review Work Plan;
- Travel in selected Pacific countries including Australia, NZ, and WMO Sub Regional Office to consult with stakeholders;
- Define regional and national level services costing, and use cost-benefit analyses to evaluate options;
- Deploy skills and experience in institutional reform and strengthening, economic analysis for efficient service provision, delivery of technical meteorological and climatological services, plus additional skills as set out below.

7. Draft Work Plan

The draft work plan is outlined below against an indicative time line. This timeline is further laid out correspondingly in Figure 1.

Activity	Timeline Week #
The Review Team meet in Samoa. Team meets with SPREP; Government of Samoa; WMO. Other national delegates as opportunity presents (Solomon	1

Islands)	
Team in home countries	2
Team in Fiji; Team meets with FMS Nadi; PM Suva. Other discussions to be scheduled with: SOPAC; SPC; ForumSec; EU; JICA; UNDP; user groups (Maritime, aviation, utilities). **Progress Report to SPREP 30 November**	3
Country Visits: Tuvalu and Kiribati; meetings with national met services and other relevant agencies	4
Country visits continued: NZ and Australia and Tonga/Vanuatu	5
Teleconferencing consultations with other NMS representatives as appropriate **First Draft of Final report to SPREP 20 December**	6
Team Xmas End of Year break	7
Team Xmas End of Year break	8
Team in home countries; Feedback on draft and further development of Final report	9
Team in Fiji: Team meets with FMS and Fiji government agencies	10
Team at home base or selected SIS countries; additional discussions as appropriate	11
Team in home countries; finalise report **Final Report submitted 31st January**	12

Part 2 Review Methodology

Review Team

The Review team comprised four members contracted separately to contribute in specified areas of expertise as described in brief below:

Bruce Chapman: Team Leader; overall coordination of the Review team and its work, including report writing.

Robert Brook: Meteorologist and Pacific meteorology development expert; specialist technical advice related to aspects of meteorological services provision to the region, institutional and capacity building issues.

Atunaisa Kaloumaira: Disaster Risk Reduction expert; specialist technical advice related to DRR aspects in meteorological service provision.

Bikenibeu Pa**eniu:** Economist; specialist technical advice related to the economics of meteorological service provision to the region; economic and cost benefit analysis; roles of regional organizations.

Timeline

Review Team – Overall Timeline	
Date	Event
November 2009	Three members of the Team (Chapman, Kaloumaira, Paeniu) assemble in Apia; meetings with SPREP, WMO and Samoa Government (including National Meteorological Service)
	Contracts agreed
	First Progress Report to SPREP
December 2009	Full Team meets in Fiji (Nadi / Suva); meetings with Suva –based organisations; Fiji Meteorological Service.
	Team members (Brook, Kaloumaira) visit Vanuatu; meetings with Vanuatu Government (including National Meteorological Service). Team member (Paeniu), with SPREP support, visits Kiribati; meetings with Kiribati Government (including National Meteorological Service)

	Team members (Brook, Paeniu, Chapman) visit Australia and New Zealand; meetings with respective governments (including National Meteorological Services).
	Schedule extended to allow time for stakeholder feedback on draft Report.
	Second Progress Report to SPREP.
January 2010	Team member (Brook) visits the USA (Hawaii); meetings with relevant officials (plus phone link with NMS in the North Pacific area).
	Team Member (Kaloumaira) visits remaining key stakeholders in Fiji
	Draft Report to SPREP.
February 2010	Full team visits Fiji; meetings with senior government officials and Fiji Meteorological Service. Schedule extended to allow time for stakeholder feedback on draft Report.
March 2010	Full Team meets in Samoa to consider feedback on Draft Report
April 2010	Final Report to SPREP

Consultation

The team was contracted to carry out this Review in November 2009 with an (initial) completion date of January 2010. This schedule required that consultation be carried out at short notice over the Christmas and New Year period; a time when travel is difficult (no flights were available to Tuvalu in the pre-Christmas period) and staff are occupied with end of year requirements or on leave, as well as being the cyclone season.

Working within the limited resources of the project, the team was fortunate to visit and meet with directors of Meteorology Services and staff from four Island Countries; Fiji, Kiribati, Samoa, and Vanuatu.

The contributions of Meteorological Service Directors from other Pacific Island Countries and Territories were solicited via a survey questionnaire, which gained a high level of response (refer Annex 4 of this report).

The team also visited Australia, New Zealand and the US and met with relevant government officials, including meteorological services

The review team's draft report was distributed by SPREP for feedback from its Members. Written comments were received from Australia, New Zealand and the US. Views of the Fiji Government were conveyed to the Team verbally during a scheduled meeting in February 2010.

Costs Benefit Analysis

The assessment of costs and the use of cost-benefit analysis is a central element of the Terms of Reference.

It was evident from the outset that in a consideration of meteorological services the costs and benefits are expressed in different terms. The direct costs are incurred by governments and others to develop observational networks and forecasting capacity. The benefits comprise a broad range of goods that affect the community in many ways and at many levels (described most broadly as underpinning sustainable development).

Conceptually it is possible to quantify all direct costs. In the current review the team has not had access to sufficient cost information to do this in full. By way of illustration, all the information provided to the team on the finances of the Fiji Meteorological Service appears in Annex 8 of this report. In addition, FMS is supported by a wide range of external inputs (through WMO arrangements, observational networks established by other countries and territories, and contributions of development partners).

Given the complexity of these arrangements and the quality of the information available, the review team has not attempted to describe full costings or conduct a full cost-benefit analysis. Instead it has developed its assessment in a way designed to provide guidance for decision-making, using the information available.

The approach taken is more aligned with Cost Effectiveness Analysis (CEA[8]). In the case of regional specialised meteorological services (Annex 11 of this report) the analysis involves comparing the relative costs of several different options offering broadly comparable benefits. Relative costs are assessed using salary scales as a proxy.

[8] See for example *New Zealand Treasury 2005: Cost Benefit Analysis Primer*

In assessing options for regional coordination, the approach differs in that in this case it is relatively straightforward to identify indicative costs. The options represent (in general) increasing levels of benefit; the analysis then involves a judgement of where costs and benefits are optimised.

Annex 2: List of Documents

This annex presents a list of reference material used in the course of the review

Selected List of Documents

Bureau of Meteorology 1991: The Changing Climate in Paradise – Feasibility Study on Climate Monitoring and Impacts in the South West Pacific, R.R.Brook et al.

Bureau of Meteorology 2000: Strategic Action Plan for the Development of Meteorology in the Pacific Region.

SPREP 2001: A Needs analysis for the strengthening of Pacific Islands Meteorological Services: meeting the challenges. – Apia, Samoa.

NOAA 2002: RANET : Using Science and Technology for People, the Environment and Development; brochure produced by NOAA2009 for the World Summit on Sustainable Development (WSSD) Meeting in Johannesburg, S.A. 2002

SPREP 2002: Pacific Island GCOS Action Plan 26 March 2002

SPREP 2004: Action Plan for Managing the Environment of the Pacific Islands Region 2005 – 2009

SPREP 2005: Pacific Islands Framework for Action on Climate Change 2006-2015

AusAID 2005: Economic Impact of Natural Disasters On Development in the Pacific (Volume 1 Research Report & Volume 2 Economic Assessment Tools; AUSAID 2005

SOPAC 2005: Disaster Risk Reduction and Disaster Management Regional Framework for Action 2005 -2015 Building the Resilience of Nations and Communities to Disasters: An Investment for Sustainable Development in the Pacific Island Countries; SOPAC Misc Report 613, 2005

World Bank 2006: Not if but When: Adapting to natural hazards in the Pacific Islands Region – A Policy note.

SPREP 2006: Report of the Eleventh Meeting of Regional Meteorological Service Directors (RMSD), Noumea, New Caledonia, 10 – 14 July 2006. – Apia, Samoa

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WMO 2007: Abridged Final Report With Resolutions, Fifteenth World Meteorological Congress, Geneva 2007; WMO-No 1026

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Annex 3: Linking Meteorological Services with Disaster Risk Reduction

The Pacific region is one of the most vulnerable regions in the world to natural disasters: both meteorological (climate and weather) and geological (seismic and geo-physical). The Pacific Ocean covers approximately one third of the global surface, and therefore plays a significant role in determining in the basic climate inherent in the natural environment of the region:

(a) There are Pacific Island Developing States(PIDS) astride the equator in the general gestation region of cyclones (50 South - 100 South) and typhoons (50 North - 100 North). These are the countries of Kiribati, Nauru, Tokelau, Tuvalu substantial parts of PNG, Solomon Islands and FSM. Areas within the gestation region will experience seasonal heavy rains, storms with surges and strong winds and occasionally cyclone strength winds.

(b) The rest of the PIDS are present in the strong cyclone regions immediately south and north of the gestation region before cooling effects de-energise the cyclones and typhoons as these weather phenomena move further to the south and north respectively.

(c) Similarly extreme weather conditions of severe droughts, excessive rainfalls and frosts (in the highlands of PNG) associated with El Nino/La Nina Southern Oscillation are inter-annual climate variations driven from equatorial ocean-atmosphere processes.

The vulnerability of PIDS to natural disasters is dominated by meteorological hazards, and this has for long shaped the public and national concept on the service domain of NMS to one of a social nature relating directly to public safety and security. This is strengthened recently with NMS's now having the added function of being the national focal point for regional and international tsunami warning systems. The reference "Economic Impact of Natural Disasters in the Pacific" provides a list of 122 natural disasters events that occurred in the Pacific region from the decade 1994-2004, comprising climate and weather induced disasters of 73 cyclone events, 18 floods, 6 landslides, 2 droughts, 2 storm surges, 1 each thunderstorm and hailstorm disasters. The rest were volcano (7), earthquakes (6), tsunamis (3) and bush fires (3). In addition there was a strong ENSO event in 1997/98 followed by a mild one in 2002.

Hence for the PIDS, meteorological disasters make up 85% of all disasters and these impact on all the countries, with just a relatively smaller occurrence of manmade disasters[9]. Hence

[9] About 70% of all natural disasters worldwide are attributed to weather and climate "A needs Analysis for the Strengthening of Pacific Meteorological Services, 2001".

addressing meteorological hazards effectively will improve the fiscal capability of the small economies of PIDs.

The important and critical role that meteorological services provide and which is essential to underpin sustainable development is one not fully assimilated as yet in national development efforts. Linking disaster risk reduction and sustainable economic development is a recent initiative now being driven through SOPAC and articulated in the "Disaster Risk Reduction and Disaster Management Regional Framework for Action 2005 (2005-2015)". As meteorological service products are easily linked to disaster risk reduction, the DRR & DRM Framework is a major contributor in the raising of national profiles of Meteorological services, discerning the necessity to use meteorological science in mitigation, adaptation, prevention, preparedness, response and recovery measures. This drive underpins the need for strengthening meteorological services Pacific- wide, through budgetary provisions and structural improvements and organisational re-structure aimed to improve service integration, product quality and nationwide dissemination.

The initiative for National Action Plans for Disaster Risk Management advocates that Disaster Risk Management is a sustainable development issue and supports an 'all hazards' and integrated approach to the mainstreaming of disaster risk reduction and disaster management. It requires a whole of country approach, involving partnership between and amongst governments, communities and other stakeholders, at all levels of decision-making, supporting communities managing their hazards and disasters, adopting a programmatic approach through prevention, mitigation & adaptation to

Disaster Risk Reduction (DRR) needs, challenges and opportunities particularly Small Island States (SIS) needs relating to regional meteorological services

The challenges on sustainable development relating to meteorological services for PIDS are to identify meteorological products that would best serve the key economic development sectors. Additionally to strengthen community communication systems and networks reaching "to -the-last-mile" and needs driven to heighten inter-community security and safety whilst concurrently fostering socio-economic progress through active dialogue and community exchanges.

Specifically HF radio systems, have proven success record, they have been pragmatic and robust means of communication systems, in the public good. The corporatisation of telecommunication in the region is resulting in a demise of HF radio networks.

PIDS have open economies which make them very vulnerable to negative external economic shocks over which they have little or no control such as increasing oil prices, unattractive

movement in foreign currency and trading accounts and impacts of natural disasters[10]. These are a few of the common and typical external shocks that impact badly on all PIDs, but particularly more vulnerable are the SIS as they have relatively much smaller and narrower spread of natural resources. In addition to health, education, water and sanitation other key development sectors for the SIS are the fisheries and tourisms whilst the larger land mass island countries also have agriculture, mining and forestry.

The PIDs are all heavily entrenched with subsistence living and they depend heavily on their natural environment for socio-economic sustenance. Improving meteorological services and products, particularly targeted at key economic sectors, is essential to underpin communities' capacity to manage their hazards and disasters.[11] Forecasts and climate prediction that provide improved locality climate science data is needed in the dispersed island settings of Small Island States (SIS), to enable these communities to adopt a programmatic approach to their development that captures the range of disaster risk management measures from prevention, mitigation & adaptation to preparedness, response and recovery. SOPAC is taking the lead role in this approach to support the countries reach these goals through developments and implementation of National Action Plan on Disaster Risk Management.

Disaster risk management basically looks at reducing community exposures to hazards. PIDS have small land mass hence small economy and revenue base to support economic development. In the agriculture and tourism sectors, these constraints coupled with client preferences have driven PIDS developments to focus along the coasts. Supporting physical and social public utilities and lifeline infrastructures follow suit making the coastal region the commercialised and administrative zones which intrinsically places these high value built assets and businesses on the coastal regions at very high risks of exposures to coastal meteorological hazards comprising storm surges, coastal geomorphologic changes, flooding, sea spray, health risks, soil erosion, water resources constraints and droughts.

Meteorological Products

A list of improvements on the current layers of responsibility in meteorological service essential to reduce disaster risks along the coastal zones as well as enhance operational planning in key economic sectors of PIDS include:

[10] "A Voice of Reason *The Writings of Savenaca Siwatibau, Edited by Wadan Lal Narsey, USP.*

[11] Annex 5 SPREP Member Countries and Territories Basic Socio-Economic Indicators (2005) lifted from 'A Needs Analysis for Strengthening Pacific Meteorological Services" 2001

- ➔ Specific weather bulletins to include localised context with attention to the needs of touristic and hotel zones such as including surf forecasts as many hotels promote organised water-based sports and recreational activities.
- ➔ Special advisories and warnings on Tropical Cyclones to be localised in context and both to reach directly to hotels and eco-tourist resorts.
- ➔ In agriculture, national climate services to include a lower layer of regional zones to meet agricultural geographical spread of interest. The effort on PIDS will be on improving production technology (including new varieties), preparedness planning and response operations as land tenure does not really allow much room to re-locate production as a mitigation option. To meet today's needs, meteorological service products need to include forecast probability, and for extreme events improve on reliability on the "on-set" and "break-off" points. Such products will assist improve planning for food security as well as planning on environmental bio-security concerns .
- ➔ The fisheries sector is known to be impacted by EL Nino/La Nina where catches are affected and revenue dwindles. Licensing linked to extreme events is a policy option that can be explored to buffer periods of low return. Accurate data is a pre-requisite.
- ➔ Weather and health are closely linked as with the increase of dengue noted during recent ENSO events; and of leptospirosis and malaria following heavy rainfall and cyclones. Climate prediction and weather forecasts as currently provided are serving to meet public health policies dealing with epidemics and public awareness and education. Intrinsically health will value add on improvements to meteorological products on provision of locality specific information.
- ➔ In commercial Forestry, weather and extreme events forecasts probability will allow better forestation management decisions particularly maintenance, new plantings, and fire risks management.
- ➔ For water resources management and Hydropower operation, being accurately informed on extreme events and having reliable forecast probability underpins improved decision making which should reflect in more economical services and better human security on the basic necessities of water and affordable energy.
- ➔ Consultancy Services – all new developments today need to meet strategic development policy directions and stringent environmental impact assessments, for which decision making requires the provision of basic meteorological, climate and hydrological data and the assessed impacts of storm surges, cyclones, extreme events, climate variations and coastal processes. These are national and site specific requirements for which PIDs look to NMS to have a

leading collaborative role in efforts at building baseline data. Consultancy services from NMS would input at policy and operational levels of DRM:-

- In mainstreaming DRM into national development planning processes, information on weather and climate impacts availed through meteorological and hydrological science and data is a fundamental consideration in approvals for development license and permits, EIA, building codes and public health requirements.
- in selection of design parameters
    - as rainfall for designs of drainage and of water supply systems, flood mitigation and river training;
    - wind speeds for building designs;
    - tidal heights together with storm-surge / wave heights for setting designing criteria on safety and security of coastal developments including reclamation aimed towards sustaining the meagre and fragile island –ocean ecosystem;
    - tide, wind and ocean parameters in embracing new technologies for renewable energy .
- in consideration of coastal trend analysis to show historical movement induced by wind and wave pattern impact for assessing mitigation needs on new developments
- And in consideration of managing measures to alleviate impacts of disaster risks and climate change to strengthen resilience, improve human security and support sustainable development through well designed preparedness, mitigation, adaptation, response and recovery measures.

The Fiji NMS and RSMC Nadi –TCC have capability and already provides a bulk of these products in cooperation with the various end users. They do provide scopic forecasting which individual nations have to update to produce county specific details. To have better definition of product needs, RSMC and NMS need to collaboratively conduct user needs surveys to establish inventory of product requirements.

Communication

The observational and telecommunication networks[12] of Meteorological Services and the regional telecommunications network for exchange of data are viewed by PIDS governments as strong and robust inter-regional telecommunication structures on which to structure national all hazards early warning systems. Though early warning is incidental to core meteorological functions, NMS are now generally designated 24/7 focal points for all hazards, end – to – end warning systems. This directly reflects the increasing values nations

[12] "A Needs Analysis for the Strengthening of Pacific Meteorological Services 2001" – SPREP Document

place on the resources and availed capacity in meteorological services particularly their 24/7 work culture. Development of such early warning systems is a core responsibility that nations have committed to in the Framework and in the spirit of the Pacific Plan for regional cooperation.

Whilst the role of the NMS is clear in that it is a conduit in the relaying of the warnings, an effective national early warning system will only be realised by concerted and collaborative efforts from and within the national agencies responsible to set up and implement national response systems, plans and warnings. For the islands dispersed over vast ocean distances, communication system is vital. Unfortunately the corporatisation of telecommunication system in regional countries has brought a lowering of services and capacity to remote areas, as commercial objectives outweigh the primary social functions that HF radio-telephone systems have traditionally provided. To compliment the communication node available through NMS, in- country communication systems to reach the last mile needs to be developed. Modern mobiles are providing this vital link during normal times but service providers mostly close discs as precautionary measures during cyclones. The old HF systems need to be revived from public good perspectives.

KEY Projects linked to Met Services Providers NZ, Aus, USA , JICA & others

Severe Weather Forecasting - WMO and NZ

This is an inaugural project for the region driven by WMO and for which Wellington RSMC takes the lead role. Its ultimate goal is to upgrade skills with new manual guidance for interpreting weather models in support of disaster risk reduction of member countries. The Project involves strengthening communication and media relations. This Project is timely meeting a key need of PIDS on better information relating to severe weather gestation, build up, locality, duration and severity as communication and ocean travel are basic building blocks for PIDS.

Radio-Internet "RANET" for the Communication of Hydro-Meteorological and Climate Related Information - USA (NWS - Hawaii)

RANET is thriving in Africa with communities largely dispersed over immense land masses and geographically dislocated from commercial and administrative centres, similar to PIDS. RANET is described as a collaborative effort of many National Hydro-Meteorological Service, non-government organizations, and communities. These varied partners come together to make weather, water, and climate information available to rural and remote populations, which are often most in need of environmental forecasts, observations, and warnings.

RANET serves to build a "radio-internet pathway between scientific results and individuals in remote areas for whom information might matter tremendously"[13]

Through NWS, the RANET is being mooted through a loose Pacific RANET Committee as very suitable for the Pacific. To push momentum a regional organisation such as SOPAC should be formally tasked to do a feasibility study of RANET use in the Pacific. The use of HF with internet is prevalent in the SI as PeopleFirst network set up through UNDP support in the early millennium.

WMO Training Support

This support is currently availed through Fiji NMS and providing appropriate skilling of regional NMS staff including forecasters.

JICA Training New Focus

JICA this year starts its 3rd Phase of third-country training in meteorological services where it promotes regional cooperation from Fiji. This phase is to reflect the change in focus to communication and is aimed to promote collaboration with users of meteorological service information in quest of :-

- Why met information is important
- How it works and disseminated
- What kind of information

The WMO and JICA work in close collaboration with Finland, SPREP and the RSMC/Nadi to determine needs and provide courses including strengthening capacities of local instructors.

[13] Ranet Brochure presented at the 2008 WSSD Summit at the

PIDS Status Summary

The following tables reflect the context in which DRR management is being managed in the region.

Table 1: PIDS Vulnerability to Meteorologically Induced Natural Disasters

Table 1(a) for Countries in Fiji NMS and RSMC Nadi – TCC Area of Responsibilities							
Country	TC	Strong Winds; swells	Heavy Rainfall ; River Flooding	Severe Storms; Surges; Coastal Flooding	Reduced Rainfall; Drought	ENSO Events	Sea Level Rise
Banaba	–	√	–	√	√	√	√
Cook Island	√	√	√	√	√	√	√
Fiji	√	√	√	√	√	√	√
Kiribati	–	√	–	√	√	√	√
Nauru	–	√	–	√	√	√	√
Niue	√	√	–	√	√	√	√
Tokelau	√	√	–	√	√	√	√
Tonga	√	√	√	√	√	√	√
Tuvalu	√	√	–	√	√	√	√
Wallis & Futuna	–	√	–	√	√	√	√
Samoa	√	√	√	√	√	√	√
Vanuatu	√	√	√	√	√	–	√

Table 1 (b) for Countries whilst taking Fiji NMS leans on Other Service Providers							
Country	TC	Strong Winds	Heavy Rainfall and River Flooding	Severe Storms, Surges and Coastal Flooding	Reduced Rainfall and Drought	ENSO Events	Sea Level Rise
French Polynesia (France)	√	√	√	√	√	√	√
New Caledonia (France)	√	√	√	√	√	√	√

Table 1 (c) for countries totally reliant on other providers (Brisbane TCWC for the SI; and NOAA-NWS for the North Pacific USA Freely Affiliated States and Trust Territories).							
	TC	Strong Winds	Heavy Rainfall and River Flooding	Severe Storms, Surges and Coastal Flooding	Reduced Rainfall and Drought	ENSO Events	Sea Level Rise
Solomon Island	√	√	√	√	√	√	√
American Samoa	√	√		√	√	√	√
Marshall Islands	√	√		√	√	√	√
Federated States of Micronesia	√	√	√	√	√	√	√
Palau	√	√	√	√	√	√	√
CNM Islands	√	√	√	√	√	√	√

Table 2 WMO-Designated Area of Responsibilities (on its Member Countries) for Weather Forecasting and Warnings:[14]

FIJI	Coastal waters and land areas of Banaba, Cook Islands, Fiji, Kiribati, Nauru, Niue, Tokelau, Tonga, Tuvalu, and Wallis & Futuna.
RSMC Nadi	RSMC Nadi is a designated ICAO TCAC RSMC Nadi – TCC also provides special advisories for Samoa and Vanuatu NMS/TCOC in the preparation and issuing of warning
French Polynesia	Coastal waters and land areas of French Polynesia and Pitcairn; has its own TCOC (* – takes Fiji and leans on France).
New Caledonia	Coastal waters and land areas of NC; has its own TCOC (* – takes Fiji and leans on France).
Papua New Guinea	Coastal waters and land area of PNG; has a TCWC in Port Moresby
Samoa	Coastal waters and land area of Samoa Independent State; has its own TCOC, Samoa NMS and USA NOAA NWS Office (WSO) Pagopago have established agreements on cooperation for issuing of tropical cyclone forecasts, watches and warnings.
Solomon Islands	Solomon waters and land areas of Solomon Islands; has its own TCOC where Brisbane TCWC is the service provider in the preparation and issuing of warnings.
Vanuatu	Coastal waters and land areas of Vanuatu; has its own TCOC

[14] Extracted from WMO Fact Finding Mission Briefing Notes

Table 3 Relating Elements of the Framework on DRM 2005-2015 and the Framework on Climate Change 2005-2015

Disaster Risk Reduction and Disaster Management Regional Framework for Action 2005 (2005-2015)	Pacific Islands Framework for Action on Climate Change 2005 (2005-2015)
Theme 1:Governance – organisational, institutional, policy and decision-making frameworks	**Principle 1**:Implementing adaptation measures
Theme 2: Knowledge, information, public awareness and education	**Principle 2**:Governance and decision making
Theme 3:Analysis and evaluation of hazards, vulnerabilities and elements at risk	**Principle 3**:Improve understanding of climate change
Theme 4: Planning for effective preparedness, response and recovery	**Principle 4**:Education Training and Awareness
Theme 5: Effective, integrated and people-focused early warning systems	**Principle 5**:Contributing to global greenhouse gas reduction
Theme 6: Reduction and underlying risk factors	**Principle 6:** Partnership and cooperation

Table 4 SPREP Member Countries and Territories Basic Socio-Economic Indicators (2005)

{Ref (a) A Needs Analysis for the Strengthening of Pacific Meteorological Services (b) CIA World Fact Book}

Table 4 (i) Member Countries and Territories: Basic Socio-Economic Indicators (2005)

Country	Land Area (Km^2)	NMS's Annual Operating Budget US$ 000 (yr 2000)	Annual Growth Rate (%)	GDP – PPP (bn) US$	Total Population	Density (People/ km^2)	Urban Population (%)	
American Samoa	200	660	3.7	0.573 (2005)	65,628	233	48	
Cook Islands	197	150	0.4	0.183 (2005)	11,870	237	59	
FSM	710	2,199	1.9	0.238 (2008)	107,434	149	27	
Fiji	18,333	1,500	0.8	3.587 (2008)	944,720	39	46	
French Polynesia	3,521	5,700	1.9	4.718 (2004)	287,032	62	54	
Guam	541	2,000	2.3	2.5 (2005)	178,430	246	38	
Kiribati	811	165	1.4	0.58 (2008)	112,850	96	37	
Marshall Island	181	800	4.2	0.133 (2008)	64,522	240	65	
Nauru	21	xxx	2.9	0.06 (2005)	14,019	472	100	
New	19,103	5,200	2.6	3.158	227,436	10	71	

Caledonia				(2003)				
Niue	259	40	-1.3	0.01 (2003)	1,398	8	32	
Palau	488	820	2.4	0.164 (2008)	20,796	35	71	
Papua New Guinea	462,243	821	2.3	13.17 (2008)	6,057,263	8	15	
Samoa	2,935	132	0.5	1.021 (2008)	219,998	55	21	
Solomon Island	28,370	325	3.4	1.546 (2008)	595,613	10	13	
Tokelau	12	12	-0.9	0.0015 (1993)	1,416	125	0	
Tonga	747	160	0.3	0.548 (2007)	120,898	131	36	
Tuvalu	26	183	1.7	0.0142 (2002)	12,373	348	42	
Vanuatu	12,190	270	2.8	0.99 (2008)	218,519	12	18	
Wallis and Futuna	255	See New Caledonia	0.6	0.06 (2004)	15,289	56	0	
				33.2554	9,277,504			

Table 4 (ii) Regional Comparison with Developed Countries Providing Services

Country	GDP PPP (US$)	Population	GDP ranking
USA	14.4 trillion	307,212,123	1 in world DGP
France	2.123 trillion	64,057,792	9 in world GDP
Australia	0.802 trillion (802 billion)	21,262,641	19 in world GDP
New Zealand	0.116 trillion (116 billion)	4,213,418	61 in world GDP

Table 5 Economic Impacts of Natural Disasters in the Region (Appendix 3 "Economic Impact of Natural Disasters on Development in the Pacific; Volume 1 Research Report)

Year	Location	Disaster Type	Population Affected	Lives lost	Estimated cost	Notes
	Federated States of Micronesia	Typhoon				
1998	Papua New Guinea: Ramu R, Madang	Floods	38,000	28		
	Papua New Guinea: Sepik R. East Sepik	Floods	23,000	0		
	Papua New Guinea: Aitape, Sandaun	Tsunami	12,427	2,227		
	Samoa	Tropical Cyclone Tui	1,143	1	SAT 2,506,602	6 houses damaged, power and communications disrupted, Food crops destroyed
	Samoa	Drought and bushfire			SAT 402,722	Forests and agricultural crops destroyed
	Tonga	Tropical Cyclone Cora	77,000		T$ 19.6 million	Housing and agricultural sector damage
	Niue	Tropical Cyclone Dovi	100		NZ$ 1 million	Structural damage to wharf only
	Vanuatu	Tropical Cyclone Katrina			Vt 800 million	Housing and schools, agriculture, water supply and health facilities
	Federated States of Micronesia	El Niño Drought	103,000			Water supplies and agriculture affected
	Marshall Islands	El Niño Drought				
	Tuvalu	Drought	10,000		AU$ 1.5 million	
1999	Papua New Guinea: Mid Fly, Western	Floods	10,000			
	Fiji	Tropical Cyclone Dani	2,000	12	US$ 2 million	Housing, business, agriculture damage – mainly by flooding
	Vanuatu	Tropical Cyclone Ela	28,600	5	Vt 700 million	Housing, agriculture, schools and health facilities damage
	Vanuatu	Earthquake & Tsunami	5,000	10		Housing and crop damage from earthquake, tsunami and landslides
2000	Papua New Guinea: Pangia, S Highlands	Thunderstorms	400+	1		Houses and gardens destroyed

Year	Location	Disaster Type	Population Affected	Lives lost	Estimated cost	Notes
	Papua New Guinea: Laloki, Central	Floods	1,000			Food gardens destroyed
	Papua New Guinea: Bougainville & Buka, N Solomons	Tsunami & Flood	1,600			Houses and food gardens destroyed
	Papua New Guinea: E New Britain	Earthquake	100,000		Kina 14 million	Infrastructure and property damage
	Papua New Guinea: W New Britain	Volcanic Ash Fall	3,750			House and crop destruction
	Papua New Guinea: S Highlands	Floods	16,000			Destruction of infrastructure
	Papua New Guinea: Bereina, Central	Floods	500+			
	Papua New Guinea: Morobe	Landslide	5	2		
	Papua New Guinea: Long I, Madang	Flood	1,900			
	Fiji	Coup and subsequent mutiny				
	Tonga	Tropical Cyclone Mona	65,000		T$ 4.2 million	Agriculture damage
	Vanuatu	Tropical Cyclone Iris				Housing and agriculture damage
	Fiji	Floods	5,000	4		Minor damage
2001	Papua New Guinea: Mumeng, Morobe	Floods	400			Infrastructure destroyed
	Papua New Guinea: Madang Town	Explosion (Contaminated kerosene)	60+	5		
	Vanuatu	Tropical Cyclone Paula		1		Housing and agriculture damage
	Fiji	Tropical Cyclone Paula Storm Surge	7,000	1		Housing damage

Year	Location	Disaster Type	Population Affected	Lives lost	Estimated cost	Notes
	Tonga	Tropical Cyclone Paula	20,000		T$ 700,000	Tourist resort damage
	Vanuatu	Volcanic eruption	1,700 +			Water supply contamination, respiratory problems, crop damage
	Samoa	Floods	5,000 directly, 28,000 indirectly		SAT 11 million	Houses and commercial buildings damaged. Lifelines (roads, bridges, water supply, hydro power stations) damaged and supplies interrupted.
	Palau	Tropical Cyclone Utor	11,000		US$ 4 million	Homes destroyed, communications, transportation and utilities systems disrupted
	Tonga	Tropical Cyclone Waka	68,000		T$ 104 million	470 houses destroyed. Food supplies, power system health and sanitation damage
	Tuvalu	Boarding school fire	36	18	AU$ 500,000	Affected almost every family in the country
	Guam	Earthquake				
2002	Papua New Guinea: Wewak, East Sepik	Earthquake	5,000	4		Building damage
	Papua New Guinea: Mt Pago, W New Britain	Volcano	13,000			Lifelines disrupted, major bridge destroyed by mudflow, homes affected by flooding. Major evacuations affected agriculture.
	Papua New Guinea: Ramu R, Madang	Floods				Houses affected
	Papua New Guinea: Wantuat, Morobe	Earthquake & Landslide	138	36		Village destroyed
	Papua New Guinea: Milne Bay	Mild El Nino drought	35,000			Reduced food security
	Vanuatu	Hailstorm	3,000		Vt 800 million	500 houses destroyed. Agricultural, infrastructure and water supply damage
	Federated States of Micronesia	Tropical Cyclone Mitag	8,000			Damage to housing and agriculture
	Guam	Tropical Cyclone Pongsona				
	Federated States of Micronesia	Tropical Cyclone Chata'an	1,000	47		Damage to housing and crops. Many landslides

Year	Location	Disaster Type	Population Affected	Lives lost	Estimated cost	Notes
	Guam	Tropical Cyclone Chata'an	1,600		US$ 60 million	Damage to housing, agriculture and utilities
	Vanuatu	Earthquake	1,100			Housing, schools and churches damaged
	Tuvalu	Tidal surge	50		AU$ 20,000	Flooded all low lying areas
2003	Papua New Guinea: Sepik R, E Sepik	Floods	4,365			
	Tuvalu	Tropical Cyclone Ami	27		AU$ 6,000	Coastal damage
	Solomon Islands: Rennell & Bellona	Tropical Cyclone Beni	2,010			Housing and agriculture damage
	Fiji	Tropical Cyclone Ami	60,000	15	FJ$104.4 million	Housing, infrastructure and agriculture damage
	New Caledonia	Tropical Cyclone Erica	1,000 +			Housing and agriculture damage
	Solomon Islands: Tikopia and Anuta	Tropical Cyclone Zoe	1,678			Housing, schools, clinics and agriculture damaged. Water supplies affected
	Tonga	Tropical Cyclone Eseta	15,000		T$ 1.9 million	Housing, harbour facilities and resort damage
	Papua New Guinea: S. Highlands	Landslide		13		Housing and crop damage
	Papua New Guinea: Bukawa, Morobe	Floods	1,197			
	Papua New Guinea: Madang Town	Internally displaced	13,000			
	Federated States of Micronesia	Tropical Cyclone Lupit	2,000			Damage to housing, water supplies and crops
	American Samoa	Floods and landslides				
2004	Papua New Guinea: Simbu	Landslides				Highlands Highway – the main transport link – disrupted. Cash crop movement stopped

Year	Location	Disaster Type	Population Affected	Lives lost	Estimated cost	Notes
	Papua New Guinea: Pamu R. Madang Markham R, Morobe	Floods				Major bridges destroyed or damaged. Cash economy disrupted.
	Tuvalu	Fire	16		AU$ 6,000	
	American Samoa	Tropical Cyclone Heta				
	Samoa	Tropical Cyclone Heta	Total		SAT 90 million (US$ 35 million)	50+ houses destroyed, Wind damage to houses, crops, utilities, and coastal ecosystems. Wave damage to roads, culverts and seawalls as well as depositing debris across roads and in coastal villages.
	Niue	Tropical Cyclone Heta	1,300	1	NZ$37.7 million	Whole country affected. Damage to housing, hospital, commercial buildings, crops, utilities, and transport systems.
	Wallis & Futuna	Tropical Cyclone Heta				Damage to power supplies and agriculture
	New Zealand	Floods			NZ$ 180 million	Housing, transport systems, utilities and agriculture affected
	Tonga	Tropical Cyclone Heta	1200		T$ 950,000	Housing and agriculture sector damage
	Fiji	Storms and Floods	36,500	23	FJ$ 3 million	
	Vanuatu	Tropical Cyclone Ivy	54,000	2	VT 427.6 million	Housing, agriculture, schools, health facilities and water supply system damage
	Federated States of Micronesia	Tropical Cyclone Sudal	12,000			Damage to housing, public and commercial buildings, crops, utilities

Addendum Key References

4th WMO RAV Technical Conference (5-9 Dec 2005, Apia) – to achieve sustainable development, members are to

- increase profile within Government by cooperation in national, regional and global natural disaster prevention and mitigation activities through the provision of 24/7 warning systems.

- WMO and NMHS to organise public awareness activities to enhance the understanding of meteorological information including warnings.

WMO RA V (9 –16 May 2006, Adelaide, Australia)

- WMO Disaster Prevention and Mitigation Programme in RA V should be aligned with the Regional Framework for Action 2005 – 2015 for Pacific Island Countries Disaster Reduction and Disaster Management, and the Regional Strategy for Enhancing Warnings for Pacific Islands.

Annex 4: Survey of Pacific Meteorological Services

As part of the Review the National Meteorological Services of the following countries were invited to participate in a survey aimed at obtaining basic information about issues that fell within its terms of reference:

> Cook Islands, Federated States of Micronesia, French Polynesia, Marshall Islands, New Caledonia – Wallace and Futuna Islands, Niue, Palau, Papua New Guinea, Samoa, Solomon Islands, Tonga and Tuvalu.

The survey took the form of a questionnaire and all but Tuvalu and French Polynesia responded. The other major countries with National Meteorological Services in the region but were not included were Australia, New Zealand and the United States of America (which includes the US territories of Guam and American Samoa) and Fiji. All four were visited by members of the review team. Fiji is a particular case as the terms of reference specifically required special attention to issues associated with its RSMC and other regional activities.

The Survey covered six broad areas:

- Functions undertaken by the NMSs.
- Unfulfilled Services of the NMSs.
- Resource employed by the NMSs and resource needs.
- Regional arrangements.
- Climate issues.
- Training.

The last two areas specifically focused on matters of concern about the PI-GCOS and the effectiveness of the "Pacific Desk" provided by the Hawaiian Forecasting Office and was included after discussions with the US National Weather Service and is not further considered here.

The specific findings from the survey have provided background and information to the review. The following provides a broad overview of the responses to the survey.

Functions Undertaken by Pacific Meteorological Services, and Unfulfilled Services

Information was sought on the following services typically provided by NMSs:

- Public Weather Forecasts and Warnings.
- Aviation Services.
- Climatological Services.

- Hydrological Services.
- Consultative Services.
- Policy Advice to Government.
- Interfacing with Government and Private Sectors.
- Out-reach Activities.
- Any other Activities.

Specifically the NMSs were asked:

- "the extent they used the services of the Fiji Meteorological Service and RSMC Nadi";
- "if they utilised other services (e.g. those provided by the National Weather Service, the Bureau of Meteorology, MetService or Meteo France)";
- "what their attitude would be if these external product providers services were not available or charged";
- "which government agencies and departments they worked closely with"; and
- "the reasons why services were unfulfilled".

All NMSs provided at least some the services listed, but how these were provided and the extent of the role played by FMS and RSMC Nadi varied considerably across the region. For instance the Micronesian NMSs, specifically FSM, Palau and Marshall Islands virtually rely entirely on NWS products from Guam or Hawaii. On the other hand the Fijian services are critical to the operation of other SIS NMSs. The virtually all NMSs rated the "usefulness" of the FMS products (including those of RSMC Nadi) as "generally useful" (i.e. used most of the time) or "excellent". On the issue of the "quality" of these services this was judged in the main to be "fair" (i.e. of variable reliability) to "good" (i.e. sufficient to rely on all of the time).

In broad terms the NMSs in the region have a clear sense of purpose and are taking full advantage of the technologies and products that are available to them. Nevertheless there is a considerable shortfall between services provided and the potential and needs of their countries for the meteorological services. In virtually all cases there is a significant shortfall in resources but to a lesser extent a perceived lack of recognition by government of this potential.

Resources

The survey addressed the question of the Human Resource (HR) situation. Particular attention was given to the training qualifications of staff. The WMO has developed a curriculum and standards for meteorological staff and this provides a basis for determining the qualifications of these specialised categories. All NMSs accept this and seek to have staff qualified to appropriate levels. However in virtually all cases there is a shortfall in qualified

staff and indeed in staffing levels as determined by the "establishment" numbers of the services. Training facilities are not the issue; the Review found that the region is well served by appropriate institutions – (see Annex 10).

The actual staffing levels reported by each NMS over their establishment for each category is summarised in the following table.

Country	Met.	Met.Tech	Climat.	Eng.Tech	IT	Support
Cook Is	1/3	3/3	1/2	1/2	1/2	7/8
FSM	1/2	7/7	0/1	2/2		1/1
Kiribati	14/14		2/3		2/2	1/1
Marshall Is	1/3	6/7	1/1	1/1	1/1	1/1
N.Caledonia	24/25	3/2	7/7	7/8	12/12	14/14
Niue	Current staffing level is 6 staff					
Palau	2/3	6/7		2/2		
PNG	5/12	37/40	4/12	2/4	0/2	25/30
Samoa	6/6	9/9	2/2			2/3
Solomon Is	3/8	30/40	2/4	1/3	1/2	5/8
Tonga	2/2	2/2	2/2	1/1		1/1
Tuvalu	Not reported					
Vanuatu	2/8	1/3	3/8	1/3	1/4	5/6

Most services reported that their staffing levels were below the establishment levels assessed for effective operation, in some instances significantly so. This was reflected in responses to unfulfilled obligations, which in virtually all instances was either partly or wholly due to staffing shortages.

The information supplied on financial resources summarised in the table below:

Country (Currency)	Annual Budget	Revenue from Aviation	Revenue from Non-Aviation
Cook Is. ($NZ)	300k	48k	3.6k
FSM ($US)	257k1	Nil	Nil
Kiribati ($A)	123k	Nil	Nil
Marshall Is. ($US)	1,000k	Not known	Not known
New Caledonia (€)	7,900k	Not known2	100k
Niue ($NZ)	112	Nil	Nil
PNG (PGK)	5,000	Nil3	Nil3
Palau	Not Provided	Not Provided	Not Provided
Samoa (SAT)	123k	Nil	Nil
Solomon Is. (SBD)	2,000k	Nil	Nil
Tonga ($US)	100k	Nil	Nil
Tuvalu	Not provided	Not Provided	Not Provided
Vanuatu ($A)	1,737k	87.5k	Nil

[1] Staff only [2] Centralised in France [3]Not yet implemented

Although not all NMSs provided the review with details of the financial resources, those that did confirmed a mixed situation across the region. The funding is on the whole provided from the government budget. A few Services received some funding from Aviation and commercial activities or other sources, but when this was the case, it was only a minor proportion of the total budget. In terms of funding trends, once again this was mixed; in some services the trend was either steady or increasing over recent years, but in several

there was a decrease. The three NMSs covered by the Compact of Free Association[15] with the US and received funding from the NWS (viz. FSM, Marshall Islands and Palau), were in general in a stable funding environment. Funds from various development assistance agencies, such as JICA, USAid, NZAID and AusAID, provide vital assistance to the operations of a number of services.

When asked if "in your assessment, is funding in your Service appropriately recognised within government and by the community at large?" approximately half the Services felt it was not. There was some correlation between this recognition and the ability to obtain budgetary resources, but this was not universal. The recognition of the role of a NMS is one thing, but the ability of a national budget to assist in achieving the full potential of a Service is another.

Regional Arrangements

The NMSs were asked about the services provided by the FMS and RSMC Nadi. Recognising that FSM, Marshall Islands and Palau primarily rely on products from the NWS, the following findings relate to the other regional NMSs. The quality of the products from the FMS was rated fair (i.e. of variable reliability) to good (i.e. sufficient to rely on all of the time). The usefulness of these products was rated either marginal or generally useful. Although the survey did not seek specifics, it asked how well the services met the needs of the NMSs. Most NMSs indicated that there were some deficiencies. One issue that was focused on in the survey was concerns the review team had heard of about the extent to which problems were reported to the FMS and the subsequent response. Most NMSs reported that they usually reported to the FMS in all cases, or at least some of them, and the response from the FMS were assessed as fair to good.

[15] The Compact of Free Association defines the relationship that three sovereign states—the Federated States of Micronesia (FSM), the Republic of the Marshall Islands (RMI) and the Republic of Palau—have entered into as associated states with the United States. Now sovereign nations, the three freely associated states were formerly part of the Trust Territory of the Pacific Islands, a United Nations trusteeship administered by the United States Navy from 1947 to 1951 and by the United States Department of the Interior from 1951 to 1986 (to 1994 for Palau). Under the COFA relationship, the United States provides guaranteed financial assistance over a 15-year period administered through the Office of Insular Affairs in exchange for full international defense authority and responsibilities.

The responses are summarised in the table below.

Country	Quality	Usefulness	Report Problems	FMS response	Service meets needs
Cook Is	Good	Gen Useful	Always	Good	Some Defn
FSM	Not Applicable				
Kiribati	Fair	Gen Useful	Never	-	Some Defn
Marshall Is	Fair	Gen Useful	Always	Good	Some Defn
New Cal.	Fair	Marginal	Sometimes	Fair	Some Defn
Niue	Good	Excellent	Sometimes	Good	Some Defn
Palau	Excellent	Excellent	Always	Excellent	Excellent
PNG	Fair	Gen Useful	Sometimes	Good	Some Defn
Samoa	Fair	Marginal	Always	Good	Fully
Solomon Is	Fair	Gen Useful	Sometimes	Fair	Some Defn
Tonga	Fair	Excellent	Sometimes	Fair	Some Defn
Tuvalu	No Report				
Vanuatu	Good	Excellent	Sometimes	Good	Fully

The meetings of the Regional Meteorological Service Directors (RMSD) was almost universally assessed as "very useful", however the coordination and secretarial support came in for criticism, rated "poor" by the majority of respondents. The following table records the responses.

Country	Usefulness of meetings	Coordination of meetings
Cook Is	Very Useful	Poor
FSM	Very Useful	Good
Kiribati	Very Useful	Fair
Marshall Is	Very Useful	Poor
New Cal.	Very Useful	Poor
Niue	Very Useful	Good
Palau	Very Useful	Excellent
PNG	Very Useful	Good
Samoa	Very Useful	Poor
Solomon Is	Very Useful	Good
Tonga	Some Use	Poor
Tuvalu	No Report	
Vanuatu	Very Useful	Poor

The survey sought views on "options for coordination of operational matters in the region". The following comments were received from a number of the Directors and these have been considered by the review team.

Solomon Islands: I would rather see a PMO that has training capability and that it should take the place of RAV's Training Centres. An organisation that caters for the training needs of the Pacific Countries and that its accreditation should be recognised regionally and internationally. PMO should also host technical expertise on maintenance of Meteorological equipments and also it should be a research centre on weather and climate in the region.
Others:

- Regional forecasts (warnings, aviation)

Vanuatu: Role to help in capacity building of all the NMS to fully operate and ease some work pressure from FMS - Create modules/avenues to bring the assistance forecaster to WMO class 1 - Technical advice A250.

Tonga: I think the PMO is a good initiative. It is my view that Meteorology issues and initiatives are not served well under SPREP. SPREP's emphasis is only policy but most meteorological issues are technical in nature. There are issues with how such an organisation will be run as PIC's already pay a commission to run SPREP as instructed by the Forum. The PMO would ensure the visibility of Meteorological Services and provide a better platform for getting Regional projects and support implemented.

Samoa: Weather and Climate shall be with us for life, and the systems are changing with time and the foundation of data for the Region is poor and inadequately covered. This is demonstrated by the incapacitated output of numerical modelling for us. In addition, the core of the Pacific's Meteorological Offices personnel lacks the forecasting skills let alone the institutional framework to operate. Regional cooperation is essential in the field of Meteorology (Weather and Climate) and it undoubtedly shall provide baseline information for assessment of the continuing changing climate. It's been a long time coming, and the PMO concept should become a reality and always in support.

New Caledonia: If it's just changing the name from SPREP/RMSD, there's no point. If it's an added layer to already numerous international organizations there's no point either. If it's to say that Pacific problems are not the same as other RA V members from Asia, OK but then let's get rid of the WMO office in Apia.

Attachment 1 to Annex 4

Questionnaire sent to Regional Meteorological Service Directors

The following is a summary of the information sought in the questionnaire passed to the Directors of the Pacific Meteorological Services.

PART 1 – Summary of Functions Undertaken by and Source of Resources of Your NMS

The first part of the survey contained questions aimed at obtaining information on the scope and role of the Service and the extent it uses the services and products from the Fiji Meteorological Service, Nadi Regional Specialised Meteorological Centre (RSMC) and other information providers.

The survey asked if the NMS provide the following services:

- Public weather forecasts and warnings
- Aviation
- Climate
- Hydrological
- Consultative (includes those charged for)
- Policy advice to government
- Interfacing with government and private users of meteorological products
- Outreach (e.g. to the public, schools, clubs etc)
- Any other

Information was sought on source of resources to provide each service, whether they are provided:

- Entirely from within the NMS
- With support from the Fiji Meteorological Service
- With support from RSMC Nadi
- With support from others (e.g. WFO Honolulu or Guam, Meteo France in French Polynesia or New Caledonia, Bureau of Meteorology or MetService etc).

A response was sought to the following:

- "Suppose these services were transferred away from FMS to other potential service providers in the region, whereby the latter would impose charges to you for providing the same services which are currently provided free by the FMS, what would be your stance on such transfer?"
- "Please provide an indicative list of government departments or agencies and external organisations with which your Service regularly interacts."

PART 2 - Unfulfilled Obligations in the Provision of These Services and Products

This part sought to identify unfilled needs with respect to the services provided (as listed in Part 1) and the extent that these are a result of internal issues or because of deficiencies in regional arrangements from Nadi. If there were unfilled needs the NMS was asked if the reasons were:

- Lack of financial or staff resources within your Service
- Priority issues within your Service, government or other agencies
- Inadequate services provided by RSMC Nadi or FMS
- Inadequate services or support from other Regional NMSs and agencies

PART 3 - Resource Data

This part aimed at obtaining consistent information on resources of the NMSs. Firstly very broad information on the financing of each NMS was sought on the following:

- Financial Year for these Data
- Annual Operating Budget (i.e. bottom line cost of the NMS)
- Annual Operational Revenue from non-aviation sources
- Annual Operational Revenue from aviation sources

Next a general indication of the budgetary and political climate the in which the NMS is operating:

a. In general terms has your budget increased, decreased or remained constant over the past three years?
b. Does your Service experience difficulty in obtaining adequate budgetary provisions throughout the year?
c. Do you have projects funded by donors? (list projects with sources of project funds)
d. In your assessment is funding of your Service appropriately recognised within government and by the community at large?

Next information on Staff was sought under the following categories: Meteorologist, Meteorological Technician, Climatologist, Engineering Technician, Information Technologist and Support Staff. In each category the following were requested:

- Establishment Staffing Level for Category (The establishment staffing level is the number of staff in this category that your Service has approval to be operating at full strength)

- Actual Number of Staff in Category
    1. Desired Qualification for staff in this category. (The following guidance was given – The desired qualification can be the WMO definition e.g. Meteorologist – a person who holds a university-level degree or equivalent; has acquired an appropriate level of knowledge of mathematics, physics, chemistry and computer science, and has completed the Basic Instruction Package for Meteorologists (BIP-M). Meteorological Technician – a person who has completed the Basic Instruction Package for Meteorological Technicians (BIP-MT). For general orientation purposes, a broad relationship between the previous former classification and the new categorisation system would be that the new category of Meteorologist is equivalent to the former Class I and the new Meteorological Technician sub-categories of senior-level, mid-level and job-entry level are broadly equivalent to the former Classes II, III and IV, respectively. If this is the case enter BIP-M or BIP-MT as appropriate. Otherwise indicate broadly by "appropriate degree", "appropriate diploma" or similar.)
    2. Number of staff at desired qualification
    3. Indicative pay scale. Only a broad indication was required here as it was intended that these data would be used to attempt to establish the costing of provision of meteorological services in the Pacific in general terms.

PART 4 - Comments on Regional Arrangements

The survey sought comments on regional arrangements in the following terms.

Regional Services Provided by Fiji Meteorological Service

With respect to the services from the FMS, including the RSMC:

- How do you rate their overall quality?
    1. poor (i.e. unreliable)
    2. fair (i.e. variable reliability)
    3. good (i.e. sufficient to rely on all the time)
    4. excellent (i.e. virtually perfect)
- What are your views on the usefulness of them?
    1. no use at all
    2. of marginal use
    3. generally useful (i.e. used most of the time)
    4. excellent
- If there are problems with the services provided by the FMS and RMSC do you:
    1. always report them to the FMS
    2. sometimes report them to the FMS
    3. never report them to the FMS
- How do you rate FMS's responses to your concerns:

1. poor (never or hardly ever act on them)
2. fair (usually act on them, but not always in a timely and effective manner)
3. good (always act on them, but not always in a timely and effective manner)
4. excellent (always act on them in a timely and effective matter)

- How well do the services meet your needs:
  1. we receive all the services we need to fully discharge our obligations
  2. there are a some deficiencies
  3. there are significant deficiencies

Meetings of the Regional Meteorological Services Directors (RMSD)

The meetings of the Regional Meteorological Service Directors have been a feature of coordination of meteorological services for the past couple of decades. The secretariat support for the RMSD in the recent past it has been provided by SPREP by its Meteorological and Climate Officer (MCO), but that position has not been funded from its base funds. The Team is assessing the importance of these meetings and their secretarial support needs.

- How do you rate the usefulness of the meetings of Regional Meteorological Service Directors:
  1. very useful
  2. of some use
  3. not very useful
- How do you rate the coordination and secretariat support for the meetings:
  1. poor
  2. fair
  3. good
  4. excellent

Options for Coordination of Operational Maters in the Region

At recent meetings the RMSD has debated the establishment of a Pacific Meteorological Organisation (PMO) along the lines of the Caribbean Meteorological Organization (CMO). The team would be interested in any thoughts you may have on this. We recognise that this is a very complex problem and involves policy, political, administrative and other issues and are seeking here only your broad overall thoughts on its role and value, rather than specific suggestions as to its structure, area of coverage and the like.

Annex 5: The RSMC Role within the World Weather Watch Programme

Purpose and Scope of the World Weather Watch (WWW) Programme

Meteorological services are required for the safety of life and property, the protection of the environment, and for the efficiency and economy of a wide range of weather sensitive activities. Central to the provision of these services is the receipt by NMCs of observational data, analyses and forecasts. WWW is the international cooperative program that arranges for the gathering and distribution in real time, on a worldwide scale, of meteorological information required by individual Members, by other WMO programs and relevant programs of other international organisations.

The overall objectives of the WWW Programme are to:

(a) maintain and strengthen an efficient and economic worldwide integrated system for the generation, collection, processing and exchange of meteorological and related environmental observations, analyses, forecasts, advisories and warnings and other specialised products to meet the needs of all Members, WMO Programmes and relevant programs of other international organisations;

(b) promote and support, through capacity building, measures for the introduction of standards, procedures and technology which enable Members to contribute to, and benefit from, the WWW system and ensure the high level of quality, reliability and compatibility of observations and forecasts needed for the delivery of services required in Member countries; and

(c) provide the basic infrastructure for obtaining observational data and related services needed by relevant international programs addressing global environmental issues.

Components of the WWW System

The WWW operates at global, regional and national levels. It involves the design, implementation, operation and further development of the following three interconnected, and increasingly integrated, core elements:

(a) The Global Observation System (GOS), consisting of facilities and arrangements for making observations at stations on land and at sea, and from aircraft, environmental observation satellites and other platforms. It is designed to provide observational data for use in both operational and research work;

(b) The Global Telecommunications System (GTS), consisting of integrated networks of telecommunication facilities and centres, especially Regional Telecommunications Hubs, for the rapid, reliable collection and distribution of observational data and processed information;

(c) The Global Data Processing and Forecasting System (GDPS), consisting of World and Regional Meteorological Centres (WMC and RMC), Regional Specialized Meteorological Centres (RSMC) and National Meteorological Centres (NMC) to provide processed data, analyses and forecast products.

The implementation, integration and efficient operation of the three core elements are achieved through the following support programmes:

(a) The WWW Data Management (WDM) programme, which monitors and manages the information flow within the WWW system to assure quality and timely availability of data and products and the use of standard representation formats to meet the requirements of Members and other WMO Programmes;

(b) The WWW System Support Activities (SSA) programme, which provides specific technical guidance, training and implementation support, the WWW Operational Information Service (OIS) and supports cooperative initiatives.

Regional Specialized Meteorological Centres (RSMC)

The WMO designation of Regional Specialized Meteorological Centre denotes that the meteorological centre has undertaken to provide specified services and products to a defined region. A RSMC is established once the need for specific, specialised services and products has been established in a region. The needs are determined by the appropriate constituent body WMO Commission for Basic Systems and considered and if appropriate approved at a bi-annual meeting of the Commission. This approval is based on the demonstration of the capability of the centre to meet its obligations to provide the agreed services and products. Approval

will dependent on the formal commitment by the government of the Member implementing the RSMC to supporting and resourcing the Centre.

There are 30 Global Data Processing and Forecasting System centres implemented as RSMCs, of which 27 have geographical specialisation, including Darwin, Melbourne, and Wellington. These centres provide regional products to assist NMSs in the forecasting of small-scale, meso-scale and large-scale weather systems. They also provide, upon request, meteorological assistance to United Nations humanitarian relief missions. There are eight RSMCs designated for the provision of transport model products in cases of man-made and other environmental emergencies, in particular nuclear emergencies, and smoke from wild-land fires and airborne hazardous substances from chemical incidents. Melbourne is the centre designated for the South West Pacific (RA V).

Of particular relevance to the present review is the six centres designated by WMO as RSMCs, with activity specialisation in tropical cyclones and located in Honolulu, La Réunion, Miami, Nadi, New Delhi and Tokyo, monitor all tropical cyclones over their assigned areas from the early stages of formation and throughout the cyclones' lifetime using surface meteorological observations, satellite data, weather radars and computers. These centres also provide forecasts on the behaviour of tropical cyclones, their movement and changes in intensity and on associated phenomena – principally storm surges and flash floods. The centres issue information for the international community, including the international media, in addition to providing advisory information and guidance to NMSs. The provision of tropical cyclone warnings for national territory and coastal waters is, in essence, a national responsibility. Such official warnings are contained in advisories issued by the NMS.

The six Tropical Cyclone RSMCs, together with five tropical cyclone warning centres (Brisbane, Darwin, Perth, Port Moresby and Wellington) which have regional responsibility, provide advisories and bulletins with up-to-date first-level basic meteorological information on all tropical cyclones, hurricanes and typhoons throughout the world. The first-level basic information comprises reliable information from a clearly defined source on the tropical cyclone's location and size and its present and forecast movement and intensity.

Annex 6: Examples of Support for Pacific Meteorological Services

Services provided by others to the pacific region in meteorology services	
Assistance with operational activities was mainly supplied by US, France, New Zealand Australia and UK. Many other donors provided project related services involving infrastructure, training and the like. These include Japan, EU, Finland and China.	
Some ongoing key support services provided	
AUSAID	Funding of Sea Level Monitoring and the Climate Prediction Projects Aid funding support (Donor coordinated) Core funding of SPREP Scholarship that now includes meteorological training
Bureau of Meteorology	Engagement is mainly through Projects : (a) Pacific Island Climate Prediction Project Phase I & II; (b) South Pacific Sea Level and Climate Monitoring Project Phase IV; (c) National Capacity Assessment: Tsunami Warning and Mitigation Systems; (d) Pacific Climate Change Science Program; (e) Pacific Adaptation Strategy Assistance Program (f) 2008 PIFS Review of Meteorological Services in the Pacific (SIS initiated); and (g) 2009 Urgent Review of Meteorological Services in the Pacific. (h) WMO Voluntary Cooperation Project (i) RA V Severe Weather Forecasting and Disaster Risk Reduction Demonstration Project (SWFDDP) Support to south PICs national aviation weather services Maintenance of Data exchange Communication on GTS Ad hoc assistance with equipment and systems

	Back up of operations particularly Vanuatu and Solomon Island in emergency situations. Provision of Forecasters to cover staffing shortfalls in the FMS Provision of meteorologists and other training
JICA	The third-country training in met services Bi-lateral technical cooperation in kind (activity based) with major portion in the past on infrastructure and equipment projects Collaborates with SPREP.
NZ AID	Core funding of SPREP Project Funding Island Climate Update (to be transferred from SOPAC to SPREP); Part funding of the 2009 Urgent Review of Meteorological Services in the Pacific.
NZ METSERVICE	Degree course in meteorology Operational Support to FMS, Cook Islands, Niue, Tuvalu, Tonga etc (primarily through contracts with NZ Aid and UK Pacific Trust Fund). Back-up for the RSMC- TCC Nadi Commercial undertakings of ad hoc assistance projects for AusAID , WMO, and other development partners.
UK Met Office	Set up the Pacific Fund to operate, manage and maintain the upper-air programs at Tarawa and Funafuti primarily and secondarily Rarotonga upper air programme
US - NOAA	Funding PI-GCOS Operational Support to former American Trust Territories under the Compact of Free Association. Ad hoc technical support (in kind) to other PICs Training (forecasting) on the "Pacific Desk" in Honolulu
WMO	Regional Association V Sub-Regional Office in Apia WMO Programmes including World Weather Watch, Voluntary Cooperation Programme, Tropical Cyclone Programme etc.

Annex 7: Background to RMSD

Background information on Meetings of Pacific Island Regional Meteorological Services Directors, the WMO Sub-Regional Office and the Meteorology-Climatology Officer

The meetings of the Pacific Meteorological Services Directors (RMSD) resulted from recommendations contained in the "Feasibility Study on Climate Monitoring and Impacts in the South Pacific"[16]. This 1991 study had its origin at the Nineteenth Meeting of the South Pacific Forum at Nuku'alofa in 1988. Concerns about climate change expressed by the meeting communiqué in the following terms:

> "The Forum expressed concern about climatic changes in the South Pacific and their potential for serious social and economic disruptions in countries in the region. The Forum welcomed the initiative taken by the Prime Minister of Australia for a feasibility study into establishing a network of stations to monitor the effects of climatic changes in the region and in the light of the outcome of the study to fund the establishment of such a network."

That feasibility study, besides recommending the establishment of the sea level monitoring program, recommended a second, supplementary investigation on meteorological aspects of the "greenhouse effect". Through a complex set of negotiations a memorandum of understanding was signed between the World Meteorological Organization (WMO) and the Australian International Development Assistance Bureau (AIDAB) to undertake the feasibility study

That study coincided with a period of flux for meteorology in the region (which is reflected in the report of the study entitled "The Changing Climate in Paradise" – often referred to as the "Paradise" report). The Pacific Island states, developing as independent nations, had to address the many social and economic pressures that. National Meteorological Services had an important role to play in addressing these challenges, not the least of which was concern about climate change. Meteorological Services at that time were in general small and rather insular, concentrating mainly on aviation needs and forecast and warning services. Indeed some did little more than make meteorological observations and rely on external providers for their meteorological requirements. The "Paradise" report identified a range of needs for the development of meteorology and particularly Meteorological Services and their regional cooperation. These were presented as a series of seven "Projects".

[16] Brook, R.R., R.E.Basher, J.P.Bruce, S.A.Parsons and M.E.Sullivan (1991), *The Changing Climate in Paradise*, Bureau of Meteorology, Melbourne 145pp.

Project 4, “Infrastructure Support for Climate Monitoring”, addressed aspects of Meteorological Services which at that time limited the effectiveness of their climate services. It included a sub-project “Regional Meetings of Directors”. The sub-project had the objective of providing a foundation for regional cooperation in climate monitoring and climate data services. It was proposed that the meetings be held annually over a period of four days at a venue within the region. Presentations and training on climate issues and climate services management issues were to be part of the meetings. The proposal required the meetings to be funded at a level to cover travel and per diem and all Pacific Island Countries would be encouraged to be represented. The Meetings were to have an informal, consultative style and not have official intergovernmental status.

Project 5, “Regional Impacts”, addressed impact assessment and response formulation on a regional basis. The establishment of a Meteorology-Climatology Officer (MCO) within SPREP was one of its sub-projects. The responsibility of the MCO was to advise and coordinate climate studies in the SPREP region. The MCO was to be aware of the activities of national climate officers, their problems in data analysis and application to environment and economic problems and resultant local solutions. The MCO was to facilitate the sharing of relevant advice and information, organise the annual RMSD meetings and facilitate information sharing. Also the MCO was to collaborate with the SPREP Climate Change Officer and facilitate closer cooperation of national meteorological agencies with those responsible for environmental and economical development.

In 1991 the SPREP Meeting agreed, at the behest of SPREP members’ National Meteorological Services, (NMS) to establish the Regional Meetings of Meteorological Service Directors (RMSD) for the Pacific as an intergovernmental group meeting. The objective of the RMSD meeting was to provide the foundation for regional cooperation in weather and climate monitoring and data services. It was also agreed, in order for the RMSD structure to be successful, that the need existed for a full-time SPREP Meteorology-Climatology Officer to act as a coordinator and adviser for meteorological and climate activities in the region as recommended in the Feasibility Study.

The first fulltime SPREP MCO was recruited in 1993 and funded by the Commonwealth Secretariat. The RMSD meetings began on a continuing basis in 1994 and the group benefitted greatly by having the MCO in place through better coordination, collaboration, and cooperation on a wide variety of issues including climate services, backup arrangements for meteorological operations, training, capacity building, etc.

In August 1996 the MCO ceased being a full-time position dedicated to these critical functions described above. Instead, it was reverted to a part-time position which was covered by extra-budgetary resources. At that time, the U.S. Department of Energy’s Atmospheric Radiation Measurement (ARM) program funded a full-time position at the Secretariat to help administer the ARM program’s observing sites in Nauru, Papua New

Guinea (Manus Island) and Australia (Darwin). This officer also performed the MCO function on a part time basis. This arrangement ceased when the ARM program stopped funding the position and returned its duties to U.S.-based personnel.

Beginning in 2002, the U.S. Global Climate Observing System (GCOS) Program began providing extra-budgetary funding to SPREP in order to fund a regional GCOS program officer for the region. This U.S. GCOS funded officer was also tapped to serve as a part-time MCO for the region.

In part to address the problem of not having a full time MCO, and since a majority of Pacific Island NMSs of SPREP members had become Members of the World Meteorological Organization (WMO), a memorandum of understanding was agreed between WMO and the government of Samoa in 1997 which established a WMO Sub-Regional Office for its Region Association V (South West Pacific) co-located at the SPREP Secretariat. This Office was expected to take over some of the role of the MCO, while the MCO was to concentrate on providing members relevant advice on climate change policies and information. This arrangement was endorsed by both organisations in the 1999 "Strategic Action Plan for the Development of Meteorology in the Pacific"[17] and the "Needs Analysis on Pacific Meteorological Services" published by SPREP in 2000[18]. However in practice the work of the Sub-Regional Office has been fully occupied on WMO activities.

[17] Bureau of Meteorology 1999. *Strategic Action Plan for the Development of Meteorology in the Pacific Region 2000-2009*, Bureau of Meteorology Melbourne. 31pp

[18] R. Krishna, F. P. Lefale, M. Sullivan, E. Young. C. Pilon, C. Schulz, G. Clarke, M. Hassett, S. Power, R. Prasad, T. Veitch, K. Turner, E. Shea, H. Taiki and R. Brook, 2001.A Needs analysis for the strengthening of Pacific Islands Meteorological Services: meeting the challenges. SPREP Apia, Samoa. 96pp.

Annex 8: Fiji Meteorological Service – Financial information

Part 1: Expenditure Accounts 2006 - 2010

Head No. 40 - MINISTRY OF WORKS AND TRANSPORT

Department - FIJI METEOROLOGICAL SERVICE

(Expenditure Accounts Number: 40-2-1)

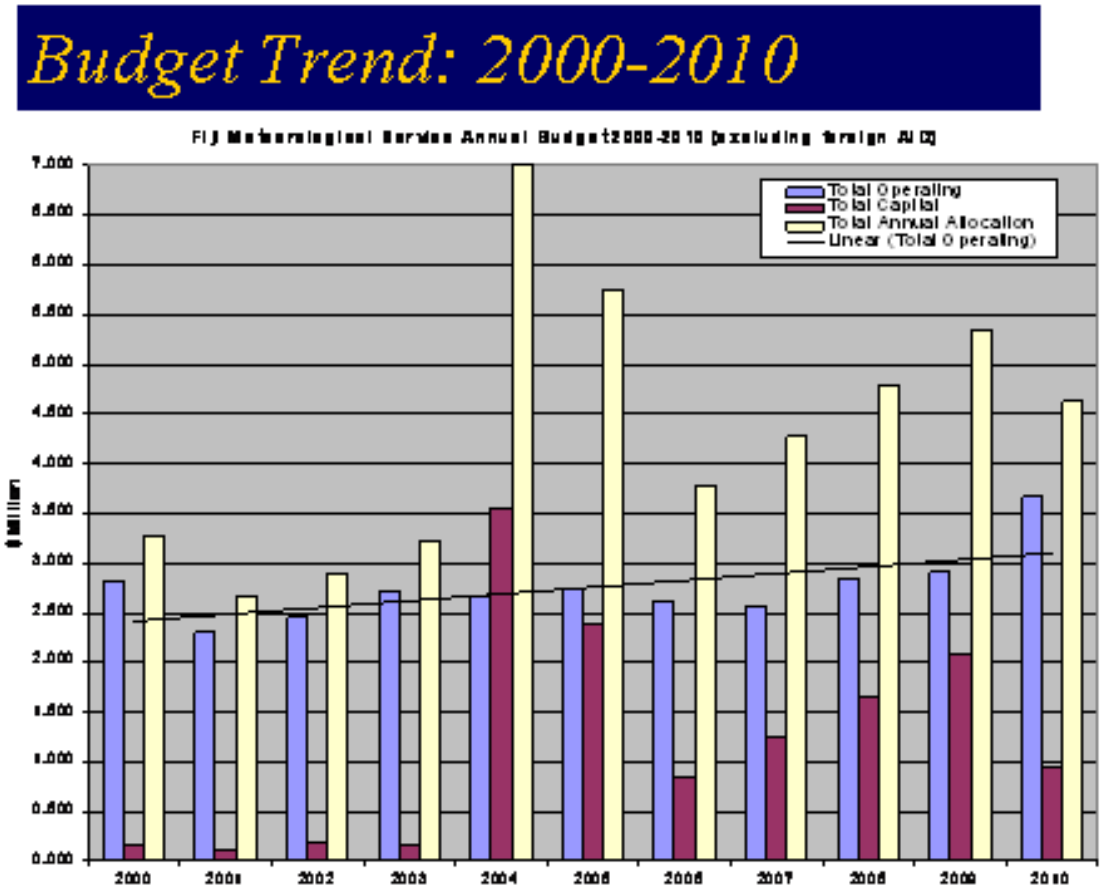
	BUDGET $000				
	2006	**2007**	**2008**	**2009**	**2010**
1. Established Staff	1978.50	1978.50	1751.80	2080.60	2105.80
2. Government wage Earners	60.70	60.70	88.40	74.80	76.90
3.Travel and Communications	184.50	184.50	212.30	196.30	199.00
4. Maintenance and Operations	357.20	357.50	298.10	309.30	518.00
5. Purchase of Goods and Services	22.80	22.50	202.20	232.20	252.20
6. Operating Grants and Transfers	18.30	22.00	17.50	15.20	17.50
8. Capital Construction	30.00	0.00	89.00	966.50	220.00
9. Capital Purchase	0.00	0.00	1329.00	100.00	730.00
13. Value Added Tax	329.20	325.50	290.90	352.30	239.90
TOTAL	**2981.20**	**2951.20**	**4279.20**	**4327.20**	**4359.30**

Revenue collected/ AFL 600

Note

Revenue collected is only from 2009 confirmed amount.

Part 2 Budget Trend 2000 - 2010



Annex 9: Persons Consulted

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Kien Teteki	ditto ditto	Met Observer

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Annex 10: Qualifications and Training for Personnel in Pacific Meteorological Services

The staff of Meteorological Services must include a wide range of skills and qualifications including administrative, scientific, engineering and technical. For the continued viability of the Service it is necessary to ensure that there is an appropriate training strategy. Some of the staff will need to have qualifications that are specific and often unique to the provision of meteorological services. These are particularly in the areas of weather forecast and warning and meteorological observations. Other positions, such as information technology officers, engineers, engineering technicians and climatologists also require training in aspects of their profession unique to the services' activities.

This Annex provides a summary of the meteorological training situation for Pacific Islands Meteorological Services.

WMO Defined Qualifications for Meteorologists and Meteorological Technicians

WMO has defined the qualifications and guidelines for the education and training of personnel in meteorology in its document WMO-no. 285[19]. Specifically it defines two levels:

> **Meteorologist** – a person who holds a university-level degree or equivalent; has acquired an appropriate level of knowledge of mathematics, physics, chemistry and computer science, and has completed the Basic Instruction Package for Meteorologists. Future meteorologists, upon completion of the Basic Instruction Package for Meteorologists program, enter the professional world and, after an orientation period and on-the-job training, they gradually assume operational duties in weather analysis and forecasting, climate monitoring and prediction, or other relevant applications. Some meteorologists will become involved in consulting, directing, decision-making and management; others will undertake research and development or teaching activities, etc.
>
> **Meteorological Technician** – a person who has completed the Basic Instruction Package for Meteorological Technicians program. Meteorological Technicians duties

[19] Drãghici, I. F. , G. V. Necco, R. W. Riddaway, J. T. Snow, C. Billard and L. A. Ogallo 2001, *Guidelines for the Education and Training of Personnel In Meteorology and Operational Hydrology Volume I: Meteorology, Fourth Edition,* WMO 285, Geneva 123pp

include carrying out weather, climate and other environmental observations; assisting weather forecasters in the preparation and dissemination of analyses, forecasts, weather warnings, and related information, products and services. NMSs typically employ many other types of technicians, such as mechanical, electrical and electronic technicians to install and maintain equipment such as ground receivers for aerological observations, automatic weather stations, weather radar or telecommunication equipment.

The three qualification requirements for a **Meteorologist** can be met through completion of one of the following two programs:

(*a*) *University-level degree in meteorology*

An adequate prerequisite knowledge in mathematics, physics and chemistry, at the level requisite for university admission into the corresponding faculties, is required before starting the Basic Instruction Package for Meteorologists. Normally, the Basic Instruction Package for Meteorologists program would require four academic years, but the actual period may vary between academic institutions. Typically, the first half of the program will be focused on fundamental science education, while the second half will be dedicated essentially to the meteorological education, which may be specialised along three major streams: Weather, Climate and Environment. The main components of this complete Basic Instruction Package for Meteorologists are:

(i) Requisite topics in mathematics and physical sciences: mathematics and computational science, physics, and chemistry, at the level of 'Major' in physical science faculties. Required complementary topics: communication and presentational techniques and international communication languages;

(ii) Compulsory topics in atmospheric sciences: physical meteorology, dynamic meteorology, synoptic meteorology (the main subject for the Weather stream), climatology (the main subject for the Climate stream), and atmospheric chemistry (the main subject for the Environment stream);

(iii) Elective fields of specialisation in meteorology: aeronautical meteorology, agricultural meteorology, atmospheric chemistry, climate monitoring and prediction, mesoscale meteorology and weather forecasting, radar meteorology, satellite meteorology, tropical weather and climate, urban meteorology, and air pollution; additional fields are listed in section 3.4. Besides the basic requirement to complete topics (i) and (ii), students wishing to obtain an early specialisation may also deepen one optional subject from among items (iii). The final degree award may specify the acquired specialisation.

(*b*) *Postgraduate diploma or master degree in meteorology*

A university-level degree in selected scientific or technical domains such as mathematics, physics, chemistry, electronic or geo-sciences engineering is required along with knowledge of mathematics, physics and chemistry at the level of the complete Basic Instruction Package for Meteorologists. The instruction components of this condensed Basic Instruction Package for Meteorologists program are essentially similar to those of the complete Basic Instruction Package for Meteorologists, but the pace of their delivery may be considerably faster, particularly when students already possess the required standard in mathematics, physics and chemistry. Normally, a condensed Basic Instruction Package for Meteorologists would require one or two academic years.

WMO Members have used various education and training approaches to qualify their **Meteorological Technicians**: from formal education in a technical school or college with specific training programmes in meteorology, to simple vocational and/or on-the-job training in meteorological observations and measurements. To become a Meteorological Technician it is necessary to complete the Basic Instruction Package for Meteorological Technicians. This requirement can be met through completion of one of the following two programs:

(*a*) *Certificate or attestation of technical/vocational meteorological training*

After completing education at the general, elementary or compulsory school, there is a requirement for continuing education in a technical or vocational school where the instruction program includes at least one semester of training in meteorology. This instruction should be supplemented by an extensive period of practice in making meteorological observations and measurements, and in operating information and communication technology. The main components of the complete Basic Instruction Package for Meteorological Technicians program are as follows:

(i) Requisite topics in basic sciences: mathematics, physics, and chemistry at the level of secondary school education. Basic communication skills;

(ii) Compulsory topics in general meteorology: introductory physical and dynamical meteorology, elements of synoptic meteorology and climatology, meteorological instruments and methods of observation;

(iii) Elective topics in operational meteorology: synoptic observations and measurements, other specialised observations and measurements, remote sounding of the atmosphere, and aeronautical meteorology for technicians.

(*b*) *Post-secondary school-level meteorological training certificate or diploma*

In case there is pre-requisite knowledge in mathematics, physics, and chemistry at the level of secondary school education (minimum 12 years of schooling), it is sufficient to complete a condensed Basic Instruction Package for Meteorological Technicians. The components of this program are essentially the same as for the complete Basic Instruction Package for Meteorological Technicians, but the pace of their delivery may be faster. Broadly, a condensed Basic Instruction Package for Meteorological Technicians may take between a few months and one year, depending on the desired qualification.

These definitions replaced earlier ones in 2001. They were fully implemented by 2005. In the gradual implementation of this system of classification, there has been found to be some ambiguous interpretation of the Guidelines in respect of the qualifications of some meteorological personnel who trained under the provision of the former classification, particularly those formerly designated as Class II. The former Class II meant university-level graduate personnel in some countries, but only technician-level personnel in other countries. Under the current WMO classification, only the former Class II possessing a degree (or equivalent education) would be reclassified as Meteorologists; the others would be referred to as Meteorological Technicians.

Training and Qualification Requirements for Aeronautical Meteorological Personnel

A specific issue arises with respect to provision of weather forecasts for the aviation industry. Under International Civil Aviation Organization (ICAO) rules all NMSs providing aviation products are required to implement Quality Assurance programs (ISO 9000) with respect to their aviation services. This in effect required Forecasters to be trained to the WMO standard of meteorologist. In some Services “old style” Class II qualified staff provided aviation forecasts and as such do not meet the ICAO Quality Assurance standards.

The training and qualifications of staff involved in servicing the aviation industry presents a significant challenge for the Pacific Island NMSs. WMO produced a Supplement to WMO No. 285[20] specifically to address training for aeronautical meteorological personnel. While

[20] World Meteorological Organization 2006, *Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology Supplement no. 1: Training and*

WMO-No. 258 explicitly acknowledges, *"in practice mid/senior level technicians may perform duties similar or overlap with duties of entry/mid-level meteorologists"*, the training and qualifications requirements for weather forecasters are currently only explicitly listed under the Meteorologists sections. There is consequently a possibility to misinterpret the position of Meteorological Technicians currently assigned independent weather forecasting responsibilities, but who were initially trained to the specifications set out for former Class II personnel. However, even in those cases where the changeover from the former to the current classification may go beyond the recommended time limit (1 January 2005 2), the spirit of the above provisions will stand: meeting the competency requirements stipulated under WMO No. 258, "*Weather analysing and forecasting*" represent a mandatory prerequisite for any person assuming weather forecasting responsibilities, irrespective whether that person is an entry-level Meteorologist or an experienced Meteorological Technician.

Training Facilities in the South Pacific

There are a number of training programs available to staff of Pacific Island Meteorological Services. These range from the formal Meteorologist and Meteorological Technicians through other specialised vocations such as electronic and mechanical engineering, information technology, human resources and financial administration. Participation in these programs can often be supported by fellowships, scholarships, internship and similar arrangements funded by WMO, international development agencies such as USAid, JICA, AusAID, NZAid or the NMSs themselves. The main training programs in the region are summarised in the following.

Fiji

The Fiji Meteorological Service has provided training programs for meteorological technicians from Pacific Island Meteorological Services since 2001. The programs were undertaken with support from Japanese International Cooperation Agency's (JICA) Third Country Training Program, which assists other Pacific Islands in the region. JICA provided funding for these courses in two phases from 2001 to 2005 and 2005 to 2010. A submission has been made by the Fiji Meteorological Service to extend the program a further three years. Over the period Meteorological Technicians from Nauru, Kiribati, Tuvalu, Tonga, Samoa, Solomon Islands, Niue, Papua New Guinea, Cook Islands, Vanuatu, and Fiji have received training. The courses conducted were as follows:

- Meteorology Level II (2001 for four weeks)

Qualification Requirements for Aeronautical Meteorological Personnel. WMO 285 Geneva 22pp.

- Basic Forecasting (2002 for four weeks)
- Basic Observers (2003 for eight weeks)
- Meteorology Level II (2004 for four weeks)
- Meteorology Level IV Course(2005 for 8 weeks)
- Operational Forecasting Course(2007 for 4 weeks)

A one week course on Climate Monitoring and Prediction was a conducted in with as part of the Pacific Island Climate Prediction Program (PICPP) with support from JICA and AusAID. Altogether 82 meteorological technicians (observers and forecasters) have attended these training courses, and twelve are expected to participate in the February 2010.

Fiji Meteorological Service also has provided on-the-job attachment training to staff from Tonga, Niue, Samoa, Cook Islands and Vanuatu in the RSMC Nadi.

United States (Hawaii)

The National Weather Service (NWS), Pacific Region training for Meteorologists is undertaken through NOAA's National Weather Service Student Career Employment Program which participants work experience directly related to their academic field of study as "student interns". The program provides formal periods of work and study while attending school. Participants in this program may be eligible for permanent employment after successfully completing their education and work requirements.

This program is used to train staff in the NWSs in the Federated States of Micronesia, the Republic of the Marshall Islands and Palau. These services have a special relationship with the NWS through the "Compact of Free Association" between the US and these nations.

The tertiary study is undertaken at the University of Hawaii whose Bachelor of Science (B.S.) in meteorology is designed to prepare a graduate for professional employment as a meteorologist. With the appropriate choice of courses graduates can satisfy the requirements for civilian employment of the Federal meteorological agencies. A new graduate may be commissioned as a meteorological officer in the Air Force or Navy or appointed to a meteorological internship in the National Oceanic and Atmospheric Administration (NOAA). A few graduates make careers in computer science. In addition to the fundamental courses in mathematics, physics, chemistry, theoretical meteorology, instruments and observations, and analysis, students may complete their meteorological requirements in a number of ways, and may emphasize, for example, tropical meteorology, climatology, statistics, or computer applications. Forty-three credit hours are required in the major field selected from among meteorology courses and from appropriate courses offered

in engineering, geography, geology and geophysics, information sciences, mathematics, oceanography, physics, and soil science.

Although this course of action is primarily for the Micronesian and NWS staff, it may present an opportunity for other Pacific Island Services to obtain WMO "Meteorologists".

The Pacific Desk

The "Pacific Desk" is a six week training program held at the Central Pacific Hurricane Center, Honolulu, Hawaii. The program began in 2001. It aims to train international forecasters from WMO Region V (Southwest-Pacific) and the RA II (Asia) portion of that includes island nations from the South Pacific. It is tailored to meet the operational needs of a modern forecast office, and to make the best use of available tools and objective forecasting techniques in applied meteorology, hydrology and climate through a training curriculum covering diverse subject such as jet stream dynamics, streamline analysis, atmosphere stability, air mass boundary detection and identification, analysis of constant pressure charts, numerical weather prediction, and PC based aid. The course is over a six week period with only one student participating at any one time, so that there is one-on-one tuition. The program trains six or seven forecasters each year. However it is planned that this will be altered to having two students per course. In addition up to three countries are visited per year by the Pacific Desk Instructor. During these visitations, the Pacific Desk Instructor conducts refresher training for previous Pacific Desk interns; verify the correct setup of the appropriate computer and update as necessary; conduct a two day general training for the National Meteorological Services (NMS) staff; and make necessary modifications to the present training plan.

New Zealand

The Meteorological Service of New Zealand Ltd (also known as MetService) has a training program for meteorologists in association with the Victoria University in Wellington. The Meteorologist course is designed to prepare trainees for operational forecasting. It includes the Graduate Diploma in Science (Meteorology) at Victoria University. MetService trains meteorologists to WMO Meteorologist standard by recruiting people who have completed, or are in the final year of, a university degree (BSc minimum) from any recognised university but usually from one of the six main NZ universities. On completion of their degree they do a Condensed Basic Instruction Package for Meteorologists (Condensed BIP-M). The Condensed BIP-M is a one-year course run concurrently at MetService and Victoria University of Wellington (VUW) with specialised meteorological training (reference: WMO-No.258 "Guidelines for the Education and Training of Personnel in Meteorology and Operational Hydrology" Vol. 1). The taught part of the course runs for 42 weeks leading to a Postgraduate Certificate in Meteorology at Victoria University, but some students then do a three-month research project that results in a Postgraduate Diploma in Meteorology.

New domestic trainees are recruited in the year prior to the Condensed BIP-M, and employment takes effect from day one of the course, late January or early February. Pacific Island students enter training at about the same time as domestic students, provided they have a suitable academic background and their NMHS has arranged for the necessary funding (tuition fees at MetService and VUW, travel and accommodation). In past years NZAid has fully supported Pacific Island students.

MetService runs the Condensed BIP-M about two in every three years, and usually have spaces for suitable Pacific Island students when the course runs. For example, since 2000 they have run courses in 2001, 2002, 2004, 2005, 2006, 2008, 2009. However are not running a course in 2010 and probably will not in 2011.

MetService does not run routine training courses for Meteorological Technicians as observations in NZ are mostly automated.

Australia

The primary objective of the Bureau of Meteorology's training program is to meet current and emerging needs for a workforce with appropriate professional, specialised technical and management skills. A secondary objective is to provide specialised meteorological training to the Defence Force and to overseas National Meteorological and Hydrological Services (NMSs). To meet these objectives the Bureau of Meteorology Training Centre (BMTC) provides:

- specialised postgraduate meteorological training in operational forecasting for new staff of the Bureau, and through agreement, to the Royal Australian Navy (RAN) and overseas NMSs, leading to a Graduate Diploma in Meteorology;
- technical and general training in specialised meteorological support duties and systems for new Bureau technical staff, and through agreement, to trainees from overseas, Defence Force personnel and approved external participants;
- in-service training to maintain professional and technical skills;
- management and development training;
- curriculum development and the development and delivery of new courses for all training activities, including 'Computer Aided Learning' and web-based modules; and
- consultative services on the education and training aspects of major new Bureau projects.

The BMTC also manages the operation of the National Meteorological Library. In support of the Bureau's corporate strategic objective of commitment to university education in meteorology and related fields, the BMTC maintained strong links with several tertiary education institutions, in particular with Monash University, RMIT University, La Trobe

University and the University of Melbourne. These included reciprocal lecturing arrangements on specialised meteorology courses and provision of a short practical meteorology course run for final year and postgraduate atmospheric science students.

The Bureau maintained a strong involvement in the World Meteorological Organization (WMO) Education and Training Program. During 2008-09 financial year five staff members of national meteorological services of Pacific Island nations and one each from Singapore and Hong Kong commenced the Bureau's Graduate Diploma in Meteorology, joining the 14 Bureau, five RAN and one RNZN student.

In the past BMTC did not charge students from other NMSs tuition fees. However, following a government review, after 2010 BMTC will be charging for tuition fees based on the full cost to the Bureau of providing the training. For Pacific Island students fortunately mechanisms exist to help with providing funding (e.g. local or WMO scholarships, AUSAID and contributions from the Bureau's own budget).

The Bureau's Graduate Diploma of Meteorology is accredited with the Victorian Registration and Qualifications Authority and is a world renowned course with a long history of overseas attendance. The course must maintain accreditation in order for overseas students to attend. The accreditation is a rigorous process. The course's integrity is also maintained through a Course Advisory Committee which consists of a number of stakeholders including a number from the Tertiary sector. The training courses for Meteorological Technician have components whereby the trainees obtain accreditations for specific activities to satisfy statutory requirements (e.g. Electrolyser hydrogen training, Hazardous area training, Working at heights, first aid etc.), but are not accredited courses per se.

No Pacific islanders have attended the BMTC Meteorological Technician courses. As these courses are not accredited they are not eligible for funding from agencies such as AusAID.

Philippines

The only WMO Regional Meteorological Training Centre (RMTC) in RA V is in the Philippines. It offers training for meteorological personnel in affiliation with University of Philippines and includes meteorologist qualifying. The training has a strong bias towards Northern Hemisphere.

To be designated as a WMO Regional Training Centre (WMORTC), institutions have to undertake training in meteorology, hydrology and related sciences satisfying the following criteria:

(a) The Centre should be established only to meet the expressed requirements of two or more of the Members that cannot be met by existing facilities;

(b) The Centre should be designed to meet the requirements of the Region, as expressed in a decision of the regional association;

(c) The Centre should be within the particular Region concerned;

(d) The following conditions should apply to each Centre:

- The Centre should be open to students from all countries in the Region and, upon request, from interested countries in other Regions,
- The education level of the various courses of instruction carried out at the Centre should be consistent with the guidance material issued by WMO,
- The Centre should have processes in place to identify needs and to evaluate the training provided,
- The Centre should have adequate buildings and training facilities, and have the necessary equipment and facilities for an efficient and effective use and exchange of training aids and modules based on modern technology,
- The Centre should have competent instructors in terms of both their technical ability and training skills, and
- The Centre should have adequate arrangements for administration, governance, planning and self assessment;

(e) The establishment and maintenance of the Centre will largely be the responsibility of the host country.

Solomon Islands

The Solomon Islands Meteorological Service Training School trains Meteorological Technicians (sometimes designated as Meteorological Observers) to meet the Services staffing requirements. The course is based on the WMO syllabus and trainees graduated with the former WMO Class IV Observer Certificate. It is of seven months duration and is run once every two or three years depending on the manpower needs of the SIMS. The entry qualifications are Form Six (Pacific Senior School Certificate) with good grades in Maths and Physics. Although no Pacific Islanders other than from Solomon Islands have enrolled in the School yet there is a possibility that these course could be run for other Pacific Islands countries. The course fees would be about SBC$15,000.

Annex 11: Assessment of Options for Specialised Meteorological Services

Preliminary Comment

For the purpose of assessing the options for best delivery of specialised meteorological services and consideration of other service providers, the review team has to make some assumptions about which of the following services might potentially be delivered by another service provider:

i Cyclone warnings
ii Other regional services (aviation, maritime)
iii Services to other PICS
iv National services for Fiji

Under the current arrangements the FMS delivers this whole bundle of services. The primary focus for concern has been the delivery of cyclone warning and aviation services delivered by RSMC Nadi; the first of these is integral to the RSMC role of Fiji Meteorological Services, while the second is not.

The Team has approached this analysis within the following broad scenario:

- A Fiji National Meteorological Service must be maintained, delivering, at least, its national meteorology needs
- Other SIS NMS will need ongoing support (from FMS or elsewhere), but may develop their own capacity to prepare national forecasts in future
- Cyclone, aviation and maritime services could potentially be provided from FMS or elsewhere

With this scenario in mind, the team reviewed options for improved delivery of cyclone, aviation and maritime services. To do this we firstly identified a set of high level criteria (table 1 below).

Table 1 High Level Criteria for Assessment	
Effectiveness	Does it address the core issue – skills and resources to support delivery of services
Cost	Comparative cost
Sustainability	Funding; human resources
Accountability	to the people it serves
Flexibility	to adapt to future change
Smooth transition	Avoiding major disruption to services or institutions

The review team then used these criteria to assess the merits of six alternative options. These options have been developed from a combination of sources, including suggestions made to the team in the course of consultations. Further elaboration is provided on the preferred option has identified through this process.

Option 1 – Status quo

Description

Fiji Meteorological Services providing services under its current structure and funding arrangements (also discussed in main body of report).

Assessment: Option 1 – Status Quo	
Effectiveness	Has been effective and resilient within its capacity; but has clear weaknesses in terms of institutional setting; for example in relation to recruitment, retention and conditions of employment for staff.
Cost	Cost relatively low, largely due to low salaries relative to global market for forecasters. Base funding is provided by the Fiji Government, but there is also significant support from outside agencies/development partners.
Sustainability	Depends on ongoing support from Fiji Government and outside agencies/development partners.
Accountability	Accountable through Fiji government. No role for other regional Meteorological Services in governance. Lack of clarity about delivery of additional functions (e.g. services provided directly to other SIS National Meteorological Services).
Flexibility	Ability to respond (e.g. to new technology) depends partially on the support of development partners
Smooth transition	None necessary
Other comment	The Fiji Government has signalled its commitment to ongoing financial and institutional support. Sustainability also relies on continuing support from development partners, including other NMS.

Option 2 – Re-structure as stand-alone government entity

Description

The Fiji Government has signalled its intent to re-structure the Fiji Meteorological Services as an entity outside the core public service. As yet no detailed planning has been undertaken (that the Review team is aware of) to determine the final form of the FMS. In particular the Team is not aware of any specific discussion on costs or funding, other than the expectation that FMS would not fall under the Public Service Commission's controls on salary and conditions of employment.

Our comments below are made against that background.

Assessment: Option 2 – Re-structure as stand-alone government entity	
Effectiveness	Other NMS are structured as stand-alone government entities of one kind or another. This institutional arrangement would not limit its ability to perform effectively, and may enhance it.
Cost	Depends on the way the agency is set up, including the way transfer of assets is handled and one-off establishment costs. A key issue is salary rates and conditions for staff. If these are to be raised/improved in order to reduce the disparity with other markets, then costs will increase, and (significant) additional funding will be necessary. There may be some rationalisation in other areas that offset additional costs. See further discussion below.
Sustainability	Potentially improves sustainability of human resources, providing additional funding is committed initially and on an ongoing basis
Accountability	The Governance structure can be designed to provide for national and regional input into governance of the agency.
Flexibility	The Governance structure can be designed to allow appropriate response to changes in circumstances and technology, subject to funding and outside support.
Smooth transition	Involves implementing an existing government proposal; some transitional issues and costs. Maintains current situation where specialised regional services are provided by FMS.
Other Comment	The Fiji Government has signalled its commitment to ongoing financial and institutional support, and for restructuring to improve the effectiveness of the agency. There are models available for restructuring and the FMS would remain an agency of the Fiji Government. Potentially an effective option; See elaboration below on certain issues.

A note on costs

The issue of staff salary and conditions of service has been repeatedly raised as being important in the recruitment and retention of skilled staff.

If salary rates are increased, it follows that the direct cost of employing staff will also increase. To illustrate the impact of different salary scales, Table 2 below shows that there is a US$67,000 difference in annual salary for a senior forecaster working in Australia (BoM) compared to the Fiji Meteorological Service under current arrangements. If this rate were applied across the board to forecasters at FMS, an additional US1$million (approx) would be required to find the increase (15 senior forecasters at US$67,000 = US$1,005,000).

Table 2 Comparative Salary scales: Senior Forecaster or equivalent

Agency	Currency	Salary (middle of range)	Exchange rate*	US$ equivalent	**US$ difference c.f. Fiji**
FMS (Fiji)	Fiji Dollar	32,000	0.524	16,768	0
Fiji School of Medicine (senior lecturer)	Fiji Dollar	75,000	0.524	39,300	**22,532**
BoM (Australia)	Australian Dollar	92,000	0.914	84,088	**67,320**
Meteorological Service of New Zealand Ltd	New Zealand Dollar	86,000	0.726	62,436	**45,668**
CROP (SPREP Grade J midpoint 2010)	Special Drawing Rights	44,303	1.476	65,391	**48,623**

* As at January 2010: source International Monetary Fund (IMF) website: www.imf.org

A more moderate scenario may be to align salaries with the mid-point between the current FMS scale and the comparative rate for regional agencies under the CROP scale (which aligns closely with the Fiji School of Medicine Senior Lecturer scale). Using the same example as above, this would involve increased annual costs of approximately US$350,000 (15 senior forecasters at US$23,000 = US$345,000). In each case the figure is illustrative only; it doesn't include other staff (e.g. the Director), allowances, or attendant employment costs (e.g. superannuation, NPF) and therefore underestimates the additional costs.

Conversely the current rate of turnover also has high costs; in terms of recruitment and training (although this has generally been funded through scholarships provided by development partners) as well as loss of capacity, stress on remaining staff etc. Viewed in this way, increased direct staff costs will be offset by reduced recruitment and training costs, increased institutional capacity, and improved staff morale.

At the same time the transition to a different organisational structure could include some rationalisation across the agency leading to reduced costs in these areas.

Option 3 Delivery of Services by another Pacific Island NMS

Description

It is possible to envisage that specialised services could be provided by another Pacific Island National Meteorological Service.

Option 3 – Delivery of Services by another PIC NMS	
Effectiveness	The capacity of other NMS is significantly less than that of FMS. Considerable improvement would be needed in terms of infrastructure, equipment and human resources for another Pacific Island NMS to assume the role,
Cost	Substantial establishment costs would be necessary, as well as ongoing operational costs. Commitments would be needed by the host government and development partners with respect to funding.
Sustainability	All the same issues that have been raised in relation to FMS would arise in another Pacific Island country (e.g. funding and human resources); perhaps more so given the generally lower baseline of infrastructure, equipment and human resources.
Accountability	Depends on institutional structure of the NMS, but should be no more complex than the current arrangement.
Flexibility	Depends on institutional structure of the NMS.
Smooth transition	A transfer of responsibilities would involve the agreement of a number of parties (including WMO, ICAO and the national governments involved). Significant lead-time would be required.
Other Comment	Transferring services to another Pacific Island NMS offers no obvious advantage over the status quo, and involves considerable additional costs.

Option 4: Regional Agency – Fiji Government hybrid

Description

An option to address the terms and conditions of employment for key staff is to create a hybrid arrangement between FMS and a Regional Agency. Under this scenario staff in key occupational categories (such as forecasters) would be employed by the Regional Agency (under standard CROP conditions) but for all operational purposes work within the structures of the Fiji Meteorological Service (e.g. by way of secondment).

Option 4 – Regional Agency – Fiji Government hybrid	
Effectiveness	Could be an effective mechanism for delivery of services.
Cost	Significant additional staff costs would be incurred (as illustrated in table 2). The costs to the Fiji Government for operating FMS would be likely to fall (depending on how the arrangement was structured). A key question would be how staff employed by the Regional Agency would be funded.
Sustainability	Dependant on commitment of Fiji Government and development partners
Accountability	There would need to be further consideration of how a dual system might work in order to avoid (or manage) dual accountabilities for staff employed by the Regional Agency. Potential for split accountability needs to be considered in the design. Particular attention would need to be given to the role of the Director under any hybrid arrangement. In the case of secondments, accountability would be through FMS to the Fiji Government, assuming the current organisational structure for FMS. Secondments could be accommodated under a restructured FMS discussed in option 2; which the Review team recommend incorporates PIC representation in the governing body.
Flexibility	Acceptable, though with added factor of dual agency agreement to certain decisions.
Smooth transition	Functions would continue to be run through existing FMS facilities. FMS organisational structure may need to be reviewed and arrangements for accountability agreed between FMS and the Regional Agency.
Other Comment	This arrangement retains the primary structures and accountability of FMS and the Fiji Government; but provides a mechanism to recognise the specialised regional role though the Regional Agency staffing. "Who pays?" remains a key question. It opens the possibility of open recruitment (i.e. from the global market) of specialist staff to work within FMS.

Option 5 Full Delivery through a Regional Agency

Description

Going beyond a hybrid arrangement; responsibility for specialised regional services could transferred wholly to a Regional Agency. This could be co-located with FMS, or could be sited elsewhere.

Option 5 – Full Delivery by an existing Regional (CROP) Agency	
Effectiveness	Could be an effective mechanism for delivery of services.
Cost	Costs would be as for a Regional Agency in terms of staff and overheads. Depending on where it is sited, additional infrastructure and equipment costs may be incurred.
Sustainability	Depends on Regional Agency budgeting decisions/commitments unless funded separately. Either way dependent on Regional Agency membership and development partners for resources / funding.
Accountability	Would involve clear accountability through the Regional Agency to its Governing Body; possibly through a specialised sub-committee or similar arrangement. Separates Specialised Regional Services from National Meteorological Services; creates additional agency role outside the current WMO /ICAO systems. FMS would function separately and be accountable, as now, to the Fiji Government. Fiji Government costs for operating FMS would reduce, reflecting the fact that it would only be providing national services.
Flexibility	Acceptable; subject to Regional Agency governance decisions.
Smooth transition	Involves removal of functions from FMS. May involve (re)negotiation of host agreement between Regional Agency and host country.
Other Comment	Addresses the issue of staff salaries and conditions through employment under CROP conditions. A further, more costly, possibility within this option is to create a new Regional Agency specifically to deliver specialised regional Meteorology and climatology services. This would depend on the willingness of participating countries to establish and fund such an agency.

Option 6: Aus/NZ/France/US

Description

The role of running specialised regional services could be transferred to the NMS of a developed country in the region: Australia, New Zealand, US or France.

Option 6 – Aus/NZ/France/US	
Effectiveness	Provides access to developed country resources.
Cost	Costs would be as for the prevailing costs on the country concerned. Other costs will depend on where the service is delivered from (e.g. from the developed country, or through an office based in a Pacific Island Country).
Sustainability	Subject to undertakings of the country concerned.
Accountability	Directly through the accountability structures in the country concerned. Relationships with other NMS would need to be determined (including for observational networks and timely access to data).
Flexibility	Largely in the hands of the country concerned.
Smooth transition	Involves removal of functions from FMS.
Other Comment	This arrangement could be implemented a number of ways. It could be fully funded by, and located in, a developed country. Alternatively it could be co-located with the FMS or some other Pacific Island NMS. The Fiji Government could simply run a tender for provision of specified services and assess the proposals and costs provided on an open-market basis. Again, a key question is "Who pays?" A developed country could simply offer to deliver and pay – though none have raised this proposal with the Review team during the course of consultations.

Analysis

Position of the Fiji Authorities

As highlighted in the Terms of Reference, the position of the Fiji Government is a crucial element of the analysis. It is axiomatic that, because FMS is an agency if the Fiji Government, the Fiji Government is the primary decision-maker with respect to the future of the agency. All of the options canvassed above involve some level of agreement with the Fiji Government whether it be through active Government decisions and funding (options 1 and 2); partnership arrangements (options 1, 2, and 4); or transfer of assets or responsibilities (options 3, 5, and 6).

The Review team met with senior officials of the Fiji Government in February 2010 to discuss the Fiji Government's position. The Team was assured that the Fiji Government remained committed to providing ongoing effective support of specialised and other meteorological services to the region through the Fiji Meteorological Service. At the same time, officials advised the Team that the Government is working actively towards restructuring the Fiji Meteorological Service along lines consistent with the guidance included in the Review team's draft Report of January 2010.

These assurances, which the Review team accept at face-value, underpin the assessment below.

Overall Assessment of options

The comparative assessment of these options involves a combined consideration of a number of issues including effectiveness, accountability and cost.

Effectiveness

Of the six options, the review team is confident that options 2-6 all have the potential to provide effective service if the appropriate resources are made available.

Accountability

The review team considers it appropriate to have some system of accountability to those who receive services and those that fund services.

The current arrangement (option 1) provides for accountability only to the Fiji Government. Options 4 and 5 provide a mix of accountability through the Fiji Government and membership of the relevant regional agency (some, but not all, of which receive or fund

services). Accountability under options 2, 3 and 6 depend on the arrangements put in place by the host government.

Costs and funding

The key issue which underpins an assessment of sustainability for all of the options is cost and funding. Table 2 provides illustrative information of the relative costs with respect to different organisations and host countries (using salaries as an indicator of overall cost structures). It is clear from this information that moving specialised services away from FMS has attendant costs in terms of both the transition and ongoing operational costs.

On balance, the Review Team considers that Option 2 provides the most straightforward and potentially cost-effective way of providing specialised regional services. The main advantages of this option are that:

- it builds on the existing structures and skills,
- it is consistent with existing policy of the Fiji Government, in terms of both institutional change and ongoing support,
- the design (as elaborated below) can include elements of accountability that reflect the regional interest
- All other options involve greater costs, greater uncertainty in relation to funding, and additional transitional hurdles.

However the success of Option 2 depends on a number of factors in terms of design, implementation, and ongoing access to resources. We provide elaboration on these, and ways to address them, below.

Further elaboration of Preferred Option

In terms of the institutional design, we have identified a number of issues that we consider need to be recognised in the restructuring process to address the issues of sustainability and accountability.

a) Governing Body

The Fiji Meteorological Service is, and would remain, a Fiji Government Agency therefore it is appropriate for the Fiji Government to have responsibility for making appointments to the governing body (Council or Board).

Within this framework, the Review team sees the benefit of having some level of regional input into the operation of services to the region delivered by RSMC Nadi. The proposal we make is for the Board to include representation from outside Fiji. We have in mind 1-3

persons from other Pacific Island Countries with an interest in the delivery of services. We see the appointees as having experience in the field of weather and climate.

This proposal has a precedent in Fiji. The Fiji School of Medicine was established under the Fiji School of Medicine Act 1997. The provision in the Act relating to composition of the governing Council stipulates that:

> 4 – (1) The members of the Council shall be appointed by the Minister and the Council shall comprise [amongst a total of 19 members]:
>
> > (*n*) three members as representatives of other Pacific Island Countries appointed by invitation to be members of the Council

We understand from Fiji School of Medicine staff that this arrangement worked very effectively. NB Fiji School of Medicine became part of the National University of Fiji in February 2010.

We therefore propose that:

- A Governing Council or Board to be appointed by the Fiji Government; membership to include representation from another Pacific Island Countries representing the wider regional interest weather services provided by FMS (cyclone warning; aviation services; or Small Island State NMS) from the perspectives of both user and funder.

b) Conditions of Employment

A central benefit of the stand-alone entity model is flexibility on the terms and conditions of employment that can be provided. This can only occur if the agency is disconnected from the Fiji Public Service Commission salary scales and conditions. The ability to set these within the agency will allow it to set salaries etc that offer appropriate recognition of the skills held and long hours worked by staff, the importance of the role they play, and relativity with other employment markets.

We therefore propose that:

- The Council/Board to have the ability to set terms and conditions of employment appropriate to recruit and retain appropriately skilled and experienced staff.

c) CEO role

Under a stand-alone agency, we consider that the CEO should have the authority run the agency under the direction of the Council/Board.

A particular aspect of the Fiji Public Service conditions is that the Public Service Commission is responsible for selection and appointment of staff. We consider that the CEO should be able to make staffing decisions subject to appropriate procedures to ensure fair processes are followed.

We therefore propose that:

- The CEO have responsibility for day-to-day operation of services, including hiring/firing of staff.

d) Ability to enter Agreements

We have made the point elsewhere that there are no formal agreements that cover the delivery of services to other countries / territories. There is a lack of clarity about what services are to be delivered, meaning that the parties may have different expectations about what they are responsible for (we have in mind the services that are additional to the core obligations/expectations inherent in the formal designations held by FMS under WMO and ICAO).

We consider that significant services of this kind should be agreed between the National Meteorological Services involved. To implement this it must be clear in the FMS constitution that it can develop such agreements; subject to appropriate procedures regarding government-to-government arrangements.

We see this as including arrangements with development partners and outside agencies that provide support (for example for training, infrastructure and professional support).

We therefore propose that:

- The Agency have the authority to enter into agreements with other agencies outside the Fiji Government, including other national meteorological services and development partners.

e) Agency not profit-seeking

We appreciate that a stand-alone agency could encompass a range of models including a corporate or business model under which the agency is expected to be self-funding. We concur with the conclusion of earlier reports that the services provided by FMS are

predominantly of a public good nature, and that the potential to charge fees is not sufficient to sustain the agency.

We add to this that a corporate business model would risk losing the support of the development partners which currently provide substantial support to FMS. We see this outside support as being crucial to the sustainability of FMS / RSMC Nadi.

We therefore propose that:

- The agency is set up as a government entity but not based on a corporate model (though it may have the ability to recover costs for certain services).

f) Going Concern

We assume under this option that FMS would be restructured as a 'going concern' i.e. that it would continue to operate from its current premises and that assets and infrastructure necessary for the service to function would be transferred to the restructured agency.
We therefore propose that:

- The Agency continue to operate as a going concern from its existing sites and with existing assets/infrastructure.

Annex 12: Assessment of Options for Regional Coordination

We have used the set of high level criteria as used previously to assess models for regional coordination and support (table 1 below).

Table 1 High Level Criteria for Assessment	
Effectiveness	Does it address the core issue – skills and resources to support delivery of services
Cost	Comparative cost
Sustainability	Funding; human resources
Accountability	Clear accountability to an appropriate body
Flexibility	Able to be adapted to future change
Smooth transition	Avoiding major disruption to services or institutions

We then used these criteria to assess the merits of five options. These options have been developed from a combination of sources, including suggestions made to us in the course of our consultations.

Once a preferred option has been identified through this process, we provide further elaboration of this option.

The five options we have considered are:

Option A: Work through WMO – No separate Pacific coordination
Option B: RMSD – as currently established (status quo)
Option C: Meteorology Standing Committee under a CROP agency
Option D: Dedicated Desk to support Pacific National Meteorological Services
Option E: Pacific Meteorological Organisation (PMO) – modelled on the Caribbean Meteorological Organisation

Assessment of options

Option A – Rely on WMO processes

Description

This first option is essentially a fallback position in which there is no dedicated meeting or forum in which Meteorological Service Directors from the Pacific Islands can address issues of specific relevance to the region. In this situation the region would rely solely on WMO processes such as WMO Congress, RA V meetings, and Technical Committees under RA V (WMO operates a series of technical committees that address specific issues such as tropical cyclones, climate etc). WMO provides funding for Pacific Island Members' attendance at Technical Committee meetings, but not their attendance at Congress or RA V meetings.

Assessment: Option A – Rely on WMO processes	
Effectiveness	Limited – Directors would meet 2 yearly WMO has limited ability or mandate to follow up on national or sub-regional issues
Cost	Costs fall to WMO to fund WMO meetings; cost savings associated with not having a separate RMSD meeting (US$50k plus secretarial costs)
Sustainability	WMO meetings will continue as they are core activities of a UN agency
Accountability	Through formal WMO processes
Flexibility	Limited – subject to WMO requirements and procedures
Smooth transition	No specific transition required – other than the absence of RMSD meetings
Other comment	Meetings of Pacific Island Directors could only be held as opportunity presents in the corridors of other meetings. Benefits associated with the dedicated RMSD meetings would be lost. An important consideration also is that RA V includes Southeast Asian countries and so has wider interests than simply the Pacific.

Option B – RMSD Supported by a permanent Executive Officer

Description

Annex 7 points out that the original concept for RMSD incorporated support for the meeting in the form of coordinator/advisor appointed for this purpose. In recent years the level of support has diminished leading to the current situation where there has been increasing concern about the management of these meetings in terms of logistics, secretarial support and, crucially, follow-up from RMSD decisions. In the survey of Directors carried out in the course of the current Review, RMSD meetings were judged as very useful, but confirmed that their administration was found wanting.

This model builds on the current RMSD meeting (which has two decades experience of coordination meteorological matters in the region) and proposes that secretarial support be fully funded, in line with the original concept. The model therefore has two elements; RMSD meetings and secretarial support.

RMSD Meetings

The purpose of these meetings will continue to be:

- Exchange information of mutual interest concerning the operational matters, plans and programs of Regional Meteorological Services;
- Coordinate regional strategies on approaches to relevant actions within WMO;
- Provide advice or assistance to relevant regional bodies including those having oversight in the key sectors of Tourism, Water, Shipping, Aviation, Health, Power on issues pertinent to the meteorological matters in the region;
- Commission plans and reviews on regional operational matters;
- Assist in the coordination and provide advice on regional development assistance programs related to meteorological activities in the region.
- Provide coordinated advice to the individual Director's government on issues of common interest;
- When appropriate develop coordinated approaches to pertinent matters, affecting meteorological services within regional organisations and bodies;
- Any other matters where it is beneficial to the effective and efficient development and operation of meteorology in the Pacific;
- Develop coordinated approach to mainstreaming of meteorological science into national development planning processes and projects;

- Assist in the development and strengthening of regional communication hubs and national "to the last kilometre" communication networks for all hazards Early Warning Systems;
- Develop coordinated approach for high-profiling NMS through project integration;
- When possible the meetings to be held contiguously with similar meetings of heads of regional services which have common interests (such as the very successful 2009 joint meeting with Directors of Disaster Management Services).

The scope of the issues covered and the need to coordinate action on matters such as WMO means that these meetings should be held annually.

Secretarial Support

This option proposes the permanent appointment of a full time RMSD Executive Officer (REO) whose responsibilities include organising the meetings and coordinating follow up action. In addition the REO will work closely with SPREP's MCO and the WMO sub-Regional Office in Apia. The REO will be located in, but not part of, an appropriate organisation or agency in the region such as a National Meteorological Service, SPREP or SPC. The administrative arrangements will depend on the situation, but the position will need to be funded in a regionally equitable manner.

Budget

On past experience the RSMD meetings cost about $US60k each. However when held in conjunction with WMO meetings, which occur about every other year, this can be reduced by as much as $US50, giving an average cost of approximately $US35,000 per year. It is assumed that, as in the past, the venue and facilities for the meeting are funded by the host or some external donor.

The funding requirement for the REO position will depend on the level of appointment and location of the appointment. If appointed at the Advisor level of the CROP scale, salary and attendant employment costs would be approximately US$85,000. Allowing an appropriation for travel and office accommodation/overheads, the total secretarial costs would be approximately US$120,000 annually.

Assessment: Option B – RMSD Supported by a permanent Executive Officer	
Effectiveness	Simple and concise role and implementation through the REO. The model has clear and focused outcomes and would not be subject to external pressures to take on functions outside these.
Cost	Relatively low cost; annual costs would be in the order of US$155,000. This is comparable with existing arrangements, but recognising that the REO function has, in recent years,

	been undertaken using funding from other projects managed through SPREP.
Sustainability	Providing funding can be sustained there is no reason why this arrangement cannot be sustainable for as long as it plays an effective role.
Accountability	The Regional Meteorological Service Directors are accountable to their individual governments and to themselves. The REO would be accountable to the RMSDs and through the administrative arrangements put in place by the funding and host agencies.
Flexibility	By its nature this model has the flexibility to meet all the requirements set out in the role of the RMSD meetings. It is not bound by rules and protocols of formal regional organisations.
Smooth transition	None necessary
Other comment	No treaty, MOU or similar instrument is required for the establishment of the model.

Option C – Meteorology Standing Committee under a CROP agency

Description

A proposal that has been put to us is for RMSD to be constituted as a Standing Committee under CROP agency (the specific proposal was for such a committee to be established within the SPREP structure, but for the purposes of this assessment it be within any agency).

The concept behind this proposal is that if a Standing Committee were established as an integral part of the organisations functions, then the agency would recognise a commitment to fund the Committee and associated secretarial support.

Assessment: Option C – Standing Committee under a CROP agency	
Effectiveness	Effective if fully funded.
Cost	Full costs involve Committee meeting costs (as for RMSD) plus full secretarial support (estimated at xx per year)
Sustainability	Sustainability assured through institutional commitment. However unless funds are dedicated for this purpose, they will always be vulnerable to reallocation to other priorities of the host agency.

Accountability	Clear accountability exclusively to the host agency
Flexibility	As for usual host agency functions
Smooth transition	Involves an explicit decision and commitment of host agency governing body as well as agreement of NMS Directors
Other comment	The host agency could only undertake this role if it was prepared to commit its own resources, or had assured access to outside resources, to support the Committee and its attendant costs. The host agency would also need to support the work and aims of the Committee and have a mandated that encompassed the work of NMS

Option D – Desk for Pacific National Meteorological Services

Description

The model proposes that a "Regional Desk for Pacific National Meteorological Services" be established and housed in one of the CROP agencies. The Desk would be initially staffed by a Coordinator, with additional technical staff being recruited over time. It is envisaged that the desk would form the nucleus of the regional coordination structure and ultimately have a very extensive remit in this activity. It's focus will be mainly on coordination, resource mobilisation and provision of regional support to the FMS and NMSs of all PICTs. One element of its work would be to provide secretariat support to the regional meeting of Directors of Met Services (RMSD) as described in Option 2 above.

This will be the regional window for all donors and other key stakeholders to engage in the enhancement of meteorological services in the region. In this model, the FMS will continue to provide regional services in meteorology to PICTs as a Fiji institution while all regional inputs to support the sustainable delivery of meteorological services to Pacific Islands on top of the capacity of FMS will be provided through the proposed Regional Desk.

The proposed Regional Desk will be directly responsible for the immediate execution of the approved recommendations of this Review as deemed appropriate and supported by the Management of the host regional agency. One of its immediate tasks, depending on the timing of establishment, could be to develop a strategic plan for the coordination and further enhancement of meteorological services in the region. Guidance on the scope and nature of the activities will be provided by the meeting of the RMSD initially.

The tentative Terms of Reference for the Regional Desk are envisioned to include:-

- Development of a Mission Statement for the desk.
- Development of a proposal for organisational arrangements for the desk within the agency including staffing and facilities.
- In consultation with the FMS establish explicitly right from the start a framework describing the range of assistance FMS may require from a regional backstopping mechanism that would enhance and as well as sustain the delivery of meteorological services to other PICTs.
- In consultation with regional NMS and others establish country needs and requirements.
- Development of a schedule of meetings or workshops targeting specific areas; this could include the concept of a Ministerial level meeting as appropriate.
- Coordination of regional training programs in consultation with training providers (see Annex 10), Development Assistance Agencies, NMSs, WMO and other relevant bodies.
- In consultation with NMSs and giving particular weight to the contemporary situation with respect to regional support provided by the FMS arrange for the placement of appropriately qualified staff in FSM and RSMC Nadi to ensure both the operation of regional services and the development of staff experience and capacity that may be transferred to other regional Meteorological Services.
- Mobilising resources to address the needs at regional level and for National Meteorological Services.
- Development of a coordination process for maintenance of those facilities and infrastructure needed to support meteorological activities (such as observing, telecommunications and IT systems) but are beyond the resources of individual NMSs (particularly the smaller ones). If appropriate, feasible and cost effective this could include direct support from the desk.

Budget

The baseline costs associated with the Desk will comprise a Coordinator and 1 - 2 technical staff, plus operational costs and administrative overheads. These baseline costs are estimated 350,000 annually (further elaboration of the budget is provided at the end of this Annex).

Assessment: Option D - Regional Desk for Pacific National Meteorological Services	
Effectiveness	Simple and concise role and implementation through the regional meteorology coordination desk. The model has clear and focused outcomes and would not be subject to external

	pressures to take on functions outside these.
Cost	Moderate baseline cost, estimated at around $350,000 annually.
Sustainability	Providing funding can be sustained there is no reason why this arrangement cannot be sustainable for as long as it plays an effective role.
Accountability	The "regional desk" would be accountable to the RMSDs for outcomes and to the host CROP agency for administrative matters through the arrangements put in place by the funding and host agencies.
Flexibility	By its nature this model has the flexibility to meet all the requirements set out in the role of the RMSD meetings in addition to its regional coordination responsibilities.
Smooth transition	None necessary
Other comment	No treaty, MOU or similar instrument is required for the establishment of the model.

Option E Pacific Meteorological Organisation (PMO)

The proposal for a ' Pacific Meteorological Organisation' (PMO) has been raised repeatedly in recent years, notably in the context of RMSD. The PMO has been discussed as a concept broadly modelled on the Caribbean Meteorological Organization (CMO). Because of the frequent references we have heard to the Caribbean Meteorological Organization as a model we provide below a description of the CMO and comment on its applicability in the Pacific Islands region. We then draw on elements of the CMO model to outline a possible Pacific Meteorological Organisation and assess this against our criteria.

Caribbean Meteorological Organization - description and comment

CMO - Main features

(This description is adapted from material available at the Caribbean Community Secretariat website: www.caricom.org)

- The Caribbean Meteorological Organization (CMO) is the successor to the British Caribbean Meteorological Service, established in 1951 and later replaced by the Caribbean Meteorological Service (CMS) in 1963 following the break-up of the Federation. In 1973, the CMS became the CMO following the independence of several Member States.

- It was established through a formal multilateral Agreement (Agreement for the Establishment of the Caribbean Meteorological Organisation) signed by the 16 member countries and territories.
- The objectives of the CMO are to promote and co-ordinate regional activities in the fields of meteorology and allied sciences; provide support and advice to governments in dealing with issues of an international nature affecting weather and climate and to represent the regional meteorological community's interests at the international level. The CMO has a special working arrangement with the Geneva-based World Meteorological Organization (WMO).
- The CMO is governed by the Caribbean Meteorological Council (CMC), a ministerial body, founded in 1963. Its other organs are the CMO Headquarters Unit located in Trinidad and Tobago, the Caribbean Institute for Meteorology and Hydrology (CIMH) located in Barbados and the Caribbean Meteorological Foundation (CMF), established to support the research activities of the CIMH.
- The CMO does not have any role in meteorological forecasting nationally or regionally; this is carried out by National Meteorological Services (with some outside support).
- There is an annual meeting of the Governing Council (with representatives at ministerial level), the CIMH Board of Governors, and Heads of Meteorological Services.
- It is funded through member contributions and also manages project funding from development partners (notably an EC Regional Weather Radar Project to the value of 13m Euro).

Comment on key elements of the CMO:

i) Overall Structure and Funding

The CMO is established through a formal multilateral Agreement which defines its functions; its component entities and their governance, and funding.

The structure of the CMO has been subject to an institutional Review that was commissioned by the governing body in 2000 and completed in 2004. The Coordinating Director (who heads the Headquarters Unit) noted in a 2009 paper that "Regional and international events in recent years have intensified the need for changes within the organs of the CMO, far outstripping the pace of implementation of any of the recommendations of the Institutional Review". Current proposals for organisational change appear to focus on increasing staff numbers at the CMO Headquarters Unit; with attendant increase in costs.

CMO core funding is through member contributions. The Report of the 48th session of the CMO Council (the ministerial governing body) included the statement that "The Council recalled that for many years, both main arms of the CMO, namely the Headquarters Unit and CIMH, had been forced to operate under very difficult circumstances because of large arrears of contributions by Member States." The annual contributions sought from Members total approximately US$ 0.5 million t support the CMO Headquarters Unit and US$2.5 million for the CIMH.

ii) CMO Headquarters and staff

The CMO records show ongoing discussion on the role of the Headquarters Unit, for example over whether it should "take on a more formal oversight role to ensure professional and operational standards of the Meteorological and Hydrometeorological services in the region" or maintain its current advisory role. In addition to this advisory role, the main activities of the Headquarters Unit appear to be managing project funds, participating in (multiple) WMO processes, and organising annual meetings.

iii) Heads of Meteorological Service meetings

This is a one-day meeting held annually. Its agenda typically covers: Review of the previous hurricane season; Training; and Operational Issues. Since 2007 the latter element has been supplemented by the Caribbean Meteorological Organisation Operational Meteorology Advisory Group (COMAG). The Heads of Meteorology meeting appears to operate in a similar way to RMSD (i.e. it discusses operational issues of mutual interest but has no governance function).

iv) Annual Governance meeting - Ministerial

An annual governance meeting is necessary to provide formal governance for the various entities set up under the founding Agreement. That the governing meeting is at Ministerial level adds status to the work of the Organisation and the Meteorological Services of Members. However Ministerial meetings are costly - more so in the Pacific due to the distances involved and the costs of air travel.

v) CIMH

The CIMH is primarily a training organisation, with some research functions. In the Pacific Islands region there is a strong link with existing providers of training, notably the Australian Bureau of Meteorology, New Zealand Meteorological Service Ltd (Refer Annex 10). The Review team therefore sees no benefits in creating a separate training organisation in the Pacific Islands, particularly as the costs would be substantial. With respect to research, we consider other issues are of more immediate priority for NMS, and that the existing links

with the WMO, Australia, New Zealand, France and the US provide sufficient points of access to research for Pacific Island Countries and NMS staff with research interests.

vii) Caribbean Meteorological Foundation

The Foundation's function is to support training and research, and is therefore closely linked with the CIMH.

In the Pacific Islands region, support for staff to participate in training is available from a range of sources (WMO, US, Australia, New Zealand, Japan). Support is generally provided directly to candidates (with endorsement from their NMS) rather than being pooled into a regional fund. The creation of a separate Foundation for this purpose appears to involve significant additional administrative costs (e.g. governance, fund management, audit etc) without comparable benefit.

Overall comment on CMO Model applicability to the Pacific

In our view the CMO model involves a number of elements that have little appeal as a model to follow in the Pacific:

- A formal multilateral Agreement would involve considerable time and effort to negotiate and ratify. Such an Agreement is necessary under the CMO model to provide governance and funding of its various organs.
- The CIMH and associated Foundation serve functions are provided for the Pacific by other agencies and development partners. We see little benefit, and considerable cost, in setting up new institutions in the Pacific for this purpose.
- Much of the cost involved in the CMO result from the governance and funding for institutions that we don't see as being applicable in the Pacific.
- The role of the CMO Headquarters Unit and its funding arrangements are under scrutiny within its own membership; its roots are in the past (going back to the 1950s) and there is evidence from CMO records that the organisation and its members are looking for change.

We recognise that Caribbean countries are facing many similar issues in relation to weather and climate services as Pacific Island Countries. We also acknowledge the merits of some elements of the CMO concept. However we see the opportunity for the Pacific to develop its own model that is more flexible and carries less weight of governance functions and costs; while at the same time targets key issues of coordination and operational effectiveness.

Pacific Meteorological Organisation – a possible model

A potential Pacific Meteorological Organisation may be based around selected elements of the CMO along the following lines:

- Something resembling the current RMSD meeting (in terms of membership and participation) could be established as a new entity (the PMO) with its own constitution and legal personality.
- The PMO would have the authority to employ staff and manage funding.
- It would require formal agreement of member governments and appropriate administrative and accountability procedures (with attendant costs).
- Its functions could encompass the current role of RMSD, and could be expanded, for example into the area of managing donor funding and projects.
- It could potentially provide services (such as maintenance of equipment) and charge fees.
- It should not duplicate existing functions or services already provided by other agencies (e.g. training)

Assessment: Option E – Pacific Meteorological Organisation	
Effectiveness	Could be very effective if fully funded
Cost	High – full agency costs (including governance and technical meetings, administration, IT/computing, building/facilities, staff etc). Administration costs could be reduced if co-located with another agency with sharing of costs. A conservative estimate is that it would cost a minimum of US$800,000 annually (in addition to preparatory and establishment costs).
Sustainability	Would have the strong foundation of a formal agreement, but sustainability would depend crucially on funding/resources.
Accountability	Formal accountability to its own governing body
Flexibility	As a dedicated Meteorological agency it can respond directly to the changing needs of its field.
Smooth transition	Negotiating a formal agreement to establish a new agency would take considerable time and resources. Assuming this could be achieved there would be further time and cost associated with an establishment phase.
Other comment	While potentially very effective, this model has high transitional and ongoing costs. We note that while some new agencies have been established in the Pacific in recent years (e.g. PASO), there is an overall trend towards amalgamation of agencies. The PASO experience is illustrative; several years of preparation were required to establish the agency.

Overall Analysis of Options

A summary assessment of the Options is provided in the table below

Summary Assessment of Regional Options			
Option	**Costs (estimated US$)**	**Benefits**	**Risks**
A: Rely on WMO	Costs reduced by approximately $100,000 annually	No specific benefits for Pacific Island countries; a step back from the current situation	Loss of forum to address issues of interest/concern for Pacific Island NMS.
B: RMSD with Secretarial support	$155,000 annually	Focussed secretarial support for RMSD with funding ring-fenced to ensure it is not diverted to other agency priorities.	Relies on continuing commitment of donor funding. Does not meet full foreseeable needs of Pacific Island NMS.
C: Standing Committee under CROP Agency	$155,000 annually	Locks in the Committee as a required function of the host agency.	Vulnerable to changes in priority of the host agency.
D: Desk for Pacific NMS	Base costs to run the desk: $350,000 annually	Provides for extended range of functions to meet foreseeable needs of Pacific Island NMS. Provides means to mobilise additional project resources (additional $3-500,000 from year 3 of operation)	Relies on continuing commitment of donor funding.
E: Pacific Meteorological Office (PMO)	$800,000 annually	Establishes dedicated regional body to support and enhance NMS in the region	Lack of support for new regional agency.

The review team's assessment is that Options B, D and E all offer some degree of benefit for coordination and support of Pacific Island NMS.

The team recognises the reality of the present climate is not favourable for the establishment of new regional organisations such as the PMO described as Option E.

However the need for coordination of regional meteorological services is clearly a priority for reasons that have been addressed in this Review. The contribution to national security and wellbeing from a viable meteorological service is not only self evident, but is of such concern that over recent decades it has been the subject of much study, review and debate. There is a genuine wish that the regional metrological services continue to develop and serve their nations and the region.

The team is aware that there are other smaller regional organisations already established with specific focus on sectors such as immigration, customs, police and parliament. While the Team does not wish to undermine the importance of these sectors to the overall welfare of the Pacific people, it strongly believes the meteorology and climate change are of paramount importance to the sustainable livelihoods of the Pacific people and thus warrant greater level of support both by donors and the Pacific Island Countries themselves.

The team has therefore identified Option D (Regional Desk) as the preferred way forward is to strengthen the regional arrangements while at the same time supporting NMS. The Team considers that Option D offers a positive vision for the future of NMS in the region; at modest cost it provides a permanent focus for NMS from a regional perspective and provides sufficient resources (in terms of dedicated staff) to mobilise further resources through project development and donor liaison.

The question as to within which CROP agency the “regional desk for Pacific National Meteorological Services” be placed will need to be determined by the appropriate process. It is the team’s view, however, that the agency should have a mission compatible with those of the NMSs. At this point in time the Team considers SPREP to be most appropriate agency due to its mandate and the co-location of WMO and SPREP staff dealing with related issues. It is recognised that the other agencies such as SPC may also be appropriate hosts and this is rightly a matter to be decided at the regional level.

Elaboration of Preferred Option

The first three years will be critical to the success of this model:

Year One

In the first year the desk will be established, the Coordinator will be recruited and an initial RMSD meeting will be held to help guide and give a mandate to the Desk.

Year Two

In the second year, two additional staff – Research Officer and an Admin/Finance Officer – shall be recruited. A human resources development needs audit will be commissioned aimed at determining training and development needs in the Pacific NMSs. Also, if appropriate, resources would be provided in support of the FMS and RSMC Nadi's regional responsibilities. Also, if far enough advanced, a start could be made on implementing the strategic plan.

Year Three

By the third year the desk would be fully operational. Appropriate staff and funding arrangements will be in place for the desk to be fully operational.

Detailed Costing for the Regional Desk for Pacific National Meteorological Services

Breakdown of the costs for establishing the Regional Desk is outlined below for the initial 3 year period.

Note that:

- Activity 1 represents startup costs that are not ongoing
- Activities 2 – 5 represent ongoing baseline costs
- Activities 6 – 8 represent project costs that are expected to be funded through resources mobilised from donors through the work of desk staff.

Proposed Costing/Budget for a Regional Desk for Pacific National Meteorological Services (RD-PNMS)

ACTIVITIES	TIMEFRAME & ACTIONS	2011	2012	2013	TOTAL
Activity 1 Establishment of Regional Desk for PNMS[21]	Purchase of equipment, furniture and office space setup[22]	30,000	0	0	**30,000**
Activity 2[23] Staff recruitment (starting with	a) Coordinator	100,000	100,000	100,000	**300,000**

[21] Regional Desk for Pacific National Meteorological Services
[22] Computers and as appropriate office renovation plus acquisition of relevant furniture and office equipment
[23] Gradual recruitment of staff depending on the further research and analysis to be undertaken in the first year by the Coordinator with the support of a Research Officer (i.e. in the first and second years, it is envisaged recruitment of a minimal number of staff to start-off the secretariat. The proposed budgets for the rest of the years is taking into account a gradual increase in the number of staff at the regional level depending on the approved organizational structure.

Coordinator and Project Assistant, and later per justification for other professional and technical personnel)	b) Research Officer	0	50,000	50,000	**100,000**
	c) Admin/Finance Officer	17,000	17,000	17,000	**51,000**
	d) Project Assistant	15,000	15,000	15,000	**45,000**
Activity 3 Operational Cost	In-country transportation, telecommunications, office needs, utilities etc.	20,000	20,000	20,000	**60,000**
Activity 4 RSMD and other appropriate regional meetings	a) RMSD	60,000	20,000[24]	100,000	**180,000**
	b) Specialised Meetings	0		30,000	**30,000**
	c) sub-regional meetings	0	0	40,000	**40,000**
Activity 5 Project Travel	Travel by Pacific Desk Coordinator	30,000	30,000	30,000	**90,000**
Activity 6	Support by way of human				

[24] Secretariat to aim at continuing tagging with WMO meeting arrangements as currently practised.

Support to FMS	resources and projects	0	200,000	200,000	**400,000**
Activity 7 Support to NMSs	Technical assistance and urgent on the spot needs	0	100,000	100,000	**200,000**
Activity 8 Training	A HRD Audit Programme[25]	0	100,000	0	**100,000**
Total		**272,000**	**652,000**	**702,000**	**1,626,000**

[25] To be conducted by a consultant