ASSESSMENT OF CURRENT INFORMATION, METEOROLOGICAL SERVICES AND RISK MANAGEMENT SYSTEMS & ARRANGEMENTS TO USE THEM FOR THE PROJECT

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Vanuatu Klaemet Infomesen blong Redy, Adapt mo Protekt (Van-KIRAP) project

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Acronyms

APCC – APEC Climate Center

BOM – Australian Bureau of Meteorology

CIS – Climate Information Services

CLIK-P – Climate ToolKit for the Pacific

CROP – Council of Regional Organisations in the Pacific

COSPPac – Climate and Ocean Support Program for the Pacific

ERA – Emergency Response Activities

ENSO – El Nino Southern Oscillation

GCF – Green Climate Fund

GCM – Global Climate Model

IOD – Indian Ocean Dipole

MME – Multi-model ensemble

MSLP – Mean Sea Level Pressure

NASA – National Aeronautics and Space Administration

NIWA – National Institute of Water and Atmospheric Research

NMS – National Meteorological Services

NMHS – National Meteorological and Hydrological Services

NOAA – National Oceanic and Atmosphere Administration

OCOF – Online Climate Outlook Forum

PACCSAP - Pacific-Australia Climate Change Science and Adaptation Planning Program

PacMetDesk – Pacific Meteorological Desk Partnership

PCCSP - Pacific Climate Change Science Program

PICASO – Pacific Islands Climate Advanced Seasonal Outlook tool

PMC – Pacific Meteorological Council

POAMA - Predictive Ocean Atmosphere Model for Australia.

RCC – Regional Climate Centers

ROK-PI CliPS - Republic of Korea – Pacific Islands Climate Prediction Services Project

RSMC – Regional Specialised Meteorological Cenres

SCOPIC – Seasonal Climate Outlook Tool for the Pacific Islands

SHTC – Southern Hemisphere Tropical Cyclone

SOI – Southern Oscillation Index

SPC – Pacific Community

SPREP – Secretariat of the Pacific Regional Environment Programme

SLR – Sea level rise

SST – Sea Surface Temperature

SSTA – Sea Surface Temperature Anomalies

TC – Tropical Cyclones

TCP – Tropical Cyclones Programs

VCU – Vanuatu Climate update

Van-KIRAP – Vanuatu Klaemet Infomesen blong Redy, Adapt mo Protekt

VMGD – Vanuatu Meteorology and Geo-hazards Department

WMO – World Meteorological Organization

Table of Contents

1.0 Introduction

The Vanuatu Meteorology and Geo-hazards Department (VMGD) provides meteorological services and supporting research in climate and weather related activities to Vanuatu government agencies, sectors, businesses and communities.

The Green Climate Fund (GCF) is supporting the delivery of enhanced and expanded climate information services, including procurement of new items of equipment and delivery of climate information tools for five target sectors – fisheries, water, tourism, agriculture and infrastructure – under the Climate Information Services for Resilient Development project in Vanuatu (known locally as Van-KIRAP).

Climate Information Services (CIS) provide communities and sectors with timely, tailored climate-related tools and products that they can use to reduce the impacts of climate variability and change on lives, livelihoods, natural resources and property. CIS supports better policy, planning and decision-making across sectors, and at national and community scales for both long- and short-term timeframes.

Without timely and tailored information about the impacts of climate variability and change, next- and end-users such as sectors, governments and communities risk significant loss and damage due to extreme events such as drought, heat waves, cyclones and flooding, and slow onset changes, such as rising temperatures, sea-level rise and ocean acidification.

Project Objective:
The project objective is to *increase the ability of decision-makers, communities and individuals across five target sectors – agriculture, fisheries, infrastructure, tourism and water – to plan for and respond to the long- and short-term impacts of climate variability and change*.

The project will build capacity to collect and manage climate data, develop and deliver practical CIS tools, support improved coordination and dissemination of tailored information, enhance CIS related information and technology infrastructure, improve the accessibility of CIS to sectors and communities, and support the application of relevant CIS through real-time products and processes. The project will deliver the following components and outcomes:

Component 1: Institutional strengthening and capacity development includes activities that focus on addressing identified capacity and skills gaps and priority training needs of target sectors and community to support understanding and use of CIS tools. Increased capacity will be achieved through the delivery of skills-based training, awareness raising, technical placements, accredited curriculum, internships and cadetships, sector case studies and community Climate Centres.

Component 2: Develop a user interface platform that supports CIS data communication and application that focuses on developing and delivering customized CIS information, education and communication products to support awareness raising across the five target sectors and communities, with sector-specific awareness and capacity for CIS delivery and uptake in Vanuatu.

Component 3: Enhanced IT and CLEW systems to support delivery of CIS includes activities to develop and enhance VMGD operational IT delivery systems (software and hardware), visualization of CIS,

operational CLEWS, and decision-support systems and other online platforms to support the delivery of CIS to sectors and communities.

Component 4: Collect observational climate data to fill (spatial and temporal) gaps and monitor changing conditions will focus on enhancing the current VMGD climate observation network by rescuing data, installing instruments to fill spatial and temporal gaps, and monitor data collection, management, infrastructure and maintenance.

Component 5: Conduct targeted research, modelling and prediction for Vanuatu includes multi-disciplinary research, advanced models and predictions that will draw on observational and monitoring data to deliver the science to underpin the CIS tools for sectors and communities.

2.0 Purpose

The purpose of this document is to provide supplementary material to that outlined in the Project Operations and Maintenance Plan, on the assessment of the information, meteorological services and risk management system currently in place from previous or related projects, and arrangements to use them for the Project objectives.

3.0 Assessment of current climate information services (CIS) and technical arrangements by Sector

The following information overviews a range of climate information tools currently available in the Pacific region. It includes products and services provided by VMGD, Council of Regional Organisations in the Pacific (CROP) agencies, regional technical agencies and global agencies. The assessment considers which sectors are most likely to use these tools, how user-friendly they are, and whether they can be enhanced or improved for Vanuatu. It is intended that this information will inform development of CIS tools and delivery of tailored products under the Van-KIRAP project.

A summary of the CIS tools, the climate information they deliver and sectors they can inform is in Table 1 and Annex 1 provides further detail on the function of each tool and how useful it would be for sectors.

Table 1. Summay of available climate information products and tools, the type of information they deliver and expected target sector interest

Climate Tools		Agency responsible	Climate information delivered	Technical skills	Output	Van-KIRAP Relevant sectors	Current use
Ocean Portal		SPC, BOM	Near real-time & forecasts – SST, subsurface temp, salinity, currents, sea level, tides	Moderate	Online maps and graphs	• Fisheries • Tourism • Infrastructure	• This tool is mostly used by VMGD with trainings received from SPC and BOM to develop the Ocean bulletin (proposed)
Climate Information toolkit for the Pacific (CLIK-P)		APCC	Data from a range of sources – POAMA, NASA, APCC	High	Online tool – customized forecasts	• Water • Agriculture • Fisheries • Infrastructure • Tourism	• VMGD use this seasonal prediction tool to generate the Vanuatu Climate Update (VCU) bulletin that goes to end users (sector and community)
Pacific Island Countries Advanced Seasonal Outlook (PICASO)		APCC, SPREP	Seasonal forecasts – rainfall	Moderate	Online maps, charts & interp	• Water • Agriculture • Fisheries • Infrastructure • Tourism	• VMGD use this seasonal prediction tool to generate the Vanuatu Climate Update (VCU) bulletin that goes to end users (sector and community). The VCU bulletin is circulated to about 200 sector users via an email listing that goes to end users (sector and community), which in turns recirculated to farmers associations, tourism area councils, fishing companies and fishing associations.
Tide calendars		BOM	Long-term tidal forecasts	Easy	Online maps and charts	• Fisheries • Infrastructure • Tourism	• Currently clients are calling in to VMGD office to seek information on tides; additionally the tide tables are published daily on the Daily Post newspaper. Anyone with internet access can download the tide tables online as well
Pacific Climate Change Data portal		BOM (PCCSP & PACCSAP)	Historic climate data – rainfall, air temp, diurnal temperature range, MSLP	Easy	Online graphs and trends	• Water • Agriculture • Fisheries • Infrastructure	• Currently VMGD uses this portal to store datasets, conduct basic analyses and homogenization of selected data.
Pacific Climate Futures		Aust Gov (PCCSP & PACCSAP)	National & sub-national projections – SST, air temp, rainfall, wind speed, solar radiation, humidity, evap.	Easy	Online projections	• Water • Agriculture • Fisheries • Infrastructure • Tourism	• This is a technical tool that is only available to VMGD (password protected) to carry out climate projection analyses (different climate change scenarios) when requested by sectors or private clients/businesses.
Southern Hemisphere Tropical Cyclone Data Portal		BOM	Historic TC tracks (1969)	Easy	Online TC tracks	• Fisheries • Infrastructure • Tourism	• This is available only for VMGD to use in extracting historical tropical cyclone data since 1969 when requested by clients (government departments and communities)
Seasonal ocean forecasts (bleaching)	Predictive Ocean Atmosphere Model for Australia (POAMA)	BOM	9-month projections – SST, SSTA, thermal hotspots; seasonal sea level forecasts	Moderate	Online projections	• Fisheries • Tourism • Infrastructure (SLR)	• VMGD use this seasonal prediction tool at the moment to generate the Vanuatu Climate Update (VCU) bulletin. The VCU bulletin is circulated to about 200 sector users via an email listing that goes to end users (sector and community), which in turns recirculated to farmers associations, tourism area councils, fishing companies and fishing associations. • VMGD also uses this tool for the Online Climate Outlook Forum every month with BOM and SPREP.
	Bleaching Futures	NOAA/ Symbioseas	Historic & projected SST, SSTA, thermal	Easy	Potential for online maps	• Fisheries • Tourism	• VMGD currently uses this information from NOAA to generate marine and coral bleaching alerts to the Fisheries/Tourism and Environment users.

	downscaled		stress (DHD), bleaching risk				• The localized coral bleaching alert is available on https://www.vmgd.gov.vu/vmgd/index.php/climate
	Coral Reef Watch	NOAA	9-month projections – SST, SSTA, thermal hotspots, bleaching risk	Easy	Online projection maps	• Fisheries • Tourism	• VMGD currently uses this information from NOAA to generate marine and coral bleaching alerts to the Fisheries/Tourism and Environment users. • The localized coral bleaching alert is available on https://www.vmgd.gov.vu/vmgd/index.php/climate
Risk Scape		NIWA	Land-use planning tool that includes sea level, rainfall, elevation etc.	Moderate	Risk-based land-use assessment	• Water • Agriculture • Infrastructure • Tourism	• NDMO and VMGD uses this tool to estimate extend of damage generated by different hazards under different conditions and scenarios. • Risk maps and risk analysis are then provided to different sectors and communities to support planning and development activities.
Climate communication products		**Agency responsible**	**Climate information delivered**	**Frequency/ timing**	**Output**	**Relevant sectors**	
Online Climate Outlook Forum (OCOF)		SPREP & PacMet	ENSO and seasonal climate outlook forum (e.g. rainfall)	Monthly	Summary report (minutes)	None (technical forum)	• Currently, VMGD participates in the monthly regional teleconferences. This allows VMGD to generate the Vanuatu Climate Update (VCU). The VCU bulletin is circulated to about 200 sector users via an email listing that goes to end users (sector and community), which in turns recirculated to farmers associations, tourism area councils, fishing companies and fishing associations.
Seasonal Climate Outlook Prediction model for Pacific Island Countries (SCOPIC)		SPREP, PIC met offices, BOM	Seasonal outlooks – rainfall, air temp, SST, sea level, drought	Monthly	Vanuatu Climate Update	• Water • Agriculture • Fisheries • Infrastructure • Tourism	• VMGD uses SCOPIC to generate seasonal climate predictions for Vanuatu. These climate predictions are essential elements of the Vanuatu Climate Update (VCU). The VCU bulletin is circulated to about 200 sector users via an email listing that goes to end users (sector and community), which in turns recirculated to farmers associations, tourism area councils, fishing companies and fishing associations.
COSPPac Climate Bulletin		BOM, Pacific Met. Council, National Met. Services, SPREP	Near real-time & 3-month predictions – ENSO, MJO, cloud, rainfall, MSLP, TC, SST, subsurface temp	Monthly	Climate Bulletin	• Water • Agriculture • Fisheries • Infrastructure • Tourism	• VMGD uses the COSPPac Climate Bulletin
ENSO Wrap-up		BOM	ENSO (SOI, IOD)	Monthly	Bulletin	• Water • Agriculture • Fisheries • Infrastructure • Tourism	•
Vanuatu Climate Outlook		VMGD	ENSO	Monthly	Bulletin	• Water • Agriculture • Fisheries • Infrastructure • Tourism	•
Meteorological Services tools		**Agency responsible**	**Climate information delivered**	**Frequency/ timing**	**Output**	**Relevant sectors**	
CLiDE: Climate data for the environment (& CLiDEsc)		BOM/ NIWA	Historic climate data – rainfall, air temp, diurnal	n/a	Climate database management system	VMGD	

		temperature range, MSLP				
WMO Operational Network	WMO	Coordinates regional climate data	Online	Disaster risk reduction management program	VMGD	

4.0 Technical arrangements for the use of current CIS tools and products in the Van-KIRAP project

The project seeks to enhance or fill gaps in the provision of CIS tools and products available in Vanuatu, customizing them so they can meet target sector needs as identified in the *Vanuatu Climate Framework for Climate Services* (VMGD 2016) and the five Sector CIS Action and Communication Plans.

A *VMGD Capacity Assessment* undertaken in early 2018 complements this report and outlines the capacity of VMGD and the Ministry of Climate Change to manage and deliver the technical equipment and online CIS products that will be procured and developed under the GCF-funded Van-KIRAP project.

The following arrangements have been put in place by the Van-KIRAP technical team to demonstrate how the project will utilize existing CIS tools and products. A number of 'Regional' initiatives and projects that currently provide CIS that the project can enhance or customize are summarized in Table 2, which is arranged by project and activities.

Table 2. CIS tools and products developed by other projects and their links to the Van-KIRAP project

Climate information/ meteorological service	Integration arrangements into the Van-KIRAP project
CIS provided by the Climate and Ocean Support Program of the Pacific (COSPPac) http://cosppac.bom.gov.au/	
Online Climate Outlook Forum (OCOF) This is a regional event that occurs on a monthly basis that is administered by SPREP/BOM under the COSPPac project. The aim of the OCOF is to support NMS (including Vanuatu) discuss their seasonal climate forecasts and conduct forecast verification. **Van-KIRAP linkages to OCOF** The project will continue to utilise the OCOF as a means of support to the project in the issuance of the monthly 'Vanuatu Climate update' (VCU) bulletin. The VCU is a nationally tailored product that is compiled by VMGD to alert sectoral users and communities about the probability of rainfall in the next three months. VMGD staff will continue to participate in the monthly OCOF to ensure that the seasonal forecasts are prepared well and then work with sectors / end users to tailore VCU in a form that suits user requirements under **Activity 2.1.1:** Develop new / enhanced CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update. The direct benefits of this will include a more realiable VCU that is better focused on sector requirements; increase confidence in VMGD staff as a result of the mentoring provided through the OCOF process.	
Seasonal Climate Outlook Prediction Model for the Pacific Islands (SCOPIC) SCOPIC is the primary climate prediction software that VMGD uses to generate their seasonal climate outlooks. SCOPIC forecasts are localised (station specific) forecasts generated using historical data collected from the site (or village). The process for using SCOPIC for seasonal climate prediction has been integrated into the VMGD standard operating procedures which leads to the development of the VCU. **Van-KIRAP linkages to SCOPIC** The project will promote the use of SCOPIC in parallel with other new dynamical models (PICASO and CLIK-P) through a multi-model ensemble (MME) approach to provide a more realiable forecast for Vanuatu. This will be part of **Activity 2.1.1:** Develop new / enhance CIS content for online tools based on sector and community priorities,	

e.g. Vanuatu Climate Update. The MME approach will include statistical-based and dynamical-based climate prediction models.

The project will also support training for the new project technical staff in the use of SCOPIC as well as general understanding of the climate system fundamentals. Targetted training for project staff is essential to ensure they have the right skills and competence to generate the climate predictions to service the project requirements.

Ocean Portal

The ocean portal is a regional resource that provides a wealth of marine and ocean information that the project will utilise for all sectors especially Fisheries, Tourism and Infrastructure.

Van-KIRAP linkages to Ocean Portal

The information available in the ocean portal will be harvested by the project and provide them back to sector end users through the new CIS platforms that Van-KIRAP will develop such as the Vanuatu CIS App, the sector CIS information portals, and the Customized operational CIS-based decision-support system for target sectors under **Activity 2.2.1.**

The project will be conducting a national training workshop on the Ocean Portal with assistance from SPC and the COSPPac project.

The existence of this resource will benefit the project by not having to develop a new portal but rather utilise what is available. Aside from the cost savings, the other benefits will include availability of high quality marine and oceans materials produced and available to meet sector and Ni-Vanuatu community needs.

COSPPac Climate bulletin

The COSPPac Climate bulletin is a regional product that is prepared by the Bureau of Meteorology and SPREP. The bulletin is updated every month and is a main output of the OCOF teleconference. National Meteorological Services (including VMGD) draw information (eg ENSO updates) from the bulletin to prepare their local and national climate bulletins, and for Vanuatu it's the VCU. BOM, the provider of the information is a WMO Global Producing Centre for Long-Range Forecasts.

Van-KIRAP linkages to COSPPac Climate bulletin

The project will utilise information from the COSPPac Climate bulletin to support the development of nationally tailored products such as the VCU (**Activity 2.1.1:** Develop new / enhance CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update.) and climate updates to support **Activity 3.1.2:** Update VMGD website with new CIS products customized to sector needs; and training materials/information given to the communities in **Activity 1.4.3:** Facilitate access to CIS for community decision-making [VMGD]]. This is done intentially as the source of the information i.e BOM is a WMO recognized organization.

The utilisation of the information from the COSPPac climate bulletin to develop national bulletins for the benefit of sectors and communities will help improve and strengthen target sectors and communities to understand, access and utilise CIS for decision-making.

Information and meteorological services provided by the Republic of Korea-Pacific Islands Climate Prediction Services (ROK-PI CliPS) Project

CLIK-P

CLIK-P is a regional climate prediction tool that is available to National Meteorological Services officers to generate large scale dynamical-based seasonal forecasts out to three months for rainfall and temperature variables.

Van-KIRAP linkages to CLIK-P

The CLIK-P tool has the capability to provide the project with graphics, maps and charts to enhance the Vanuatu Climate Update as well as to update CIS information developed in **Activity 3.1.2:** Update VMGD website with new CIS products customised to sector needs.

Information generated directly from CLIK-P will support **Activity 2.1.1:** Develop new / enhance CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update. CLIK-P will support the project through producing of high quality data and information for planning and responding to climate variability and change.

Pacific Islands Countries Advanced Seasonal Outlook (PICASO)

PICASO (Pacific Island Countries Advanced Seasonal Outlook) is a PC-based seasonal prediction tool tailored for National Meteorological Services. VMGD uses PICASO operationally to generate the Vanuatu Climate Update (VCU). PICASO is similar in nature to SCOPIC. It provides a localised seasonal rainfall forecasts for a station. PICASO will complement SCOPIC, CLIK-P and other climate prediction models assessed in the development of VCU.

Van-KIRAP linkages to PICASO

PICASO will be one of the many tools the climatologists will look at when implementing **Activity 2.1.1:** Develop new / enhanced CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update. PICASO will provide graphics, maps and charts to enhance the Vanuatu Climate Update and Vanuatu Climate Outlook bulletins.

The ability to generate seasonal predictions through VCU and apply the information prudently across a range of critical socioeconomic sectors will lead to a significant reduction in the negative impacts of climate change and variability along with enhanced capability to take advantage of other opportunities that may arise.

Application Guidelines

The Application Guidelines is a product of the Republic of Korea – Pacific Islands Climate Prediction Services project. The guideline explains the scientific background of developing the Climate Information Toolkit for the Pacific (CLIK-P) and the Pacific Islands Countries Advanced Seasonal Outlook (PICASO) and how best to utilize these systems.

Van-KIRAP linkages to Application Guidelines

The application guidelines will be key in **Activity 1.2.2:** Develop training packages and implement targeted training programmes and placements for VMGD staff which will lead to timely, reliable and quality climate information services.

Additionally, the project will also use information in the application guidelines to intergrate into mainstream climate information products and sector specific products [VMGD] **Activity 3.1.2:** Update VMGD website with new CIS products customized to sector needs.

The integration of traditional knowledge with science-based CLEWS, will provide improved communication and engagement between VMGD, the sectors and the community (i.e. through social media platforms, informed design of CLEWS as delivered in Component 1) with updates on current climate science around climate processes, including ENSO and drought, will allow for updates of key information resources (e.g. ENSO handbook) and bring sector specific examples that can feed into sector case studies and communication products.

Vanuatu Application Guidelines

The Vanuatu country-based handbook also provides the observational relevance of the dynamical seasonal prediction so that NMS can better interpret the models emulated forecasts in comparison to actual observations.

Van-KIRAP linkages to Vanuatu Application Guidelines

The Country-Based Handbook can increase VMGDs understanding and use of the PICASO forecast in the global climate context.The Vanuatu application guidelines will be key in the development of the new seasonal impact forecasts for target sectors under **Activity 5.3.1:** and (Activity 5.3.3) Suite of forecast-based CIS ground-truthed, operationalised and outreached with Next/End-Users. The integration of this knowledge into the project activities will help improved and current understanding of climate processes such as ENSO that impact Vanuatu weather and climate.

Information and meteorological services provided by the Australian Bureau of Meteorology (BOM)

ENSO Wrap-up

The ENSO Wrap-Up is a tool that incorporates interactive videos and monitoring trackers that indicates the ENSO cycle current predictions. The data is kept updated and provides near real-time data for forecasting.

Van-KIRAP linkages to ENSO Wrap-up

The project will draw from the ENSO Wrap-up to enhance the VCU and Vanuatu Climate Outlook (**Activity 2.1.1:** Develop new / enhanced CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update) . In doing so leads to improved and current understanding of climate processes such as ENSO that impact Vanuatu weather and climate; and improved ENSO forecasts can inform preparedness and community resilience activities and day-to-day planning.

Tide calendars

Tide calendar for Vanuatu provides tidal forecasts using since waves showing time and tide height.

Van-KIRAP linkages to Tide Calendars

The project will use information from the tide calendars to update the Fisheries, Tourism and Infrastructure CIS Portals under **Activity 2.2.1:** Develop customized operational CIS-based decision-support system for target sectors. Moreover, the tide calendars will be an essential resource that will be made available in Community Climate Information Centers under **Activity 1.4.3:** Facilitate access to CIS for community decision-making. Training and guidance materials will be developed for Community Climate Champions how to read, understand and train others on the use of the tide calendars.

This will lead to enhanced capacity of target next-users (VMGD) and end-users (sectors) on interpretation and application of tidal information to support operations (tourism and infrastructure) and managing fishing activities.

Pacific Climate Change Data Portal (PCCP)

The Pacific Climate Change Data Portal holds historical climate information and trends for Vanuatu.

Van-KIRAP linkages to PCCP

The data will be used by the project Delivery Partners eg BOM to train and develop of high quality climate datasets through best practice WMO quality assurance and homogenization processes **(Activity 3.2.2).** This will benefit the project/VMGD with new high resolution (downscaled) seasonal forecasts for all available Vanuatu climate variables across Vanuatu available with impact-based seasonal forecasts and operationalised for priority sectors.

The historical data housed on the portal will also support **Activity 3.3.2:** Develop an Agro-met information portal including new on-line IT infrastructure and software (VaCSA prototype). This will enhanced capacity of VMGD in developing and delivering climate change projections information into CIS tools.

Pacific Climate Futures

Climate projections data and features will advise the development of the new National Vanuatu Climate Futures portal **(Activity 3.2.2).** The new Vanuatu Climate Futures portal will contain updated climate projections for Vanuatu for years 2030, 2050 and 2090 under all emission scenarios (low, medium and high).

Van-KIRAP linkages to Pacific Climate Futures

This links to **Activity 5.4.2:** Deliver application-ready projections to target next/end-users (VMDG and sectors). The new Vanuatu climate futures portal would be useful for all sectors, especially infrastructure to develop adaptation strategies for building resilience. In the long term, people in Vanuatu (the ultimate beneficiary) will benefit from improved natural resources management and policy that account for climate change.

Southern Hemisphere Tropical Cyclone Data Portal

The Southern Hemisphere Tropical Cyclone Data Portal holds Vanuatu tropical cyclones data from 1969/70 to 2017/18.

Van-KIRAP linkages to SHTCDP

The project will extract all Vanuatu TC data from the portal and have it backed up centrally in the new VMGD ' Data Center' under activity **Activity 3.1.1** Upgrade the VMGD IT platform (eg Data Centre) and **Activity 3.2.1:** Update tropical cyclone and high quality climate data on the online Pacific Climate Change Portals and VMGD's centralized data management system CLiDE. The cyclone data harvested from the portal will support the **Activity 3.1.2:** Update VMGD website with new CIS products customized to sector needs.

By establishing a centralised storage facility and backup (Data Center) for VMGD will allow for better access, retrieval and archival of historical cyclone data for analysis of cyclone activity and risk on Vanuatu. A local depository of Vanuatu cyclone data within VMGD will improve the availability of cyclone data for VMGD, other government agencies and researchers. For wider use, this tool is able to be used by the public to examine the impacts of past tropical cyclones. This will also improves knowledge of past tropical cyclone activity in the Vanuatu by plotting tracks of cyclones within 400km of Port Vila from 1969.

Updating the Vanuatu cyclone information onto the Southern Hemisphere Tropical Cyclone Data Portal will also allows users to see the characteristics and paths of past tropical cyclone events. Meteorologists and stakeholders can use this tool to analyse the tracks of historical tropical cyclones and relate them to the impact on lives and infrastructure recorded on the ground.

Climate Data for the Environment (CLiDE)

CLiDE is the central database at VMGD that is essential to the Climate Division operations. CLiDE will be required to support project activities pertaining to developing new CIS and CLEWS. CLiDE is the underlying layer containing all the observational data for sites managed by VMGD.

Van-KIRAP linkages to CLiDE

All new instruments (eg AWS and Auto-raingauges) procured by the project will stream data into CLiDE for storage and archival. Data in CLiDE will also support BOM to train and develop of high quality climate datasets through best practice WMO quality assurance and homogenization processes **(Activity 3.2.2).** CLiDE will improve the availability of data for VMGD, other government agencies and researchers. CLiDE tool captures observational data that are periodically incorporated into the Pacific Climate Change Data Portal.

Project **Activity 3.2.1:** Update tropical cyclone and high quality climate data on the online Pacific Climate Change Portals and VMGD's centralized data management system CLiDE. Keeping the climate information current and updated will lead to improved currency, functionality and visualization of climate data records for Vanuatu. Community resilience imporves when access to these information is readily available in a visualization format that is easily understood and supports decision making.

Seasonal Prediction of Extreme Ocean Temperatures

The Seasonal Prediction of Extreme Ocean Temperatures Tool is a regional resource that is linked to the Seasonal Prediction of Sea Level Anomalies in the Western Pacific tool (see below). Forecast outlooks for both tools are generated via the POAMA seasonal prediction model.

Van-KIRAP linkages to Seasonal Predictions of Extreme Ocean Temperatures

This seasonal predictions and modeling approach will be used by the project team to downscale projections for Vanuatu to generate outputs for **Activity 5.6.1:** develop bio-geochemical and hydrodynamic model for coastal areas of Vanuatu; and CIS application products for the fisheries and tourism sectors as in **Activity 5.4.3:** Develop tailored application-ready climate change data sets for key climate variables.

Making these seasonal predictions available to the fisheries and tourism sectors will enable next- and end-users to establish medium- to long-term plans to respond to future climate risks. The information available on ocean tempeartures will help the Vanuatu Fisheries Department (VFD) and local communities manage their marine resources better and ensure sustainable management of these resources so they will continue to enjoy them well beyond their years. Both predictive and real-time SST and thermal stress information is critical to VMGD in planning coastal development and responding to safeguard agricultural, marine, tourism and water resources.

Seasonal Prediction of Sea Level Anomalies in the Western Pacific

The Seasonal Prediction of Sea Level Anomalies in the Western Pacific is a web portal that delivers gridded forecasts and skill maps using a navigable map overlaid with geospatial information. Sea level anomaly plume plots are also available for Vanuatu in PACCSAP.

Van-KIRAP linkages to Seasonal Prediction of Sea Level Anomalies

The information from this portal together with that sourced from the Pacific Ocean Portal will be used to inform outputs for **Activity 5.5.1:** Map climate hazard hotspot exposure and provide interactive risk database and CIS application products for the fisheries/tourism and infrastructure sector.

The sea level anomalies information generated by the Seasonal Prediction of Sea Level Anomalies in the Western Pacific will feed into the work undertaken by VMGD in developing new sector specific bulletins eg Vanuatu Oceans Bulletin planned under **Activity 2.1.2:** Develop and publish education and awareness materials (e.g. sector-specific bulletins, sector videos), based around new CIS tools and sector case studies.

Availability of sea level anomalies predictions will benefit the project with awareness raising, education and outreach of climate information services tools. Increase uptake of CIS information into decision making and disaster risk reduction.

Information and meteorological services provided by the Vanuatu Meteorology and Geo-Hazards Department

Vanuatu Climate Update (VCU) bulletin

The project will draw from the COSPPac Climate bulletin to enhance the VCU **Activity 2.1.1:** Develop new / enhance CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update.
The ability to generate seasonal predictions through VCU and apply the information prudently across a range of critical socioeconomic sectors will lead to a significant reduction in the negative impacts of climate change and variability along with enhanced capability to take advantage of other opportunities that may arise.

Vanuatu Climate Outlook

The project will draw from the COSPPac Climate bulletin to enhance the VCU. The benefits aligns to that mentioned above under VCU.

Observational data

Observations from the VMGD network will essential to the development of new CIS bulletins and products eg **Activity 2.1.1:** Develop new / enhance CIS content for online tools based on sector and community priorities, e.g. Vanuatu Climate Update.

Van-KIRAP linkages to Observational Data

The project will increase the number of observation sites through the introduction of 8 new automatic weather stations (AWS) and other instruments under **Activity 4.2.4:** Installation of new AWS and ARG, as part of rain

monitoring system and crop modelling system and weather equipment monitoring system. In addition, the project will also expand the observations on traditional knowledge (TK) and TK data will be developed into TK calendars and intergrate into mainstream climate information products and sector specific products (**Activity 3.4.1**).

Observational data will also be an essential part of **Activity 3.3.1:** Develop the "Crop-climate diary" (i.e. mobile App customized for Agro-Met data collection) and provide training on its use and update. APCC and VMGD has shared observational data for more than 8 synoptic sites and 80 rainfall observation sites across Vanuatu. An MOU has been signed to govern the use and sharing of these observations data.

The collection and use of localised observations data for the development of new CIS products makes it more relevant and site specific (localised) to a preferred resolution that match up with sector activities that is occurs at the same scale.

National Climate Outlook Forum

National Climate Outlook Forums (NCOFs) at the National Level is a local translation of the Pacific Islands Climate Outlook Forum (PICOF). NCOFs are a WMO initiative to enable countries to realize the benefits of climate information services. Climate services involve generating and making available to users a set of historical, real-time and prospective information products concerning climate variability and change along with information about their impacts. Delivery of these services has to be accompanied by assistance in their interpretation and in identifying a sensible set of decision options through a participatory process, while enabling mutual feedback so that ways of improving services can be identified on an on-going basis.

NCOFs aim to link climate information being generated by National Meteorological and Hydrological Services (NMHSs) with stakeholder institutions and their decision-making processes to improve application of climate information, particularly the seasonal scale climate outlooks. The forums also assess the generation and use of climate information in a national context to identify capacity gaps and create a regular platform to bring together users and generators of climate information.

Van-KIRAP linkages to NCOF

The NCOF process has been recognized by VMGD as a very crucial platform to interact with sectors, provincial representatives and last mile communities on the use of climate information into their national planning processes. The NCOF is a primary event for VMGD that has a sector focus every year.

It is this reason why the Van-KIRAP project will support an annual NCOF per year with special focus on the five targeted sectors (Agriculture, Fisheries, Infrastructure, Tourism and Water). This will also allow VMGD and regional partners to build capacity of sector on the integration of CIS and how it supports the risks from climate hazards. Additionally, the NCOF can be used to define CIS needs and products that will meet sector requirements.

The Vanuatu NCOFs will also a platform to facilitate the engagement requirements that have been identified by the CIS Sector Action Plans that have been developed in consultation with sectors. The following Vanuatu NCOFs have been held to date:

- Vanuatu First National Climate Outlook Forum (focus on Agriculture); Port Vila, Vanuatu, 14 – 18 March 2016
- Second Vanuatu National Climate Outlook Forum (focus on Health); Port Vila, 21-23 October 2017

Information and meteorological services provided by the National Institute of Water and Atmospheric Research
https://www.niwa.co.nz/

CLIDEsc

A new climate analysis and information software suite, CLiDEsc, has been installed in VMGD as part of the CLEWS, to generate products and information to support data quality assurance, climate analysis, and sector-focussed decision-support services. The installation of CLiDEsc was conducted under the VCAP project.

Van-KIRAP linkages to CLIDEsc

CLIDE and CLiDEsc are the central database and services application layer at VMGD and will be essential for the development of Climate Early Warning System (CLEWS) products (**Activity 3.4.1**)

The Van-KIRAP project will expand CLiDEsc functions to allow it to generate newly identified CIS sector-focussed decision-support services from Sector Action Plans. For example, drought monitoring for the Agriculture and Water sectors. The goal was to provide climate services staff with the ability to be able to quickly generate improved drought information and policy input for national disaster management agencies and other partners, and to support the development and implementation of Drought Response Plans.

Information and meteorological services provided by Secretariat of the Pacific Regional Environment Programme (SPREP)

http://www.sprep.org/

Pacific Islands Climate Outlook Forum (PICOF)

Pacific Islands Climate Outlook forums (PICOFS) have been operational in the Pacific since 2015 with the aim to provide collaboratively developed and consensus-based seasonal climate outlooks and related information on a regional scale. These activities support decision-making to manage climate-related risks and support sustainable development.

The outlooks generally include probabilistic predictions of seasonal mean rainfall, surface air temperature and other weather parameters, as well as the likely evolution of key drivers of seasonal climate variability relevant to the region such as the El Niño/Southern Oscillation (ENSO). This process was initiated by the World Meteorological Organization/Climate Information and Prediction Services (WMO/CLIPS) project, in collaboration with National Meteorological and Hydrological Services (NMHSs), and regional/international climate centres among many other partners. In addition, there is a strong representation from regional support organisations, WMO and science service providers.

The Pacific Meteorological Desk Partnership (PMDP) a Secretariat made up of SPREP and WMO; and the Pacific Islands Climate Services (PICS) Panel are the main organisers of PICOF with funding support from a number of sources and partnerships.

The key output from the PICOF is the Regional Climate Outlook and Tropical Cyclone Outlook for the upcoming cyclone season.

Capacity building

PICOF's generic format includes a pre-PICOF capacity-building component for operational climate experts from NMHSs to improve understanding of the regional climate processes, access/interpret global/regional climate prediction products, and gain skills in operational seasonal prediction at the regional and national scales. The PICOF itself includes sector representatives from the either (a) Agriculture (b) Fisheries (c) Tourism (d) Infrastructure (e) Water and (f) Disaster Risk Reduction.

PICOF allows the National Meteorological Services (NMSs) representatives to observe and learn how to engage sectors representatives and the different techniques employed to developed tailored climate information services (CIS) and products and consultative approaches to develop consensus-based forecasts.

Showcasing best practice/lessons learnt

The sharing of lessons learnt and best practices (approaches) is encouraged and promoted in the PICOF. Countries are able to share lessons learnt and best practices through their country presentations and updates. Other NMSs share the learnings and at the same time interact with regional organisations and development partners to secure resources for replication of these approaches in their own countries.

Taking these learnings from the PICOF, country representatives organise their National Climate Outlook Forum (NCOF) and apply these approaches with some contextualization to suit local situation and tailor national relevant CIS and products.

PICOF linkages to Van-KIRAP project

VMGD uses the PICOF regional statement as a guide in the formulation of their national climate outlook and national tropical cyclone guidance. A copy of the cyclone outlook is available on: https://www.vmgd.gov.vu/vmgd/index.php/forecast-division/public-forecast/tc-outlook

Van-KIRAP will develop at least 5 sectoral case studies that is not yet available elsewhere in the region. At least 12 Community Climate Information Centers will also be supported for the communication and dissemination of climate information to It is important that Van-KIRAP is able to showcase these lessons and contribute to the PICOF learning process on the tailoring of climate information to help 'last mile' users. This coordination and communicating mechanisms are not available or underutilised in other countries. To attract visibility and awareness to these innovative approaches, the project supports international travel of VMGD technical staff and sector coordinators to attend PICOFs and other regional events to share their knowledge and experience on how they developed their case studies and lessons learnt from the complete process.

Van-KIRAP will also support the participation of VMGD and sector coordinators in annual PICOFs so they are able to learn from other larger and advanced countries such as New Zealand, Australia, United States, Fiji and Samoa, in order for Vanuatu to also develop and enhance their national climate information systems and processes.

5.0 Assessment of the Vanuatu Information Communication Technology (ICT) capacity to manage Van-KIRAP tools and equipment

Capacity mapping for the ICT Division at VMGD was carried out in March 2019 by Ms Patricia Mawa, VMGD ICT Manager and Mr. Sunny Kamuta Seuseu, Climate Technical Officer, SPREP. The result of the ICT capacity mapping is as follows:

- The Information and Communication Technology (ICT) and Engineering Divisions currently ensure that VMGD uses up-to-date, contemporary and robust infrastructure to support all the services of the VMGD. There is a total of 8 staff (increased from 1 staff in 2000 to 10 in 2017). This includes a Division Manager, Systems Administrator, Senior Network Technician, Database Applications Officer, ICT Officer, Technician (Instruments), Technician (Electrical), Senior Technician (Volcano), Technician (Volcano) & Technician (Seismic).
- The ICT team ensures that there are robust and appropriate ICT equipment and electronics including all necessary devices, for data processing and interfaces with other VMGD Divisional requirements, including support for corporate and administrative functions.

A summary of the Vanuatu ICT Capacity mapping is provided in Table 3 below.

Table 3. Summary of the Vanuatu ICT capacity mapping conducted for the Van-KIRAP project

Task				Current Status	Comments
ICT & Engineering staff				10 staff: 1. ICT and Engineering Division Manager 2. PSO System administrator 3. Senior Network Technician 4. Database Applications Officer 5. ICT Officer 6. Technician (Met instruments) 7. Technician (Electrical) 8. Senior Technician (Volcano) 9. Technician (Volcano) 10. Technician (Seismic)	Van-KIRAP Project has recruited two new positions that will increase capacity of VMGD. These positions are 1. Apps Developer 2. Radar Engineer
Existing products	Product			www.vmgd.gov.vu	All current products are available on the VMGD website. The Van-KIRAP project will develop a *Vanuatu Climate App*, and 5 Sector Climate Information Services Portals for users to access the exisiting and new products.
	Product technology			Based on www.joomla.com which uses PHP technology	
	Running environment			Linux – CentOS	
	Maintenance			Upload documents or plain text files to server	
Infrastructure	Server room	Accessible		24/7	
		Air-conditioned		24/7	
		Security		Locked 24/7	
	Internet connection	Method		Fibre – Government ISP via submarine cable with satellite backup	
		Connectivity		10 mbps download	
	Power supply			Infrequent power interruptions	Diesel generator backup including a dedicated UPS

	Van-KIRAP will purchase new hardware and instrument tracking software that will be housed in the new VMGD Data Center. The Data Center will provide a onsite back-up to all exisiting and new ICT systems including the hardware provided by the project. VMGD plans to migrate all backup systems to a virtual environment to allow for easy restoration of affected services. The Data Center be managed by current staff with the oversight administration by the ICT Manager.		
ICT capacity	Maintenance skill set	Network, telecommunications IP transmission	Current network infrastructure will support the new equipment supplied by Van-KIRAP.
	Development skill set	JavaScript, python, PHP, MySQL, html, XML, CSS	Van-KIRAP hiring of an Apps Developer will enhance capacity of VMGD in 'programming' and 'software applications' particularly for mobile applications development

5.1 ICT Challenges

The infrastructure in VMGD is well established and maintained. The ICT & Enginering Division staff are very capable and can maintain the local hardware and support the network.

The Vanuatu Government launched the Vanuatu eGovernment Network back in July 2012. It is advertised as the best government information and communication technology (ICT) infrastructure in the Pacific Islands. VMGD has moved its internet broadband services to this network.

At the moment, the internet service in Vanuatu is complemented by a Government broadband service via submarine cable.

With VMGD's ever expanding weather sensors, and business needs throughout the country, the ICT and Engineering Division has the capacity to keep-up with the growing technologies to ensure data transmission from all weather sensors to VMGD HQ are transmitted in near-realtime from the existing weather and climate stations in Vanuatu (Figure 1).

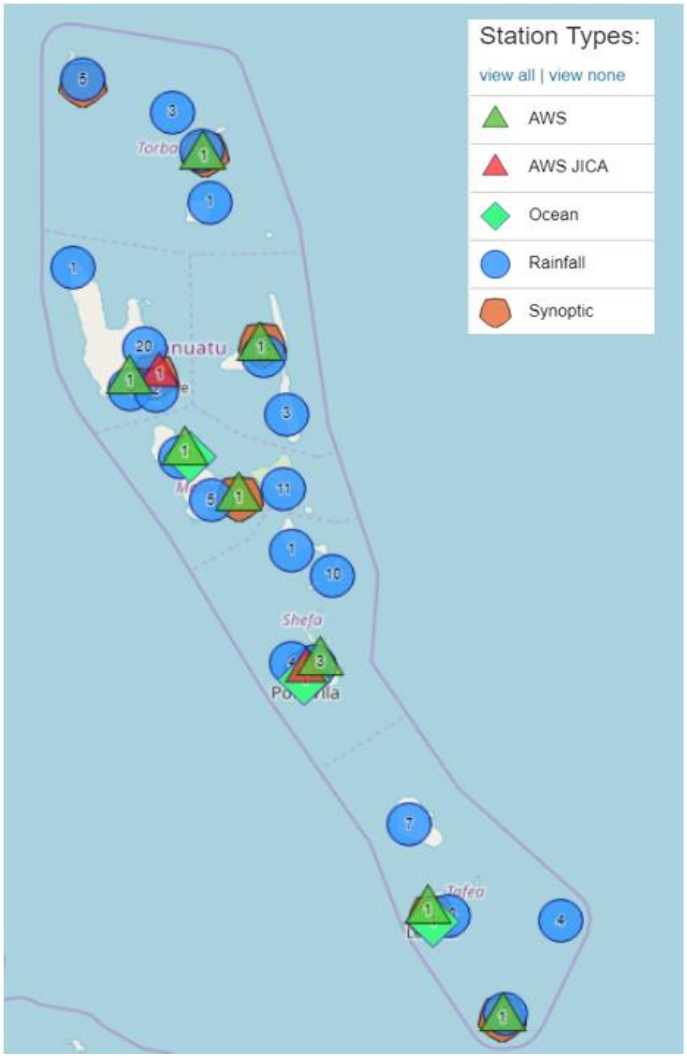


Figure 1. Current weather and climate stations throughout the archipelago of Vanuatu excluding the seismic and volcano network.

5.2 ICT Opportunities

With more Linux machines being introduced to VMGD, some Linux administration training is highly recommended.

To further enrich the current VMGD website, more advanced knowledge of python, PHP, HTML, JavaScript together with mobile device applications development would also promote future products and innovation. Van-KIRAP will provide training and capacity development for the ICT staff and by the end of the 4-year project, there will be enhanced capacity within VMGD.

5.3 ICT Capacity Summary

5.3.1 VMGD Website

Most National Meteorological Services (NMS) Climate Divisions in the Pacific region deliver their products and services via NMS websites. Among them, the Vanuatu and Samoa NMS websites are based on content management systems (CMS) using a range of website technology (Table 4). Even though Fiji, Solomon Islands and Tonga do not currently utilise CMS, they have their websites organised in a way to make frequent content updates, such as daily weather forecast, relatively easy.

Table 4. National Meteorological Services websites technologies

Country	Website Technology
Vanuatu	Joomla, with PHP frontend scripting
Samoa	Joomla, with PHP frontend scripting

5.4 ICT Infrastructure

The ICT infrastructure at VMGD already supports a range of data uploading from the national observation network of instruments. A typical network diagram for a data collection process directly from the field to the data processing system (Tideda), into the database (CliDE) then to the product generator system (CliDESC) is depicted in Figure 2.

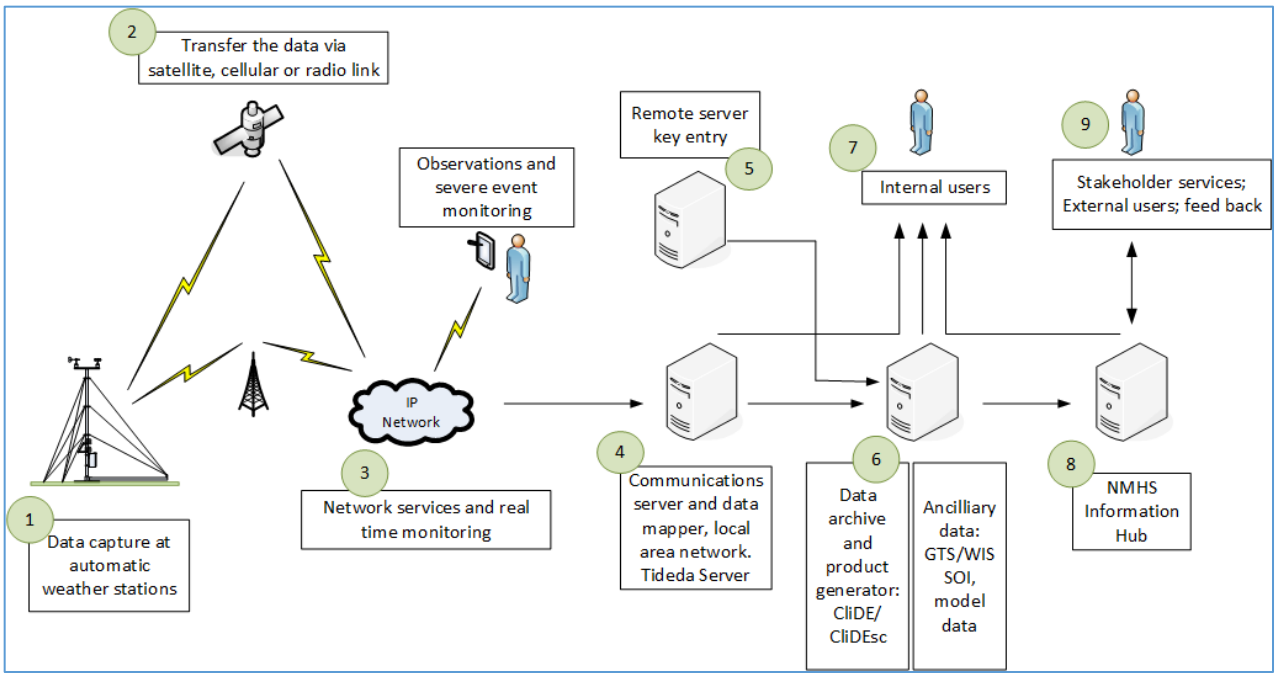


Figure 2. ICT infrastructure system collecting, storing and delivering data from remote field observations to stakeholder services.

Meteorological data are recorded and logged at the automatic weather station sites (1) and transferred by satellite link (2) to the NEON telemetry server (3). Data can be monitored in near realtime by remote access (4). Data are processed into native database format (5) and ingested to the CLiDE database (6). The database server CLiDEsc product generator creates customised products from the data that are then transferred to internal users (7), and to external users (9) via the VMGD information hub (8).

5.4.1 Internet Connection

- All the NMS climate sections have access to the Internet, with the download speed varying from 512 Kb per second to 10 Mb per second. Some countries already have submarine fibre optic cables connections and more countries, including Vanuatu, are hooked up to the fibre optic cables.
- The current internet bandwidth is sufficient to meet future demands that will be brought about by the additional instruments to be installed under the Van-KIRAP project.

The current (theoretical) download speed in Vanuatu is shown in Table 5.

Table 5. Internet download speed on paper

Country	Download Speed (theoretical)
Vanuatu	10 Mb/sec

However, the download speed that users can actually achieve is much lower than the theoretical speed. Some of the factors that account for the lower download speed are:

- The nature of different uses at the same time means long latency, high packet loss rate, etc.
- Multiple users in the VMGD office share the same internet connection.
- The current internet for VMGD is via Government broadband and has an 'essential dedicated connection' provided by the Government to support its disaster monitoring mandate.

Data Analytics tools

Currently, the VMGD website uses Google Analytics to track the number of users accessing the website. Generally, during times of unsettled weather the number of hits increase dramatically, and reduces during periods of good weather. The analytics data show different information regarding the types of users who access the website, allowing VMGD to enhance their CIS products presented on the website for different users. A typical analytics report is shown in Figure 3.

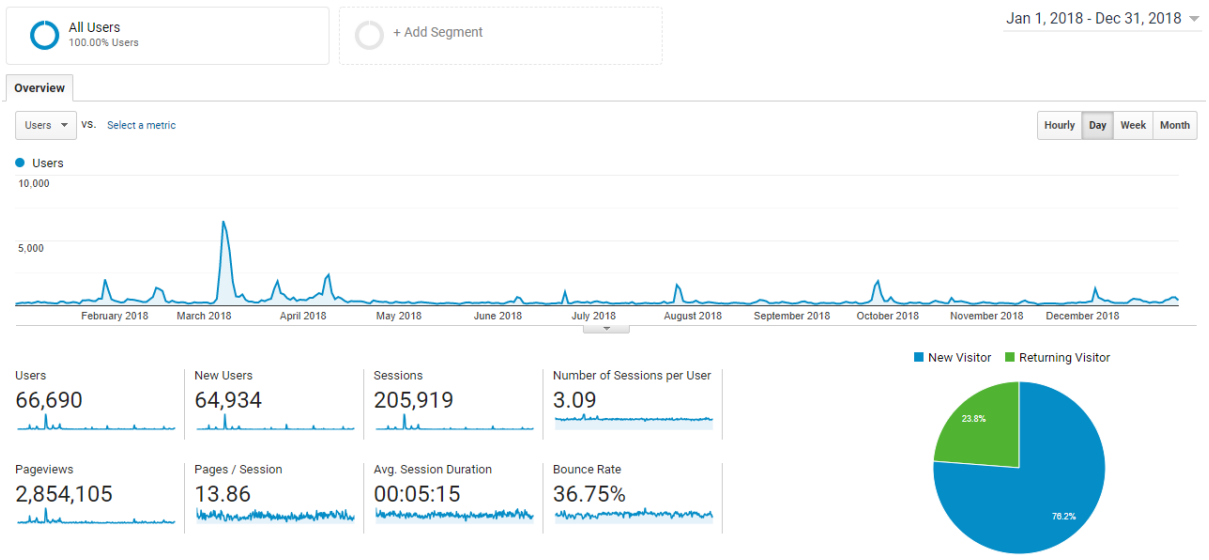


Figure 3. Summary information for the VMGD website in 2018 (Source: VMGD 2018 Annual Report)

The new CIS sector portals that Van-KIRAP will develop will also use Google Analytics and other analytic tools as part of the design to ensure the tracking of users receiving information from this tool as well as to map out which CIS is most popular to users.

HPC Clouds

HPC Clouds will not be utilized by the Van-KIRAP project. The Government of Vanuatu has a policy against the use of cloud environments for storage of government information and the security issues pertaining

to its use and access. The Van-KIRAP information and data will be stored onsite at VMGD with back-up to the Data Center for long-term archival.

5.5 Server Room and Power Supply

VMGD has established dedicated, temperature-controlled server rooms hosting large amount of computer servers and network equipment. In 2018, a dedicated UPS server was made available to enable smooth operations of any interrupted services. Additional servers will be purchased and commissioned by the project as needed when new instrument data and CIS tools come online.

5.6 ICT Capacity

VMGD currently have either in-house IT support or support provided by the Ministry of Climate Change, which in most situations means any hardware or network problems can be solved quickly and in-country (Table 6).

Table 6. ICT support

Country	Hardware and Network support
Vanuatu	In-house support

With regards to ICT capacity building, NMS are encouraged to factor the following skills areas into their training or recruitment plans for specific positions:

Essential

- ***Database administrator***: As a majority of the NMS now have operational climate data management systems (CDMS), it is critical for NMS to have a well-trained database administrator to monitor database performance and back-up.
- ***Linux system administration***: Some of the NMS websites run on Linux systems and recently introduced products are running on various Linux systems as well. Linux systems are normally stable and do not require daily maintenance or easily attract viruses. However, some basic training to help the NMS staff quickly diagnose and troubleshoot simple Linux problems is recommended.
- ***Systems security administration***: As technology expands, be it hardware or software, the security of data and physical hardware is prone to cyber attacks. It is paramount that these systems are well equipped to safeguard such attacks, particularly as the gateway to the data center. Hence firewall hardware and software should be engaged by the NMS with appropriate training for systems administration staff.

Desirable

- Website/CMS designers
- Developers
- Mobile applications development

- Systems security training particularly for firewall
- Advanced network and transmission systems training

6.0 Risk Management

The Project Operations, Maintenance and Monitoring Plan, sets out the Standard Operation Procedures that apply to the technological and operational CIS and meteorological platforms operated by VMGD. Table 7 provides further information on the corporate, as well as operation risk management systems used by VMGD and identifies how they are relevant to this project.

Table 7. Risk management proceedures in place at VMGD and their application for the Van-KIRAP project

Existing Risk Management Process / Document	Application to Van-KIRAP Project
Vanuatu 2030 – The People's Plan	The project objective aligns well with the *Vanuatu 2030 The People's Plan*. The Fourth Development Aspiration of the Peoples Plan focuses on "Enhanced resilience and adaptive capacity to climate change and resilience". Additionally, the Environment Pillar 3 of the People's Plan has a direct focus on Climate and Disaster Resilience.
Ministry of Climate Change Change (MoCC) Corporate Plan	The MoCC Corporate Plan Chapter 7 is primarily focused on Improving quality, timelines and availability of CIS, forecasts, warnings and services. The project will adopt the risk management framework that is part of this plan to ensure better coordination and alignment.
VMGD Corporate Plan 2016-2018	The Corporate Plan has a good M & E Framework and Risk Management components that will ensure internal and external support is available to support the project activities.
VMGD Decision Support and Risk Management Training Module	VMGD has developed a Training and Capacity Building Module that focuses on Risk management. The Vanuatu CISRDP will review and update the Module and where needed expand to reflect the risks associated with the project.
VMGD Climate Operating Procedures Manual	The VMGD Climate Operating Procedures Manual sets the standards and guidance for all Climate Information Services and operations. The Manual has a risk management elements that are aligned to the World Meteorological Organization (WMO) Climatological Practices Manual. The project will adhere to the manual and will seek to expand the scope of the manual to reflect the additional investments
VMGD Risk Governance Assessment Report	This RGA was initiated at the request of the Vanuatu Government. It was designed to critically analyse the NAB structure (VMGD in part of) including roles, while also expanding its focus to assess the capacities of agencies undertaking CC/DRR activities. The project will seek to support broad objectives of the report and where possible assist in the implementation of the key recommendation of the assessment.
Seasonal Climate Prediction models (tools)	The project will employ a number of seasonal climate prediction tools such as PICASO, CLIK-P and SCOPIC to provide 3-monthly rainfall and temperature forecasts for localised islands/locations. To reduce damages from extreme climate events through disaster risk management, seasonal climate prediction services play a critical role in utilising advanced climate prediction such as early warning outlooks, to understand the causes, impacts and necessary provisions to prepare for anticipated extreme climate events.

APPENDIX 1: Current Climate Information Tools in Vanuatu

Online Climate Outlook Forum (OCOF)

The Online Climate Outlook Forum (OCOF) provides a regular opportunity for Pacific Island Meteorological Services to discuss the status of the El Niño Southern Oscillation and to share seasonal climate outlooks. This important monthly forum allows partners in eleven[1] Pacific National Meteorological Services (NMS) to discuss their current climate outlook, and possible implications for each country. OCOF is administer by the Secretariat of the Pacific Regional Environment Program (SPREP) and the Pacific Met Desk Partnership.

Participants are encouraged to discuss and raise questions about climate outlooks and about the Seasonal Climate Outlook Prediction model for the Pacific Island Countries (or SCOPIC) tool (see below). The OCOF also provides an opportunity for updates and feedback on the program.

VMGD participates in the OCOF on a monthly basis and the information and reports that are compiled for the teleconference are available online at the following url: https://www.pacificmet.net/products-and-services/online-climate-outlook-forum/

This tool has been developed as part of the Pacific Meteorological Desk Partnership (PMDP) and managed by SPREP as well as the Australian Bureau of Meteorology (BOM). They regularly update the climate data with monthly climate outlooks. The outlooks are developed from meteorological services, using current data which predict climate forecasts for up to a few months at a time.

The climate variable analysed for this tool is rainfall which has been used to make future climate predictions. The tool provides real time outlooks to make future predictions of rainfall for upcoming months, predicting the probability of low or high average rainfalls.

Target sectors and utility

OCOF could be useful for the following sectors: water, agriculture, infrastructure, as well as disaster risk reduction and public health. The tourism industry would also find it useful for assessing the link between rainfall variability and tourist visitation (and expenditure). For these sectors it is a tool that is easy to use (intuitive), displaying one variable and easy to focus on specific regions.

The background provided is in the form of a summary report of the OCOF. This summary highlights the purpose, agenda, participants, observations and verification, and outlooks. The summary is presented as meeting minutes style, in a non-technical way, and so would be accessible to a large audience.

For this tool to be more useful to specific sectors, the addition of other variables specific to the sectors would provide correlations of data specific for the sector, e.g. public health may look at previous years of higher or similar rainfall and associated incidences of malaria.

Seasonal Climate Outlooks for Pacific Island Countries (SCOPIC)

[1] Cook Islands, Fiji, Kiribati, Marshall Islands, Niue, PNG, Samoa, Solomon Islands, Tonga, Tuvalu and Vanuatu.

Seasonal Climate Outlooks for Pacific Island Countries (SCOPIC) is a decision support tool that generates seasonal outlooks for rainfall, temperature, and other climate-related variables such as Sea Surface Temperatures (SST) and Mean Sea Level Pressure (MSLP). This software also has a drought monitoring module. The tool is used as a prediction method for OCOF for ENSO monitoring in the Pacific region.

VMGD uses SCOPIC as their primary tool for generating seasonal climate predictions for Vanuatu. The information generated from SCOPIC goes into the preparation of the Vanuatu Climate Update (VCU) that is prepared monthly. The VCU is a national product of VMGD.

The tool is hosted by SPREP, with the help of Pacific NMS and the BOM, with funding form DFAT. This software is kept updated as a projections and forecasting tool.

Target sectors and utility

The drought monitoring module is useful for the water and agricultural sectors. The tool is also used by the water, infrastructure, agriculture and fisheries sectors, with benefits also for public health.

Ocean Portal

The Ocean Portal is an online tool that displays ocean information on maps and graphs. Users can view information such as SST, subsurface temperatures, salinity, current direction, sea level and tidal gauge data.

This tool is kept current by the Pacific Community (SPC) with new data sourced from BOM (Climate and Oceans Support Program funded by the Aust. Government), with near real-time and forecasting. This tool is a forecasting tool forecasting between 4 weeks, 8 weeks, and 12 weeks.

Variables are linked to different areas, some overlap:

- **Ocean conditions:** Sea temperatures, swell, currents, salinity, chlorophyll. SST is near real-time (lag of two days); however other variables are not updating.
- **Sea Level**: Swell forecasts in the South Pacific region (presented as a topological map), and historical data available.
- **Environmental conditions**: Coral bleaching and other reef health warning variables, alerts and forecasts.
- **Other information**: Tidal predictions and chlorophyll.

Target sectors and utility

The information available in the tool is useful for the fisheries, tourism and infrastructure sectors. VMGD uses the Ocean Portal for the monitoring of the evolution of El Nino Southern Oscillation (ENSO) and providing advice to the Fisheries sector end users.

The website is intuitive to use and provides some historical datasets as well as pop-up explanations of information icons. This site is easy to follow, with tabs to click on area of interest and drop-down menus for checking up to date information or historical data. These features make the tool intuitive and easy to use. This tool provides a good background, presented both as a pop-up when clicking on each icon

of interest and on each monitoring page a document with a detailed background is available. The terminology is not too scientific.

COSPPac Climate bulletin

The COSPPac Bulletin delivers climate and ocean monitoring and prediction data; 3 months ahead and uses POAMA outputs relevant to the tropical southwest Pacific region, including diagnostics of ENSO, the Madden–Julian Oscillation, ocean temperature at the surface and at depth (up to 400 m), cloud and rainfall patterns, tropical cyclone information and seasonal outlooks.

The information and meteorological services are hosted by BOM, Pacific Met. Council, National Met. Services, and SPREP, supported by the Republic of Korea through the Pacific Islands Climate Prediction Services (ROK-PI CliPS) Project and administered by SPREP. The hosts of this tool keep information updated by reviewing current conditions, as well as projections. The bulletin is a review of the current conditions, as well as a projection, using graphs and diagrams.

The platform provides up-to-date information on the variables:

- ENSO,
- MJO,
- Cloud coverage,
- Rain
- SST & subsurface temp 400 m,
- Sea level
- Cyclone activity

Target sectors and utility

The resource is updated by gathering data from global meteorological services BOM, NASA and the Ocean Portal. The bulletin style format combines the data from meteorological sites and makes it accessible in a monthly review style format.

The use of graphs, diagrams and other figures as well as text making it easy to follow, with well labelled tabs that allow user to click on area of interest, drop-down menus for checking up to date information or historical data. The information uses some scientific terminology but is not overly technical. This use of text and figures makes it easy to understand, intuitive and visually appealing.

The resource would be useful for the general community interested in a review of climate conditions, the tool also provides a general outlook suitable for fisheries, tourism and agricultural sectors.

Climate Information toolkit for the Pacific (CLIK-P)

CLIK-P was developed for the 14 beneficiaries NMS of the Republic of Korea-Pacific Islands Climate Prediction Services (ROK-PI CLIPS) project and it is based on the established CLIK (CLimate Information toolKit) at the Asia Pacific Climate Centre (APCC). CLIK-P is a regionally tailored online tool for all Pacific Island Countries and Territories (PICTs). CLIK-P aids users in retrieving and using climate prediction data and information available from the data server at SPREP.

It provides Pacific-oriented information using the multi model dynamical seasonal forecast based on different combinations of the user's preference. The forecasts are combined with the past performance of each forecast generated, allowing users – climate forecasters, disaster managers,

water resource managers, researchers, and others in the Pacific – to generate customised climate predictions on seasonal to inter-annual timescales for their region of interest.

This software is kept current and provides historical and current climate data and is a climate forecast/prediction resource. The variables predicted in this tool, are precipitation and 850 hPa Temperature that is presented in colour shading on a map of the region. There is also a feature to generate data that is not available using the prediction tool and can generate the information.

Target sectors and utility

The tool is designed to be used by climate forecasters, disaster managers, water resource managers, researchers, and other users in the Pacific. The tool would be useful for fisheries, tourism, agricultural and water sectors in Vanuatu with assistance/training to learn its functions. It is simple, and intuitive to use, there is a guide available for download providing instructions on how to use the tool. This is one of the best things about this tool, and it makes data from a range of sources (POAMA, NASA, APCC) available on one site.

CLIK-P uses "Application Guidelines" that explains the scientific background of development, and how to use the system. It is easy to use, and specifically designed for climate forecasters, disaster managers, water resource managers, researchers, and other users in the Pacific.

Pacific Island Countries Advanced Seasonal Outlook tool (PICASO)

PICASO (Pacific Island Countries Advanced Seasonal Outlook) is a PC-based seasonal prediction tool tailored for PICTs jointly developed by APCC and SPREP. PICASO produces a probabilistic forecast of the seasonal mean rainfall from any given weather station by customising the data from the APCC dynamical seasonal prediction multi-model ensemble. Through a series of capacity building activities, PICASO will be operated by NMS of Pacific Island countries together with SPREP, which operates the regional data and computation server (CLIK-P) for PICASO.

This hybrid dynamical-statistical prediction system offers a more reliable seasonal forecast, where conventional empirical methods showed poor prediction skill, while also taking the prediction uncertainty into account. The forecast is based on the APCC multi-model ensemble prediction system, and is tailored to each target station taking into account the uncertainties associated with forecast-observation relationship as well as the multi-model spread. PICASO provides descriptive seasonal outlook information based on collaborative discussions between APCC scientists and Pacific NMS technical experts. The various skill assessments are also expected to guide the forecasters merging their conventional methodology to the newly developed PICASO system.

PICASO will be the first operational attempt to utilize digital data from dynamical seasonal multi-model ensemble (MME) forecast that is tailored for each observational spot. The APCC MME seasonal forecast is statistically downscaled using Bayesian regression of the predictors selected by the climate experts onto the local rainfall records. The probabilistic forecasts are generated accounting the uncertainties associated with dynamical MME forecasts and observations, as well as the model spread in the MME system. Their operational skills will be assessed by various skill scores, including LEPS (Linear Error in Probability Space) score, which is familiar to NMS staff.

Target sectors and utility

PICASO uses the variables sea surface temperature, precipitation, and wind. The tool uses the variables as a way to provide analysis in the form of maps, and color contours. This makes PICASO intuitive to use, and users can easily navigate functions through the variables generated as individualised forecasts based on users preference. This information is presented in a report form with pie charts and precipitation predictions that are easy to interpret.

The background provided is based on the relevance of this tool to climate projections and, why this is important to public health. The background provided is technical, however it provides a good description of how the software works. The 'application guidelines' is available for download, country specific handbooks, and a tutorial. The best thing about the tool is that it can be personalised, where the user has a login and can navigate the website saving the climate forecasts in their personal account.

The scientific data presented is easily interpreted and not too technical, this means that the data could be interpreted by a diverse range of people. The information presented would be useful for the agriculture, water, infrastructure and the fisheries sectors. This tool is also useful for communities to building resilience within communities.

Application Guidelines

The Application Guidelines is a product of the Republic of Korea – Pacific Islands Climate Prediction Services project. The guideline explains the scientific background of developing the Climate Information Toolkit for the Pacific (CLIK-P) and the Pacific Islands Countries Advanced Seasonal Outlook (PICASO) and how best to utilize these systems.

The Application Guidelines, along with Country-Based Handbooks, explain the methodologies used to develop CLIK-P and PICASO in order to increase the capacity of PICT National Meteorological Services.

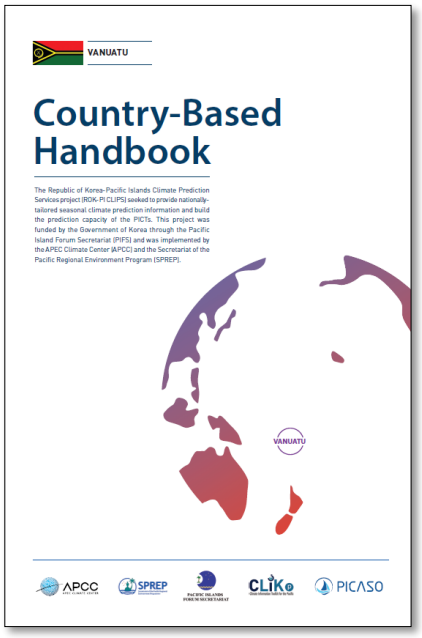
ROK-PI CliPS aims to deliver a greater understanding for the climate officers in respective NMS of how the predictions are generated utilizing various defined predictors for specific climate stations, rather than simply delivering prediction systems. This understanding will lead to higher quality national climate outlooks as well as decreasing reliance of Pacific NMS on external partners for climate expertise.

Vanuatu Application Guidelines

The Pacific Island Countries Advanced Seasonal Outlook (PICASO) brings the APCC multi-model ensemble dynamical seasonal prediction to the Pacific Island region and tailors the climate information to the local context. This Country-Based Handbook summarizes the major climate drivers in Vanuatu that were jointly identified by APCC and the National Meteorological and Hydrological Service.

The handbook also provides the observational relevance of the dynamical seasonal prediction so that NMS can better interpret the models emulated forecasts in comparison to actual observations.

The Country-Based Handbook can increase VMGDs understanding and use of the PICASO forecast in the global climate context.



ENSO Wrap-Up

The ENSO Wrap-up bulletin is a product of the Bureau of Meteorology updated every month and provides current state of the Pacific and Indian oceans. This service is found at:
http://www.bom.gov.au/climate/enso/

This resource provides weekly overviews of ENSO covering SOI, and IOD. The ENSO Wrap-Up is a tool that incorporates interactive videos and monitoring trackers that indicates the ENSO cycle current predictions. The data is kept updated and provides near real-time data for forecasting.

This tool provides information on variables that are used to track ENSO efficiently. The variables used to track ENSO are:

- **Sea Surface and sub-sea surface temperature** weekly and monthly reports.
- **SOI** presenting trends and future predictions
- **ENSO outlook** based on global trends.
- Lastly current data on the variables of **trade winds**, and **cloudiness at the dateline**. All these variables combined provide indicators to better understand the current cycles of ENSO.

Target sectors and utility

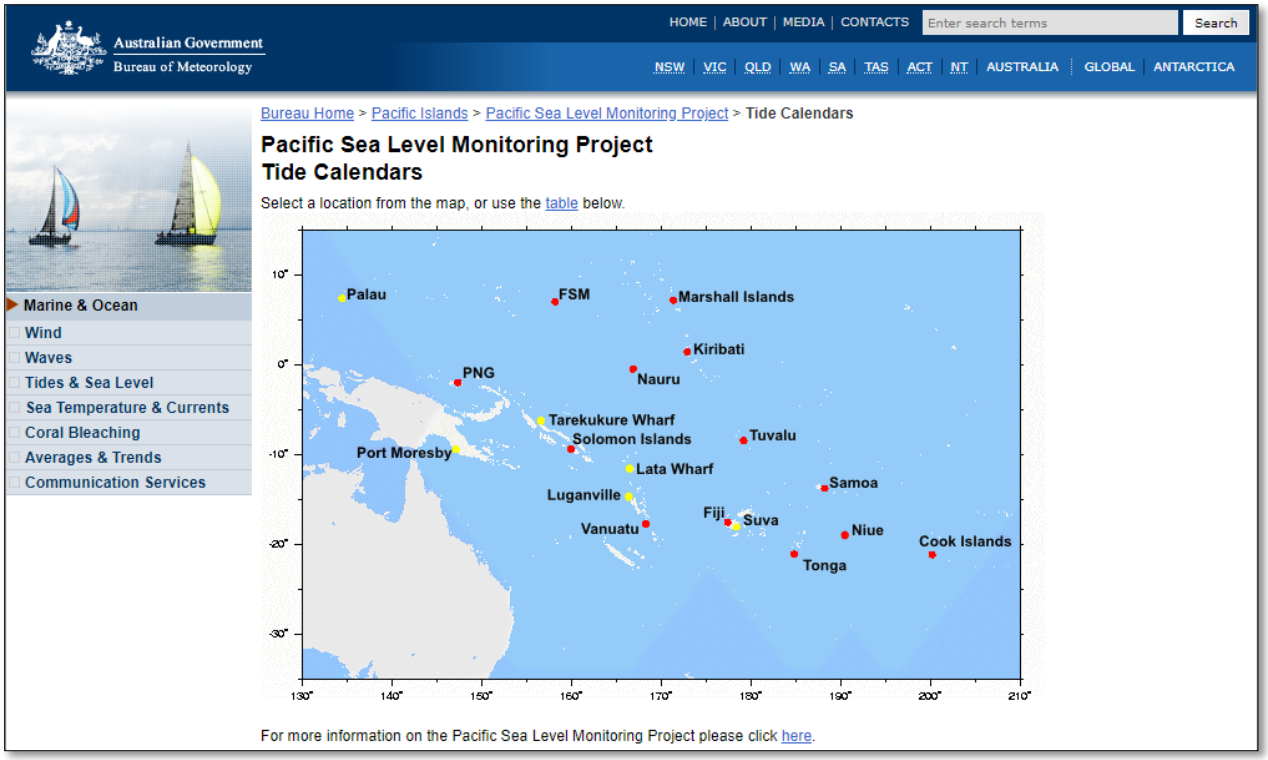
The website is intuitive, and the data provided is brief and informative, the use of a table with tabs that have each of the variables linked to each of the tabs.

ENSO Wrap-up is relevant for the agriculture, water, fisheries and infrastructure sectors. It would allow for better preparation and planning in all these sectors prior to a La Nina or El Nino cycle. Providing a better understanding of the severity of cycles through analysis of these variables.

The background information provided allows the user to better understand the relevance of each variable to ENSO forecasting. The best thing about this tool is the ease of understanding, and that language used is not too technical.

Tide calendars

Tide gauges across the Pacific Ocean provide data which is used to generate annual tidal predictions, an accurate long-term sea level record for the Pacific region, and information about the variability of extreme tidal events in the Pacific.



Tide calendar provides a long-term tidal forecast throughout the Pacific. It is kept current with 2 years of tidal data available, this data is easily interpreted, using sine waves showing time and tide height. This tool is presenting data for tide forecasts, and sea level in the Pacific.

Target sectors and utility

It is easy to use and intuitive, listing charts for countries in the pacific, with month and year file options. There is not a lot of background information on the webpage and this is one of the good aspects of the tool, it is simple and not too technical.

The tool would be useful for infrastructure, fisheries and the tourism sectors in Vanuatu.

Pacific Climate Change Data Portal

The Pacific Climate Change Data Portal provides historical climate information and trends from individual observations sites across the Pacific region and East Timor. The Pacific Climate Change Data portal was developed through the Pacific Climate Change Science Program (PCCSP) and Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program.

The Pacific Climate Change Data portal can be found at: http://www.bom.gov.au/climate/pccsp/

It has a collection of raw data on rainfall, max, min and mean temperature, diurnal temperature range, MSLP 0900hrs in the Pacific Region and East Timor. The data used is historical data for climate information of the last century.

Target sectors and utility

The data is not current, however it may by useful for the public health sector to review trends in climate changes and the possibility of analyzing these trends against public health records in disease outbreak. This could improve forecasting of how event impact communities.

This portal is easy and intuitive to use, with the use of technical style graphs and meteorological terminology make this tool technical. The best thing about this tool is the use of bar graphs that allows for easy interpretation of trends in climate variables.

Pacific Climate Futures

Pacific Climate Futures is a user-friendly, web-based tool, built upon the extensive analysis of global climate models (CMIP5 and CMIP3). It has been developed as part of the developed through PCCSP, and PACCSAP Program.

Users can explore the likelihood of future changes in a range of variables (temperature, rainfall, wind, sunshine, humidity and evaporation) based on 13 time periods (e.g. 2030, 2035, 2040, 2085, 2090) and four greenhouse gas emissions scenarios (very-low-RCP2.6, low-RCP4.5, medium-RCP6.0 and very-high-RCP8.5). Understanding projections of future climate can underpin climate change adaptation strategies and contributing to sustainable development.

Access to the Pacific Climate Futures tool is available at:
https://www.pacificclimatechangescience.org/climate-tools/pacific-climate-futures/

This tool provides national and sub-national climate projections for Countries in the Pacific and East Timor, with the use of global climate models. These models use data from global climate modelling experiments - CMIP3 & CMIP5. The projections based on CMIP3 with results derived from 18 global climate models (GCMs) give three different time periods and three emissions scenarios to be reviewed 2030, 2055 or 2090 - low-B1, medium-A1B and high-A2. While CMIP5 have results from 43 GCM and allow user to explore projections for 13 time periods 2030, 2035, 2040...2085, 2090 and four new emissions scenarios very-low-RCP2.6, low-RCP4.5, medium-RCP6.0 and very-high-RCP8.5.

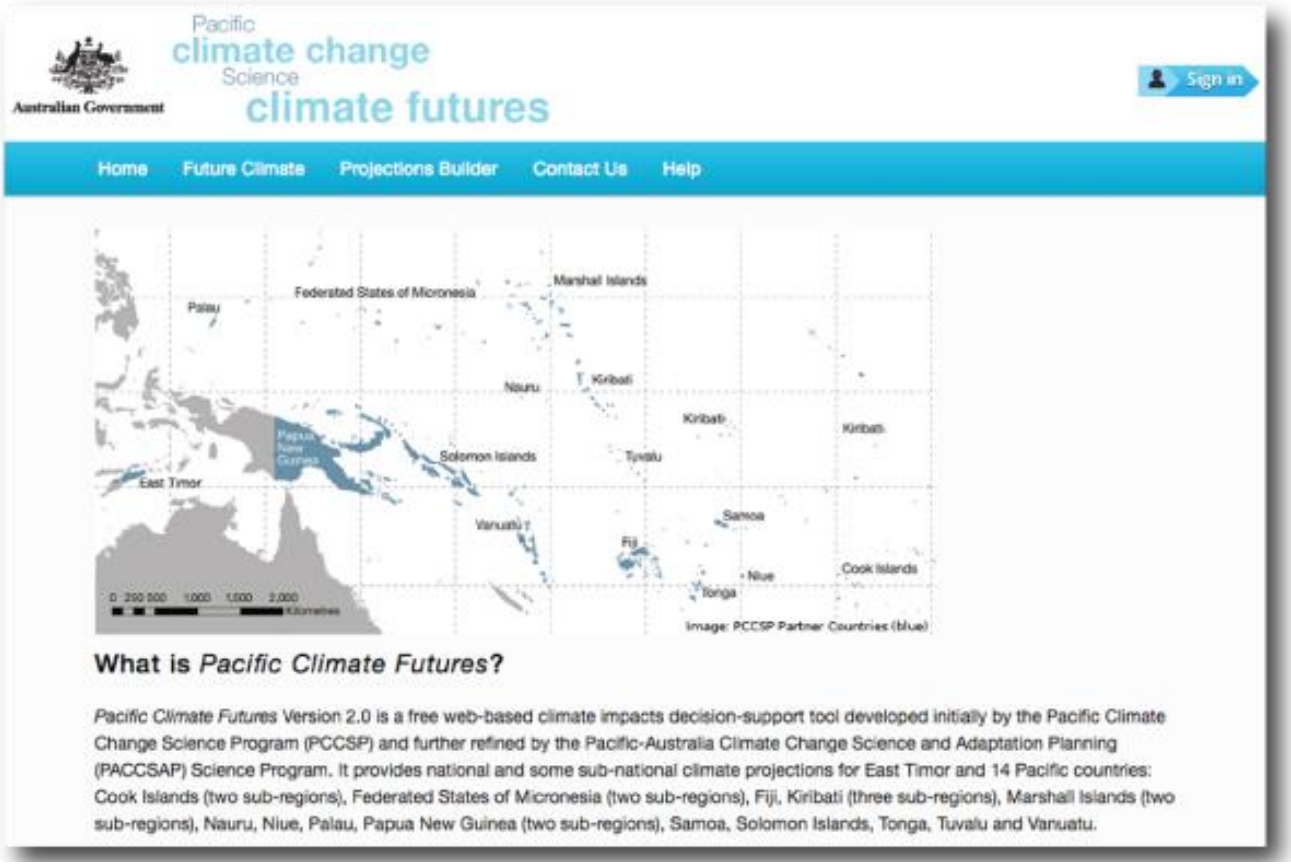
Impact assessments can be based on the following variables:

- Surface Temperature
- Rainfall
- Wind Speed
- Maximum Daily Temperature
- Minimum Daily Temperature
- Humidity
- Solar Radiation
- Evapotranspiration
- 1-In-20Y Wind Speed (Cmip5)

Target sectors and utility

This tool is built on projections and is updated as the GCM data is improved. It is available to the public wanting to gather information on climate projections. It is intuitive to use but some background knowledge on the region of interest is required for predictions.

This tool would be useful for all sectors, especially infrastructure to develop adaptation strategies for building resilience.



Southern Hemisphere Tropical Cyclone Data Portal

The Southern Hemisphere Tropical Cyclone (SHTC) Data Portal improves knowledge of past tropical cyclone activity in the Pacific Islands and Timor-Leste by plotting tracks of cyclones in the South Pacific from 1969.

The tool allows users to see the characteristics and paths of past tropical cyclone events. Meteorologists and stakeholders can use this tool to analyse the tracks of historical tropical cyclones and relate them to the impact on lives and infrastructure recorded on the ground. The Southern Hemisphere Tropical Cyclone Data Portal and the Pacific Climate Change Data Portal are connected in the sense that daily rainfall data from the Pacific Climate Change Data Portal can be used to examine the impacts of a particular tropical cyclone that is available via the Tropical Cyclone Data Portal.

This tool is lead by BOM, Australia as part of the Pacific Climate change science program. Providing historical information on cyclones, with archives from 1969/70 to 2009/10 tropical cyclone seasons. The SHTC data portal provides an archive of sources as well as current TC season data. It is kept up-to-date for the use of data collection in understanding characteristic and paths of TC events and how they have impacted lives.

The information on this site is kept current, and relevant as information becomes available. The path of the tropical cyclones for the selected years are shown on the map. The variables for this tool are (1) time (2 year intervals) and (2) Tropical Cyclone activity. The tool allows the user to add map layers for background of “plain, exclusive economic zones and elevation and Bathymetry” of TC.

Target sectors and utility

The tool is intuitive and easy to use, and there is a detailed user guide available for download that explains the features to use the tool. The colour coding of the cyclone paths means that it is easily interpreted, and you can select areas of interest.

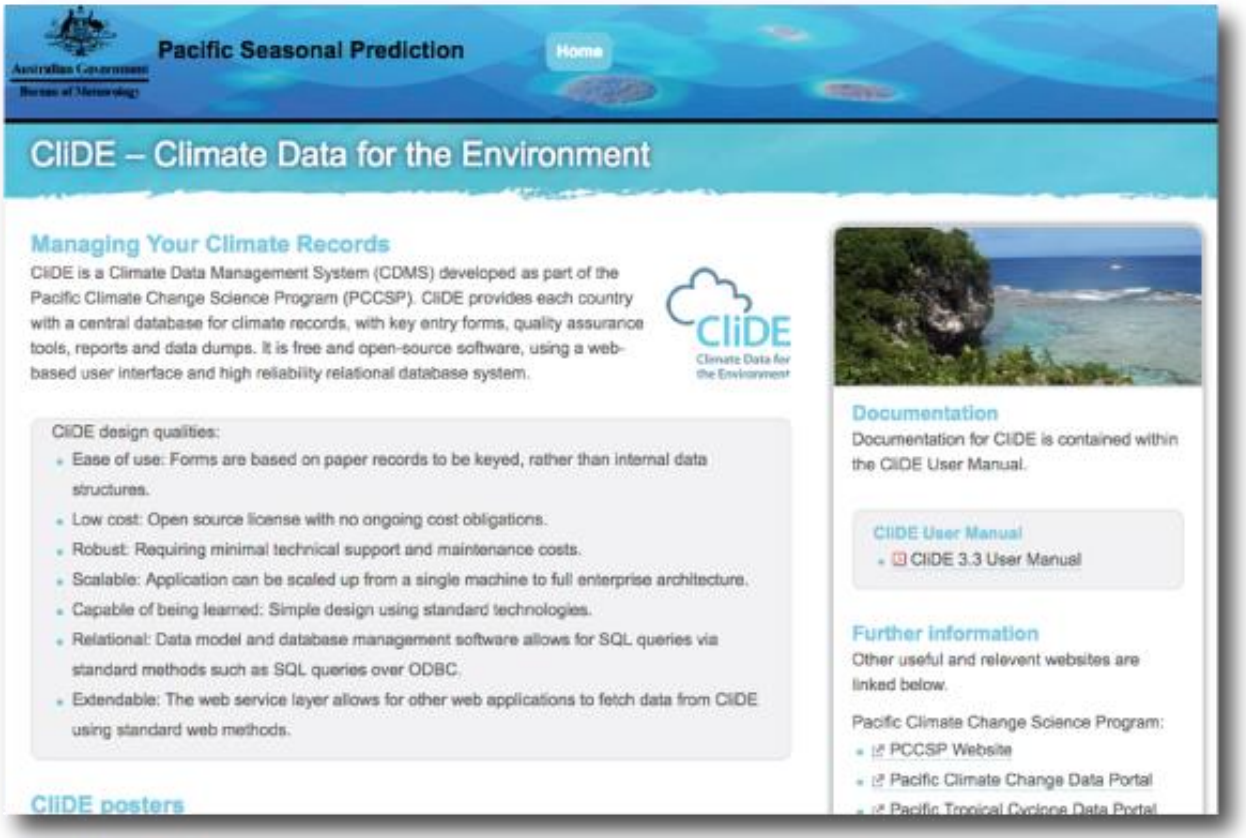
The background information provided in the user guide is minimal, however this tool is intuitive and easy to use. This tool would be most useful for infrastructure, tourism and fisheries sectors. Developing better capabilities of preparedness with the risk of increase severity on TC events.

CLiDE : Climate Data for the Environment

Climate Data for the Environment (CLiDE) is a climate database management system installed in partner country National Meteorological Services to support day-to-day operations, including the archival and basic analysis of historical and recent meteorological data.

CLiDE provides a platform for countries to rescue and secure hard copy data, which in some countries date back more than 100 years. Accurate climate records are critical for building an understanding of how the climate is changing and for verifying climate projections, monitoring and comparing droughts and other extreme events.

CLiDE will improve the availability of data for VMGD, other government agencies and researchers. CLiDE tool captures observational data that are periodically incorporated into the Pacific Climate Change Data Portal.



This is kept current with data from the last century to allow for accurate climate projections, monitoring and comparing data on past extreme events, such as droughts. CLiDE provides these projections by using climate variables wind, cloud layer, rainfall, temperature and precipitation.

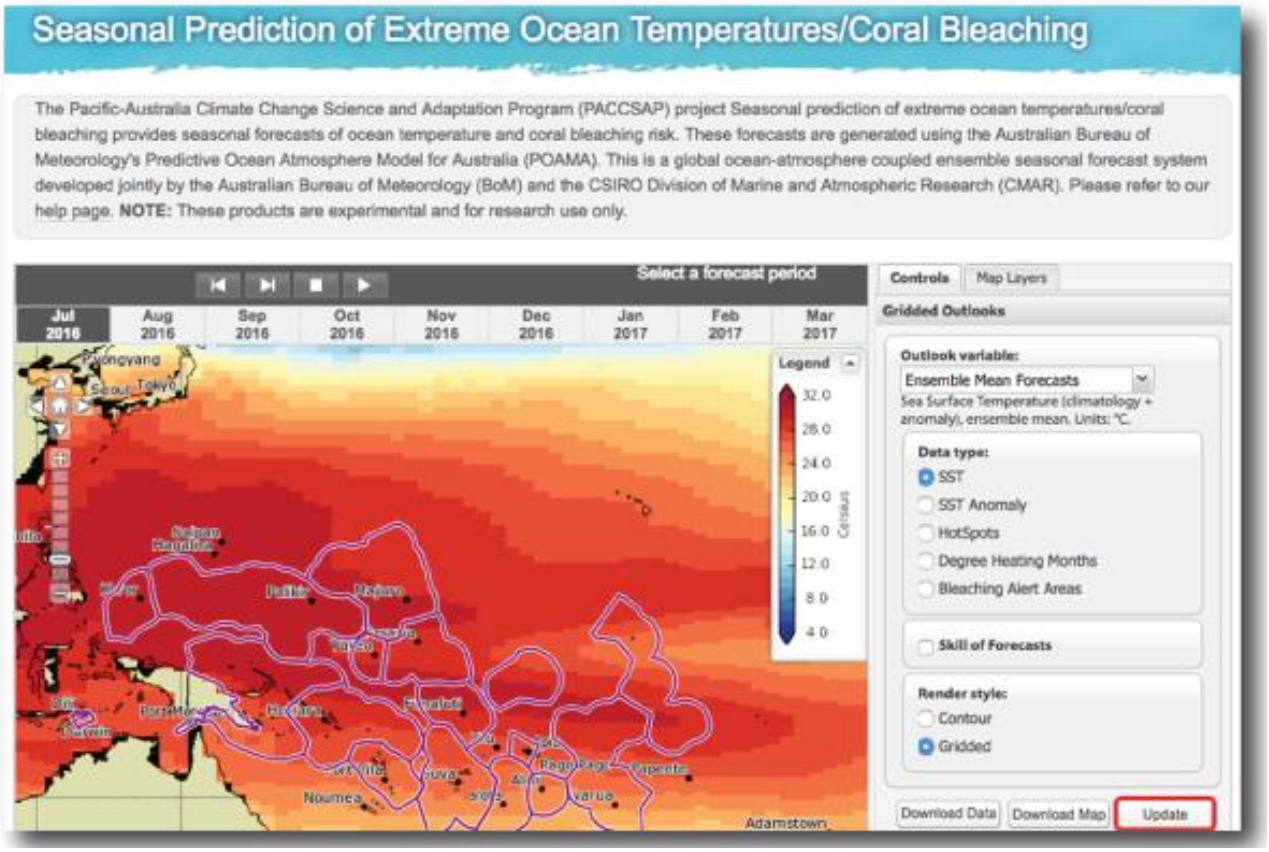
The user guide provides a significant amount of background and has detailed user guide. It is intuitive to use but is technical, however it is aimed for researchers and meteorological service professionals. This tool is aimed for use by National Meteorological Services, other government agencies and researchers. This would be useful for agricultural services, and the infrastructure sector.

Seasonal predictions of extreme ocean temperatures (various tools)

Seasonal predictions of extreme ocean temperatures are available through a range of tools that provide seasonal forecasts of ocean temperature and coral bleaching risk – POAMA, Coral Reef Watch, ReefTemp Next Generation.

POAMA forecasts are generated using the Predictive Ocean Atmosphere Model for Australia (POAMA) http://poama.bom.gov.au/. Available forecasts include sea surface temperature (SST), SST anomaly and thermal stress hotspots up to 9 months ahead. Both deterministic and probabilistic forecasts are available, similar to the NOAA global bleaching alert **Coral Reef Watch** tool: https://coralreefwatch.noaa.gov/satellite/baa.php

ReefTemp Next Generation is a high resolution and real-time online tool that complements the Seasonal Prediction of Extreme Ocean Temperature/Coral Bleaching and provides a set of mapping products for SST, SST anomaly, degree heating days and coral bleaching risk for the Great Barrier Reef region (western Pacific). This tool provides 1km^2 resolution real-time satellite data that identifies bleaching risk and locations for response actions and can be adapted for Vanuatu to generate daily and 14-day mosaic data for any current or historic period
http://www.bom.gov.au/environment/activities/reeftemp/reeftemp.shtml



Both predictive and real-time SST and thermal stress information is critical to VMGD in planning coastal development and responding to safeguard agricultural, marine, tourism and water resources. Under climate change, ocean temperatures and the frequency of mass coral bleaching events are predicted to increase, and current tools – local-scale bleaching projections (see van Hooidonk et al. 2016[2]) and resilience/vulnerability mapping – can be used to target actions that improve management of coral reefs in Vanuatu.

[2] van Hooidonk, R., Maynard, J., Tamelander, J., Gove, J., Ahmadia, G., Raymundo, L. et al. (2016) Local-scale projections of coral reef futures and implications of the Paris Agreement. *Scientific Reports*, 6: 39666. doi:10.1038/srep39666

The Seasonal Prediction of Extreme Ocean Temperatures/Coral Bleaching Tool is linked to the Seasonal Prediction of Sea Level Anomalies in the Western Pacific tool. Forecast outlooks for both tools are generated via the POAMA seasonal prediction model.

Hosted by the Australian BOM and CSIRO as part of the Pacific-Australia Climate Change Science and Adaptation Program (PACCSAP) project. Data is generated from the Australian Bureau of Meteorology's Predictive Ocean Atmosphere Model for Australia (POAMA).

This is a global ocean-atmosphere coupled ensemble seasonal forecast system developed jointly by the Australian Bureau of Meteorology (BoM) and the CSIRO Division of Marine and Atmospheric Research (CMAR). It uses Lead time - the time elapsed between when the model was run (the model starts date) and the forecast date.

This tool uses seasonal predictions of extreme ocean temperatures/coral bleaching provides seasonal forecasts of ocean temperature and coral bleaching risk. Using the variable Sea Surface Temperature (SST).

Target sectors and utility

The background provided for this tool is about the relevance to sectors and the climate change and coral bleaching. The tool is technical; however, it is available for members of the public interested in this data. Meteorological agencies from PACCSAP partner countries in the Pacific are the primary users of this tool. This tool would be relevant for fisheries and tourism sectors, and communities who depend on their coral reefs for food and income.

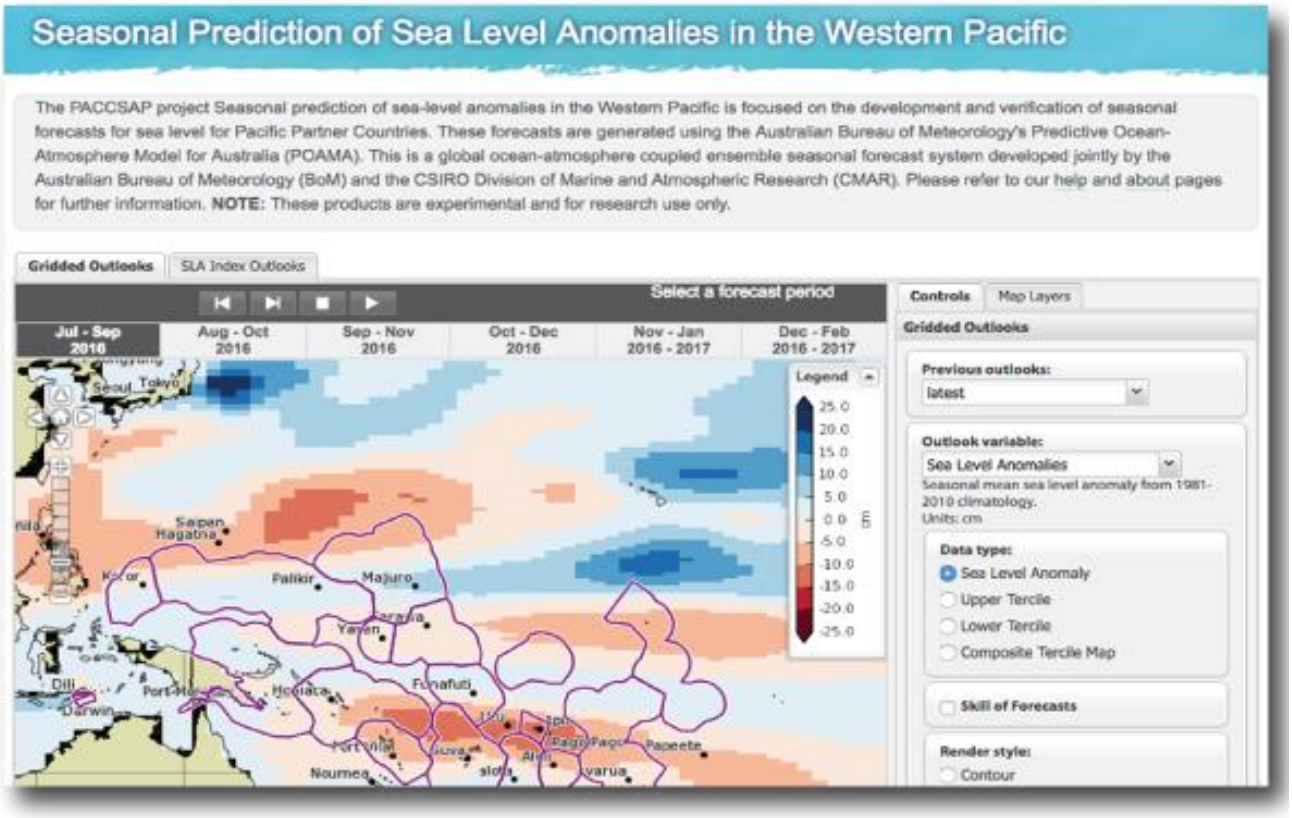
Seasonal Prediction of Sea Level Anomalies in the Western Pacific

The Seasonal Prediction of Sea Level Anomalies in the Western Pacific tool is focused on the development and verification of seasonal forecasts for sea level for Pacific partner countries. These forecasts are generated using the Predictive Ocean Atmosphere Model for Australia (POAMA).

Under climate change, sea level is predicted to rise with Pacific Island countries (including Vanuatu) being particularly vulnerable. The Seasonal Prediction of Sea Level Anomalies in the Western Pacific tool is linked to the Seasonal Prediction of Extreme Ocean Temperatures/Coral Bleaching tool. Forecast outlooks for both tools are generated via the POAMA seasonal prediction model.

The tool can be accessed here: http://www.bom.gov.au/climate/pacific/about-sea-level-outlooks.shtml

The web portal delivers gridded forecasts and skill maps using a navigable map overlaid with geospatial information. Sea level anomaly plume plots are also available for Vanuatu in PACCSAP.



The tool is kept current and used as a forecasting resource for sea level anomalies linked to storm surges and seasonal tide changes. This tool is useful for planning coastal development and safeguarding agricultural, marine and water resources. It would be relevant for the sectors agriculture, infrastructure, water and tourism.

Target sectors and utility

It is intuitive with the information easily available through selection time for prediction to be for and the region. Data for regions are available easily interpreted graphs, that add to this tool being easy to use and interpret.

The background provided for this tool is specific for the western pacific region, describing the climate variability. Describing how this tool is relevant to mitigating the effects of sea level rise. It is technical; however, the background provides good explanation of how this tool is useful.

Vanuatu Climate Update (VCU)

This is kept updated with monthly reports on ENSO, combining data from the Australian Bureau of Meteorology, SCOPIC, APCC, UKMO and ECMWF. It is set in a similar style to the ENSO Wrap-up. The VMGD provides this climate update on a monthly basis. VCU outlines the evolution of the El Nino Southern Oscillation (ENSO) and how this is expected to impact on temperature, rainfall and other climate variables that can influence the sectors and people of Vanuatu. The VCU is a combination of statistical and dynamical based predictions from SCOPIC, CLIK-P and PICASO information.

Download the latest VCU from http://www.vmgd.gov.vu/vmgd/images/climate-media/docs/VCU-March-2018.pdf

This is a climate update that is kept current on a monthly basis. The tool merges data from different sources (ENSO wrap-up, SCOPIC, CLIK-P and PICASO). It streamlines the data specific for the Vanuatu region to one source. Variables reported on the VCU are:

- Rainfall ranges
- Drought stats
- Coral Reef health
- ENSO update

Target sectors and utility

It would be ideal for most sectors in Vanuatu, because it is specific to the region and covers the variables relevant to fisheries, agriculture, infrastructure, public health and would be of interest to communities.

The tool is intuitive to use, because it is one document that contains a good source of information. It is slightly technical, however the diversity of information provided, and the format makes it easy to interpret and understand the concepts.

http://www.vmgd.gov.vu/vmgd/index.php/climate/reports-and-summaries/enso-update

Vanuatu Climate Outlook

The Vanuatu Climate Outlook product is a web-based service that provides a summary of the El Nino Southern Oscillation (ENSO) and its evolution. The service is very similar in nature to the BOM ENSO Wrap-up.

Observational data

VMGD manages a well-established climate and rainfall observations network. This network streams in sub-daily and daily observations from 7 meteorological sites around the country.

Sites in the Northern region:

1. Sola (Vanua Lava, TORBA Province)
2. Pekoa (Santo, SANMA Province)
3. Lamap (Malekula, MALAMPA Province)

Sites in the Southern region

4. Bauerfield (Efate, SHEFA Province)
5. Port Vila (Efate, SHEFA Province)
6. Whitegrass (Tanna, TAFEA Province)
7. Anelgauhat (Aneityum, TAFEA Province)

VMGD receives all data requests through their official website where clients complete the online climate data request form. The form is available at:

http://www.vmgd.gov.vu/vmgd/index.php/climate/climate-information-services/data-services

Historical climate information for Vanuatu is also available online via the Pacific Climate Change Data Portal developed by the Pacific Climate Change Science Program (PCCSP) and Pacific-Australia Climate Change Science and Adaptation Planning (PACCSAP) Program. For access visit: http://www.bom.gov.au/climate/pccsp/

The CIS information and meteorological services are local products developed by the National Institute of Water and Atmospheric Research. Data is available for request through a request form with a selection of the variables:

- Rainfall
- Temperature
- Maximum
- Minimum
- Mean
- Pressure
- Wind
- Speed
- Direction
- Sunshine hours
- Humidity
- Cloud clover
- Thunderstorm

Developed as a tool where data can be requested to create future prediction. Similar to the tool "Pacific Climate Futures" in the use of emission and climate projections based on the above variables. It is intuitive to use (filling the form) and would be appropriate for government, research, agriculture, fisheries sectors.

CLiDEsc

Developed and hosted by Aust. BOM, as a derivative of CLiDE that allows the user to source data and products from this resource.

This is an application layer software that was developed by NIWA to link to CLIDE Database Management System and produce pre-developed CIS information based on existing observations data. CLIDEsc already exists in Samoa, Fiji and other countries who have established Climate Early Warning Systems (CLEWS).

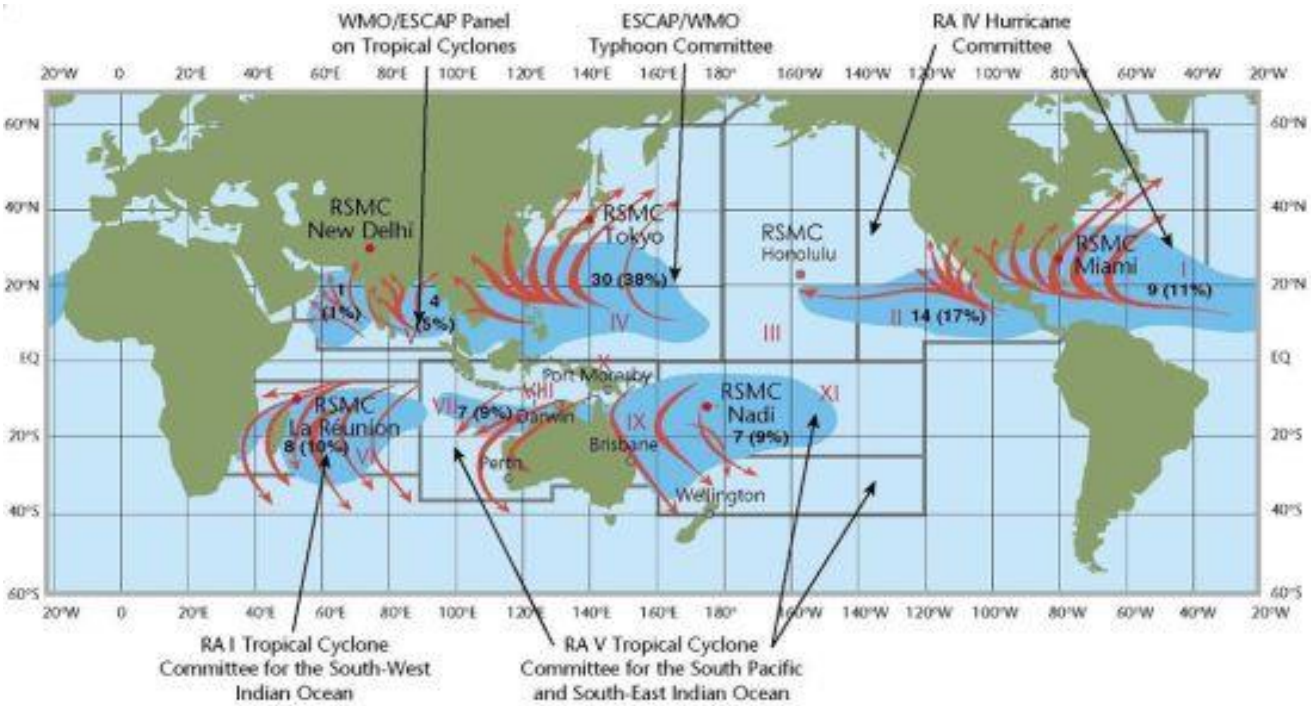
CLiDEsc is the storage and management of hydroclimatic data. This tool is technical and would be useful for meteorologists, researchers and government.

WMO Operational Network

Hosted by the World Meteorological Organisation, this is a disaster Risk Reduction Management Program that incorporates that coordinates the data from National Meteorological and Hydrological Services (NMHSs) of its 191 Members which operates a number of global systems.

1) World Global Telecommunication System – comprised of a network of surface and satellite-based telecommunication links and centres that are operated around the clock all year around.
2) World Global Integrated Observing Systems – allows for the collection of data from satellites, ocean buoys, aircrafts and ships and 10,000 land-based stations;
3) Global Data-Processing and Forecasting System – incorporates three World Meteorological Centres and 40 Regional Specialized Meteorological Centres, including Regional Specialized Meteorological Centres (RSMCs), Regional Climate Centres (RCCs) and Regional Drought Management Centres.

This tool is used by researchers and VMGD to rely information for Disaster Risk Reduction Management Program. This tool has been used for Tropical Cyclone Programs (TCP), and Emergency Response Activities (ERA) Program. The ERA monitors Volcanic Ash, Drought, Flood and other emergency management to reduce the risk to human livelihood.

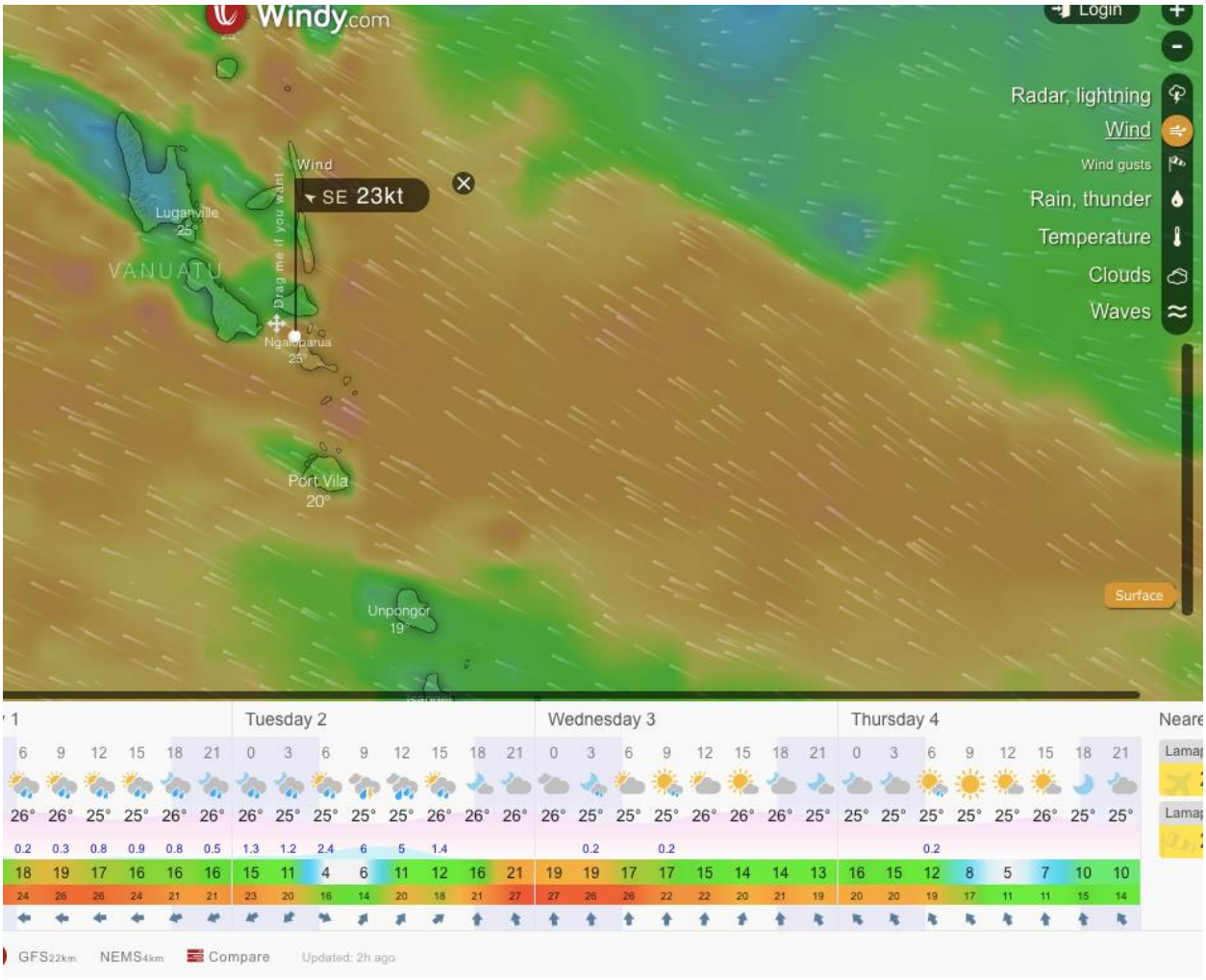


http://www.wmo.int/pages/prog/drr/wmoOppNetwork_en.html

Windy.com

This is a private Czech company run program, that provides easy to access to weather information that is not technical and is intuitive to use. It provides data in real-time with a one-week weather forecast, it is intuitive to use and covers variables, including temperature, wind, rain, tide, waves, and cloud coverage.

It would be useful for communities to track real-time weather changes, and cyclone activity. It is continuously updated, and so is useful in DRR.



https://www.windy.com/?19.436,-99.144,5

APPENDIX 2: CURRENT AND RECENT PROJECTS IN VANUATU RELEVANT TO CLIMATE INFORMATION SERVICES (DELIVERY AND USE)

A number of current and recent projects in Vanuatu have contributed to the development of VMGD's CIS infrastructure, systems and networks. Van-KIRAP will build upon the existing CIS and enhance it further to meet the demands of the targeted sectors and promote the using of climate information and services to inform sector adaptation and management decisions.

These projects provide lessons for how to deliver effective CIS to sectors and key projects are listed in Appendix 1.

Programme/ Projects	Funding agency	Implementing agencies	Objective(s)	Period of implementation
Institutional Strengthening in Pacific Island Countries to Adapt to Climate Change	US Agency for International Development	Pacific Community (SPC); Secretariat of the Pacific Regional Environment Programme (SPREP); Pacific Islands Forum Secretariat	Strengthen the national institutional capacity of countries to effectively plan for, coordinate and respond to the adverse impacts of climate change. The project will build on multi-sector, whole-of-island approaches that have been implemented successfully by regional climate change projects. Does not directly address fisheries but should ultimately (indirectly) benefit capacity to address fisheries.	2015 – 2020
Vanuatu Coastal Adaptation Project (VCAP)	UNDP, GEF-LDCF	Vanuatu Department Environment Protection & Conservation, Ministry of Lands and Natural Resources	Build resilience through improved infrastructure, sustained livelihoods, and increased food production. Key outputs: Strengthening Climate Information and Early Warning Systems for Climate Resilient Development Early Warning Systems (EWS) for key sectors Climate Resilient Integrated Water Resource and Coastal Management	2012 – 2018
Coping with Climate Change in the Pacific Island Region (CCCPIR)	GIZ	Pacific Community (SPC); Secretariat of the Pacific Regional Environment Programme (SPREP); Melanesian	Enhance the skills and capabilities of the local population, national governmental authorities and regional organisations in order to cope with the effects of climate change and combat its causes. Some artisanal fisheries addressed in some PICTs.	2009 – 2018

		Spearhead Group (MSG)		
Strengthening Climate Change Adaptation in the Pacific: Disaster Risk Management	USAID Pacific-American Climate Fund (PACAM)	Adventist Development and Relief Agency Samoa; Care International	Reduce vulnerabilities of selected communities to climate change effects through disaster risk management and income generation diversification adaptation measure s	2016 – 2018
Restoration of Ecosystem Services and Adaptation to Climate Change (RESCCUE)	French Development Agency (AFD); French Global Environment Facility (FFEM)	SPC; Opus International; Landcare Research; C_2O Pacific; Oceanswatch; Live & Learn	Increase the resilience of PICTs in the context of global changes by supporting adaptation to climate change through integrated coastal management, resorting especially to economic analysis and financial mechanisms. Includes some activities around improving coastal marine resource management.	2014 – 2018
Asia Pacific Disaster Response Fund: Fish aggregating devices (FADs) for food security	Asian Development Bank	Conservation International; WorldFish; Vanuatu Fisheries Department	Post-cyclone Pam assistance to restore FAD infrastructure and improve food security. Aims to reduce coastal fisheries pressure by transfer of effort to near shore pelagic stocks.	2017 – 2018
Climate and Oceans Support Program in the Pacific	Australian Aid (AusAID)	Australian Bureau of Meteorology; SPREP	Enhance the capacity of Pacific Islands to manage and mitigate the impacts of climate variability and tidal events	2012 – 2018
Finnish-Pacific climate and disaster ready communities through improved national meteorological services (FINPAC)	Government of Finland	SPREP	Reduced vulnerability of Pacific Island Countries' livelihoods to the effects of climate change through improved climate services and disaster risk reduction	2013 – 2017
Lessons learnt from the disaster response to TC Pam	Government of Vanuatu	Government of Vanuatu	Review of government disaster response policies and guidelines and their implementation post-TC Pam – loss and damage, governance, coordination and communication	2015 – 2016
Pacific Islands Coastal Community Adaptation Project	USAID	Various in-country agencies	Build the resilience of vulnerable coastal communities in the Pacific region to withstand more intense and frequent weather events and ecosystem degradation in the short term, and sea level rise in long term	2012 – 2016

Pacific Multi-Country Programming Framework (CPF)	Food and Agriculture Organization of the United Nations (FAO)	Various government ministries, private sector and farmers' organizations and NGOs	Promote food and nutrition security resilient to the impacts of disasters and climate change	2013 – 2017
National Climate Change Adaptation Programme	Various donors	Oxfam, Care International, Vanuatu Red Cross, GIZ, Save the Children, Vanuatu Rural Development and Training	Cross-sectoral adaptation actions throughout Vanuatu. Established the Vanuatu Climate Action Network, a national information-sharing network to discuss issues, develop joint policy positions, and provide a united NGO perspective on government policy.	2012