CLIMATE SCIENCE
TRAINING FOR SECTORS

5

SESSION 5 - Seasonal climate forecasts and drought monitoring

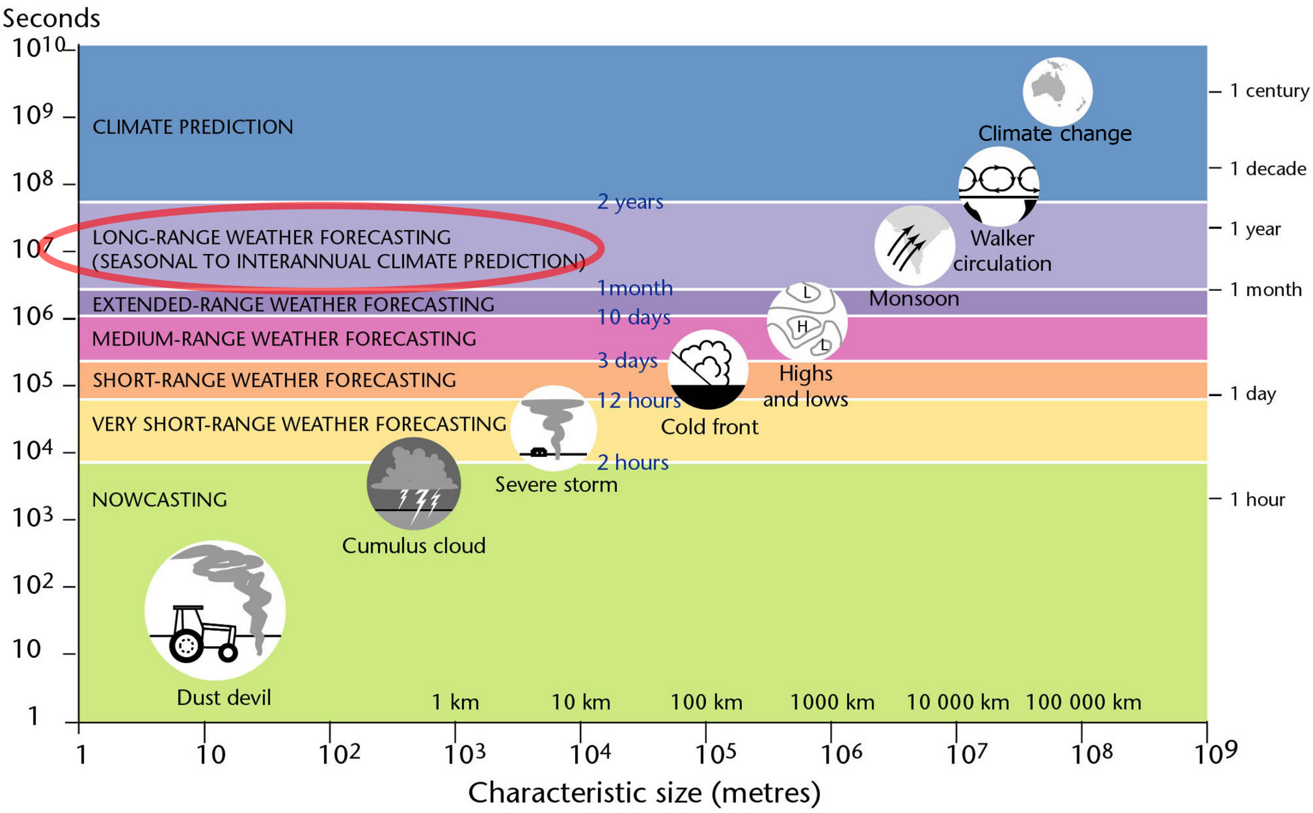
Climate in Vanuatu

TOPICS

- Understanding Seasonal Forecasting
- Seasonal Climate Outlooks from VMGD
- Understanding Drought
- Early Action Rainfall Watch

Understanding Seasonal Forecasting

Seasonal Forecasting Timescale



In this session we will focus on seasonal forecasting, the period can range from 3 months to interannual – circled in orange.

Types of seasonal forecasting models

There are two types of climate forecasting models:

Statistical model (used by VMGD) – uses historical data to predict climate for next season or seasons

Dynamical model - analyses the current atmospheric and ocean conditions to predict the climate for the next season, year(s) or decades

The statistical model compares past sea surface temperatures in the oceans to corresponding rainfall (and temperatures), and then uses these historical relationships and current observations to make a three-month rainfall or temperature outlook. In other words, the statistical model assumes that the past represents the future.

Statistical models analyses the relationship between the rainfall for specific period (3 months, 6 months etc) with observed sea surface temperature or southern oscillation index of the previous specific period (1 to 3 months) and predicts the rainfall for the upcoming seasons.

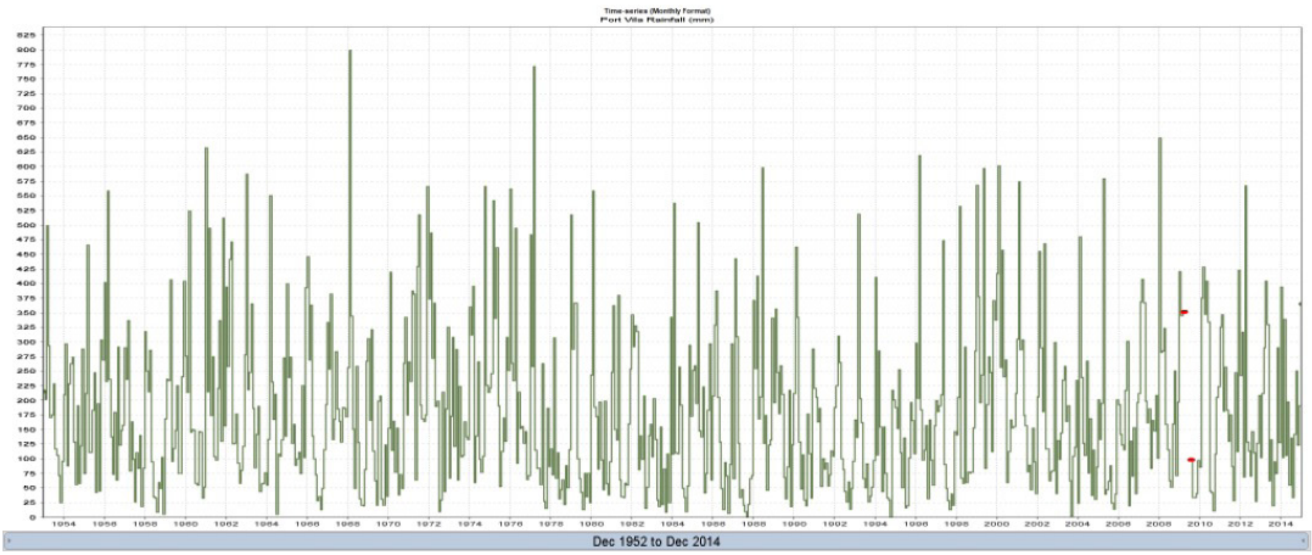
In this case rainfall is known as the predictands; SSTs and SOIs are called predictors. VMGD uses a climate outlook model called SCOPIC which can provide them with rainfall prediction for next 3 months and 6 months.

Dynamic models are lot more complex and requires supercomputers. Climate models use equations to represent the processes and interactions that drive the Earth's climate. These cover the atmosphere, oceans, land and ice-covered regions of the planet.

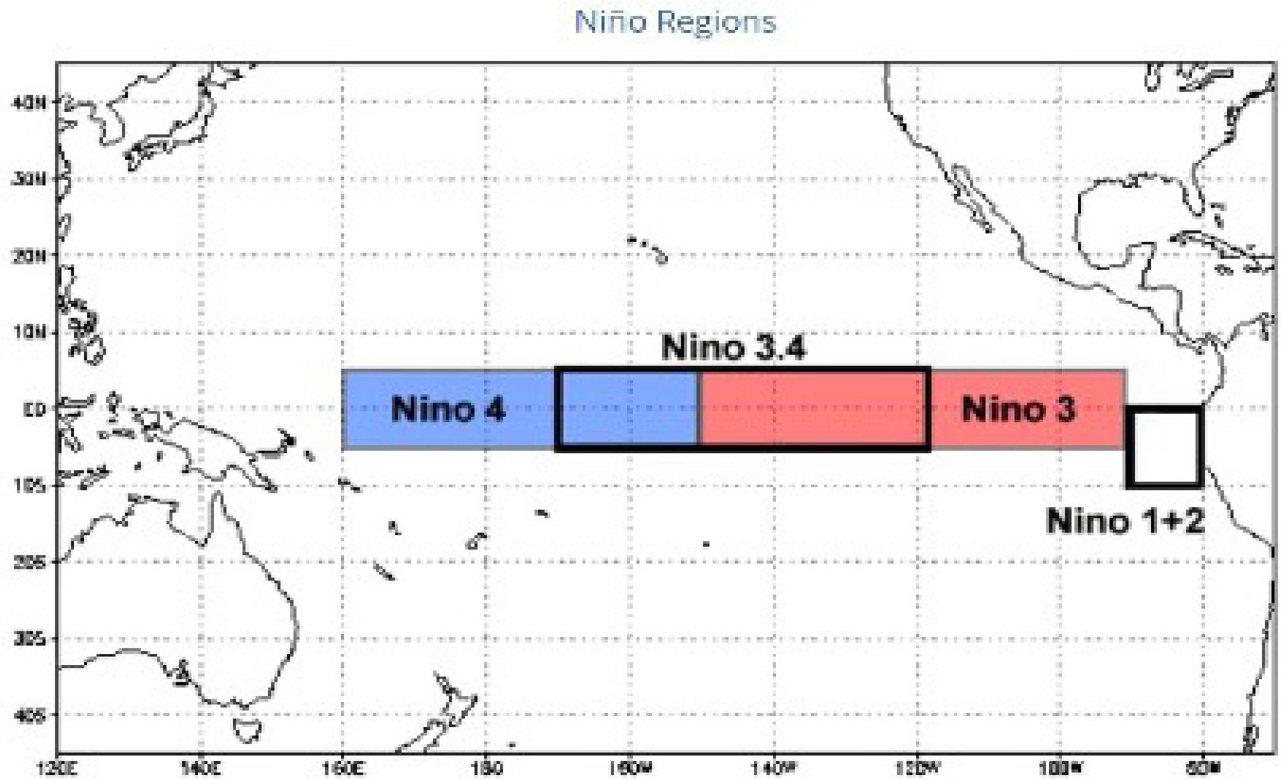
By comparing outlooks from the new dynamical model and the previous statistical model, it is expected that there will be differences, just as there would be between any two models which generate outputs using different techniques.

Apart from the differences in the models themselves, other factors may also create some difference in the outlooks. Averaged over all seasons, the accuracy of the dynamical model is better than the statistical model. It is recommended that users refer to the skill for the specific time of year when using the outlooks. Dynamical models will continue to evolve and improve over time as developments continue with the science, the observations, the models and in computing power.

Statistical models – how is it possible?



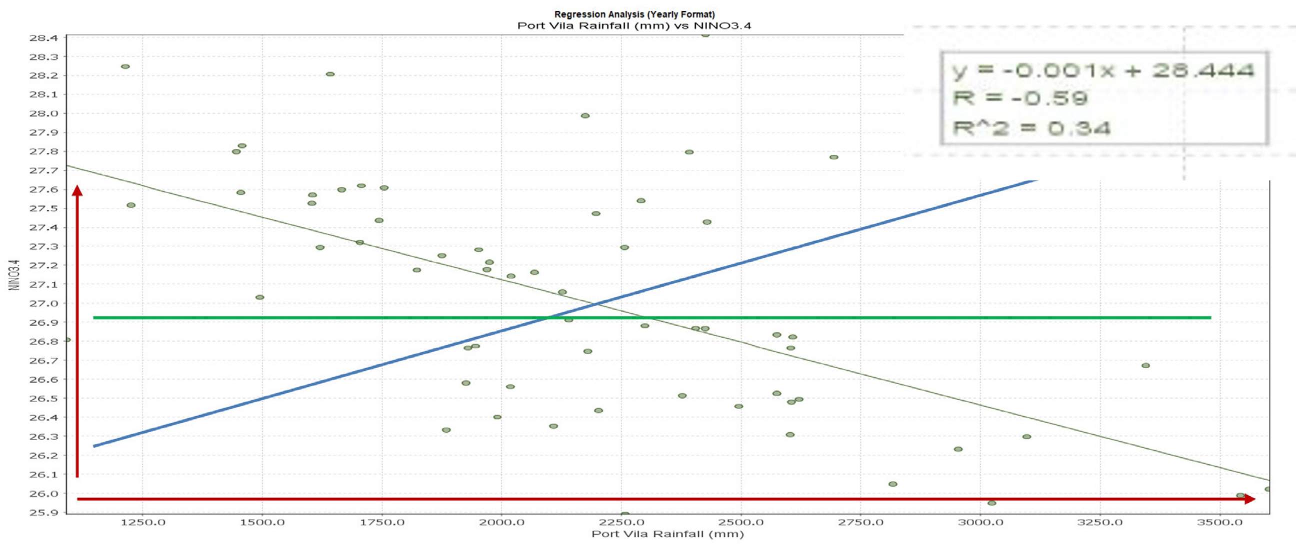
This graph shows rainfall recorded at Port Vila for each month since January 1953.
You can see rainfall tends to be quite variable.



This graph shows the regions from where average sea surface temperatures are used in climate models. The numbers of the Niño 1,2,3, and 4 regions correspond with the labels assigned to ship tracks that crossed these regions. Data from these tracks enabled the historic records of El Niño to be calculated from1949.

The Niño 3.4 is one of the favored regions for defining El Niño and La Niña events.

The climate model can only predict rainfall for a location if there is a dependent relationship between the SST and the rainfall.



The idea is to determine if the rainfall in Port Vila is dependent on changes in the sea surface temperature around the equatorial Pacific. On this graph, the average sea surface temperature are on the y-axis and monthly total rainfall on the x-axis. Regression analysis is a powerful statistical method that allows you to examine the relationship between two or more variables of interest, in this case the variables are sea surface temperature and the rainfall for Port Vila. Regression analysis tells us if and to what extent changes in one variable (sea surface temperature) will induce the changes in the other variable (rainfall) - this is indicated by the slope of the line on the graph.

This graph shows the line is sloping downwards towards the right which indicates negative impact i.e. as the sea surface temperature rises, rainfall will decrease.

Please note a line sloping upward towards right means as the seas surface temperature rises, rainfall will increase.

Therefore, if the regression line is sloping, you can use the sea surface temperature to predict the rainfall for that location. The steeper the slope, the stronger the relationship hence there is an increase in the climate model's confidence to predict the rainfall for that location.

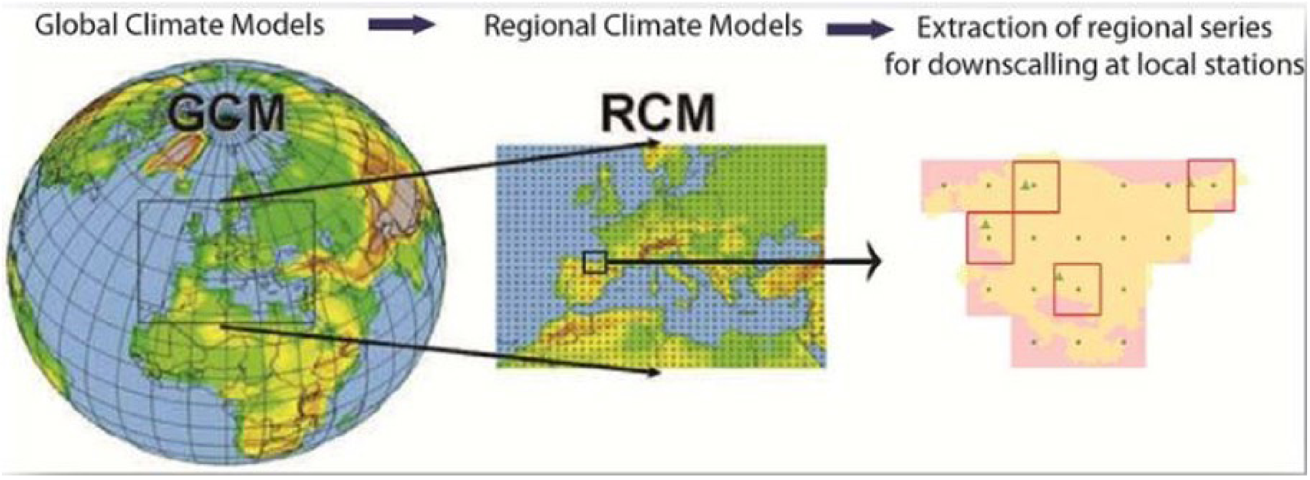
A straight line means sea surface has no influence on the rainfall therefore this is no predictive skills here.

Correlation chart

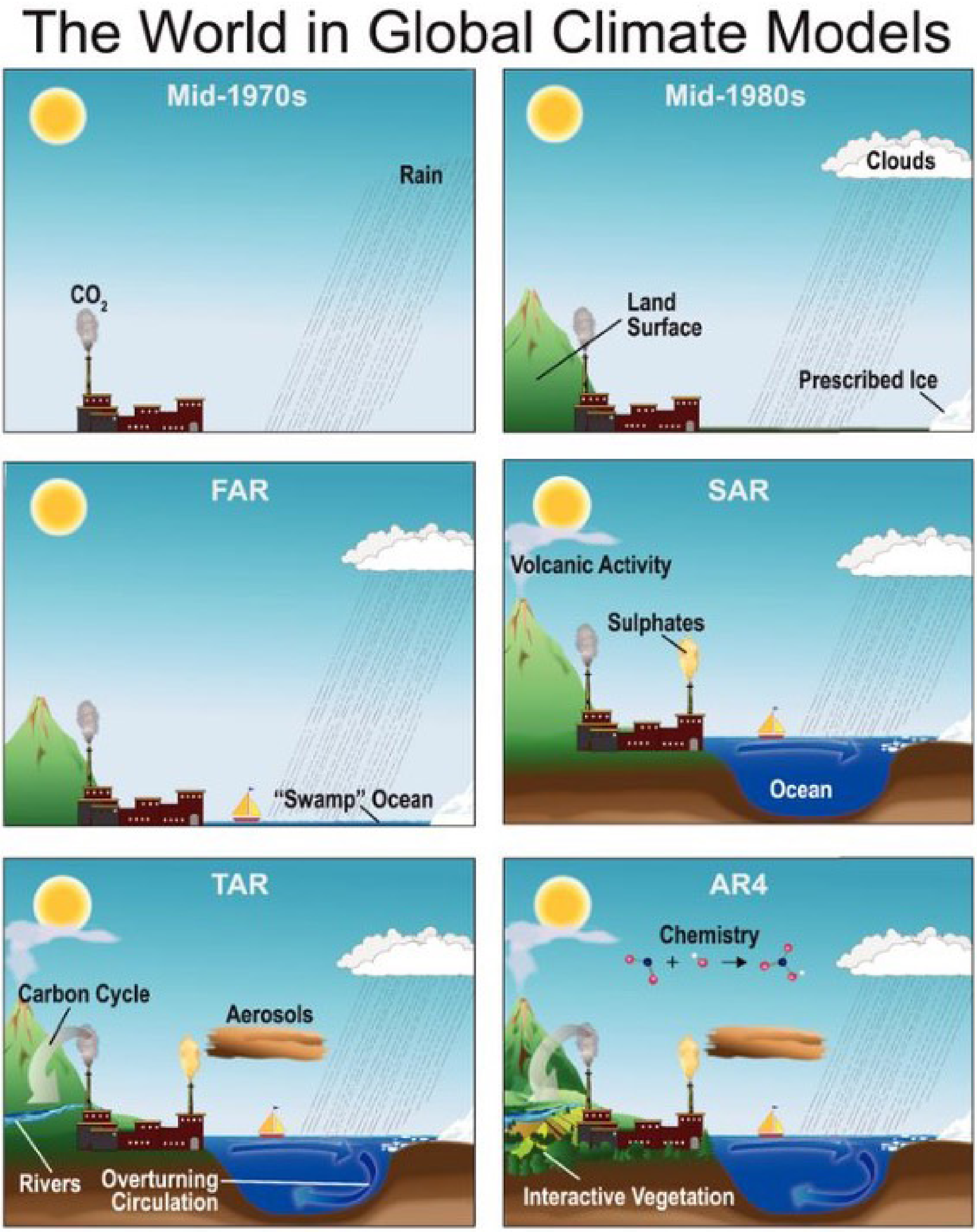
Another important consideration is the strength and type of relationship between the sea surface temperature and the rainfall (denoted by R). Here the R value is -0.59 where the negative means that the increase in the SSTs leads to decrease in rainfall.

The 0.59 can be interpreted as 59% of changes in the rainfall in Port Vila are due to the changes in the sea surface temperature. It should be noted that the rainfall in Port Vila is also influenced by other factors. This could be local ocean temperatures, topography, winds which are not included in this model.

Dynamic model – how does it work?



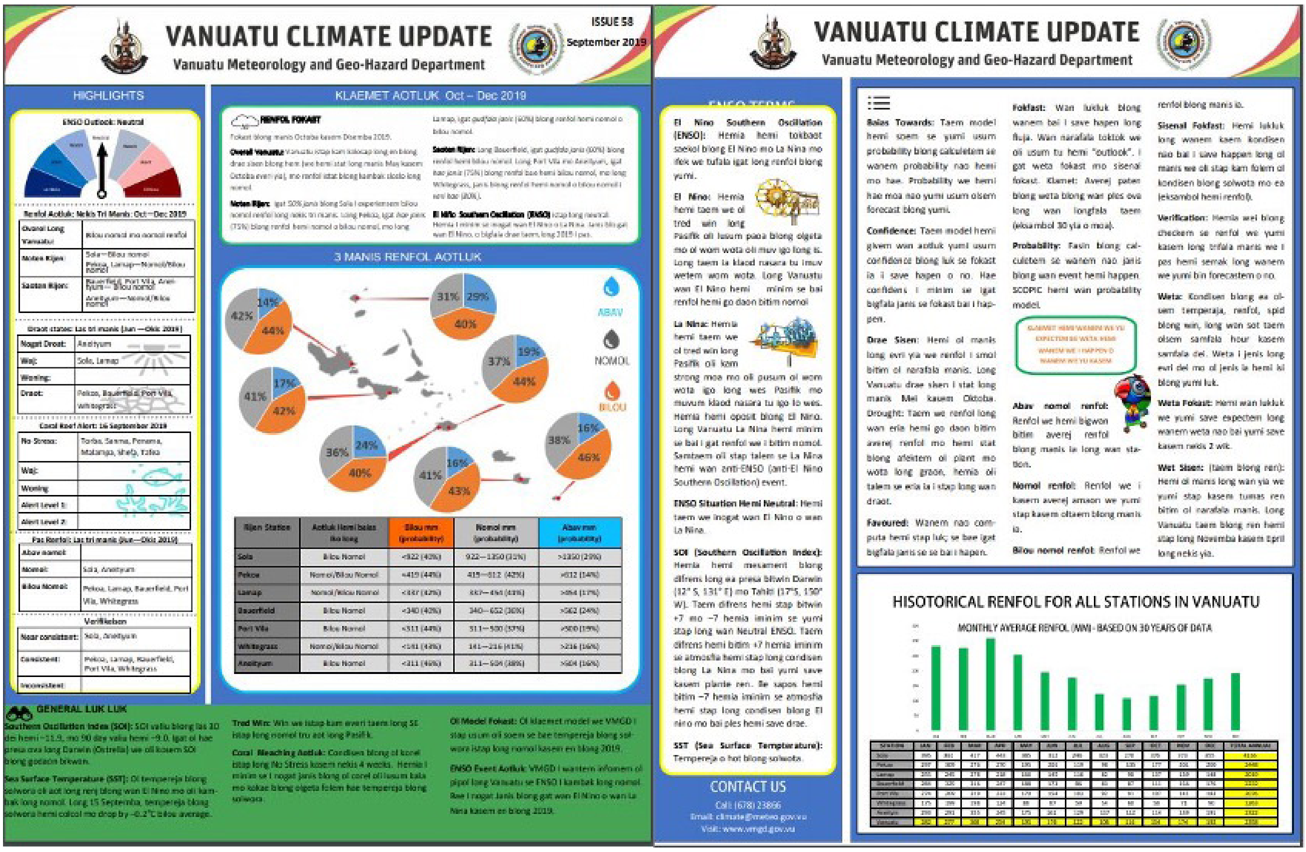
The key point to show here is that Global Climate Models and Regional Climate Models use the physics of the oceans, atmosphere, land and ice and the multiple complex interactions between them to estimate the most likely average climate state for several months ahead. As it uses physics, a dynamical model is suitable for use in areas experiencing long-term trends. Regional Climate Models focuses on a designated area, this could the Pacific Ocean, Europe, Australia, Asia etc. The regional model outputs can be downscaled to give outlooks for local sites.



This diagram illustrates the variables added to global climate models used for climate change projections, from the mid-1970s, mid 80s over several decades etc. This diagram shows how complex global climate models can be.

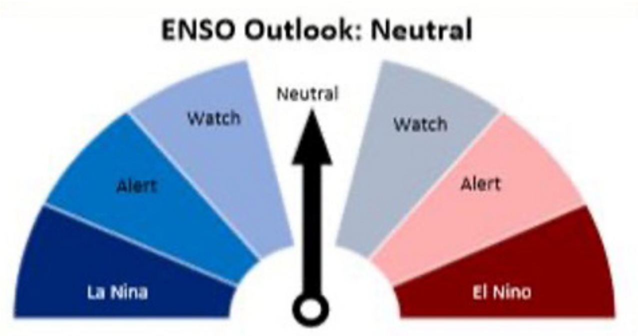
Though dynamic models may have higher accuracy, statistical models like SCOPIC tends to perform really well during El Niño and La Niña events. WHY?

Seasonal Climate Outlooks from VMGD



In Session 4 you saw some of the climate products from VMGD.

This is the Vanuatu Climate Update which is issued every month, it provides you with the three-month rainfall outlook for 6 locations across Vanuatu



The bulletin also includes the status of the ENSO

This is and ENSO dial – which has three status (watch, alert and "name of the event" once it is in place.

WATCH, for example, does not guarantee that an event will develop – rather it indicates that the tropical Pacific Ocean is showing some signs that an event may develop.

ALERT means the Pacific Ocean is showing more signs of an event developing

It is possible for either ALERT or WARNING status be cancelled if there is significant easing of the ocean's conditions.

What does the outlook means

The outlooks are issued in three criteria:

- Below Normal (tercile 1);
- Normal (tercile 2);
- and Above Normal (tercile 3)

The rainfall outlook (as shown in the image) is issued by VMGD and notes what the chance of receiving below normal, normal and above normal rainfall over the nominated three months period. This outlook has been produced by SCOPIC the VMGD's statistical climate model.

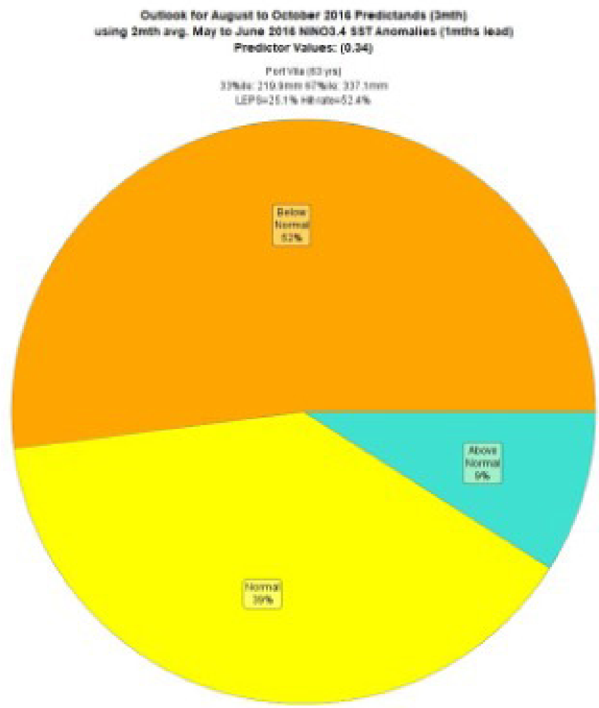
Here the outlook was indicating a high chance of below normal rainfall in August to October 2016.

The climate model will also give you the skill level of the outlook – which is translated as confidence level in the VCU (i.e. low, moderate and high). The basically shows how well the model can predict for that period (low values could be due to the predictability barrier period, or sea surface temperature (SST) are near normal or the SST influence on the rainfall at that location is not strong, or there is insufficient rainfall data to establish a relationship between the SST and the rainfall etc.)

In this case the skill for this outlook is high therefore the confidence level is high.

We will not go into details on how the skill levels are calculated or what the numbers mean but this was just to show you that the confidence levels are determined by the climate model. This information can assist you in making a decision based on the outlook. We will explore this further in the group exercises.

We will demonstrate terciles by asking everyone to participate in this exercise.



EXERCISE 1: UNDERSTANDING AVERAGES AND TERCILES

Expected Outcomes

- **Understand how terciles are generated for the purposes of the seasonal climate outlook.**
- **Understand the concepts of normal, below normal and above normal rainfall?**

Interpreting SCO

In the tercile exercise you learned about how terciles are derived. The rainfall data for a location is sorted in ascending order and then divided into three equal groups.

- Group 1 is known as tercile 1 or below normal.
- Group 2 is known as tercile 2 or normal.
- Group 3 is known as tercile 3 or above normal.

Here is the outlook for Nov 2016 to Jan 2017 for Port Vila. You may ask if the terciles are 3 equal groups, then why are they not equal on this pie chart. Well you will remember in earlier slide, I showed you that rainfall in Port Vila has some degree of dependency on the sea surface temperatures – therefore SCOPIC takes that into consideration when running the outlooks.

It takes a 2-month average anomaly of the sea surface temperature, 1 month before the season being forecasted (in other words a 2-month average SST anomaly for Aug-Sept 2016 is used to predict the outlook for Nov 2016 to Jan 2017).

Sea surface temperature are also divided into three groups – the difference from the long-term average (also called anomalies) are used to characterise them into:

El Niño - less than -0.8 ˚C

Normal between -0.8 and +0.8 ˚C

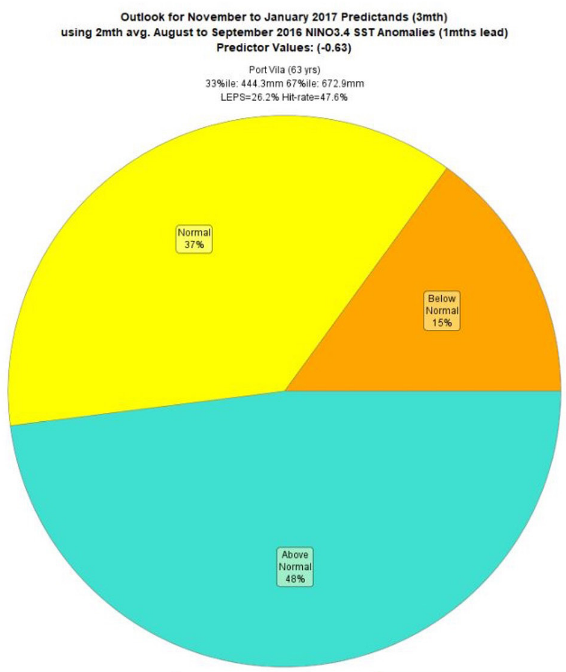
La Niña s (more than +0.8 ˚C)

So SCOPIC takes the sea surface temperature anomaly for Aug-Sept 2016 and checks how many times that anomalous temperature occurred in the Nov to Jan period for all recorded years and then calculates the percentage of rainfall in each of the terciles.

The process from here is bit more complex than this but this is just to show how the model determines the outlook.

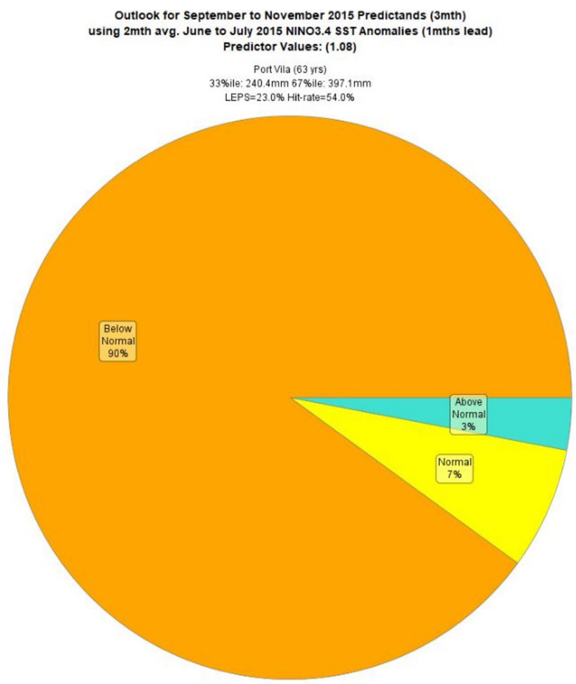
Remember this outlook would have been issued in October 2016 which would have given sectors some lead time to take appropriate actions (we will explore more on this in the group exercises).

Here are some of the past seasonal rainfall outlooks for Port Vila from SCOPIC.



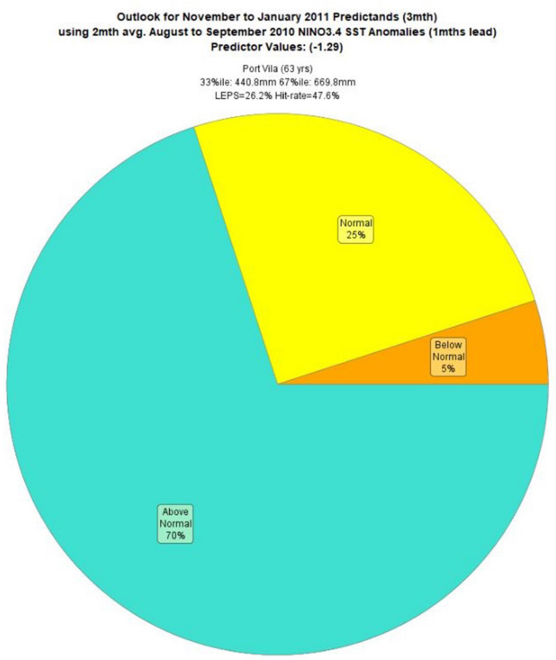
Below Normal	Normal	Above Normal
15%	37%	48%

This outlook can be interpreted as the rainfall is likely to be normal to above normal. The difference between the normal and above normal are not significant.



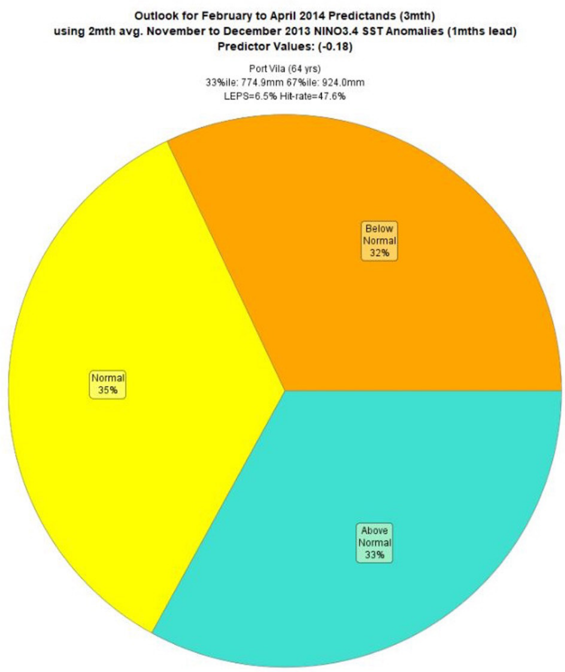
Below Normal	Normal	Above Normal
90%	7%	3%

This clearly shows that there is a higher chance of below normal rainfall. This is a high confidence outlook with 90% chance. It should be noted this outlook was issued during the 2015-2016 El Niño event.



Below Normal	Normal	Above Normal
5%	25%	70%

Similar to the previous outlook, this also shows the likelihood of receiving above normal rainfall. Once again the confidence level is high. This outlook was issued during 2010-2012 La Niña.



Below Normal	Normal	Above Normal
32%	35%	33%

This is typical outlook which shows no strong biasness towards any of the 3 conditions. This outlook is indicating the conditions to be near climatology i.e. what is normally expected during that time of year.

This outlook may not look very useful but it is! The key point to note here is that it is not predicting extreme conditions as you have seen in the previous outlooks.

Understanding Drought

What is drought?

It has many definitions based on applications and is to specific region/country

There are four types of droughts:

- Meteorological
- Agricultural
- Hydrological
- Socio-economic

Multiple definitions could apply within each type of drought.

Drought is a complex, natural phenomenon that can have significant social, economic, and environmental impacts. It occurs when there is less than normal precipitation/rainfall over an extended period, which may last from a few weeks to many years and occurs in virtually all climate zones.

Drought means different things to different people. For example, to a farmer, just a few weeks without rain during the growing season may mean crop loss. To a water manager, drought means lowered reservoir levels and affected drinking supply. Drought is commonly categorized as meteorological, agricultural, hydrological, or socioeconomic, reflecting the different aspects of the Earth system and society that it affects.

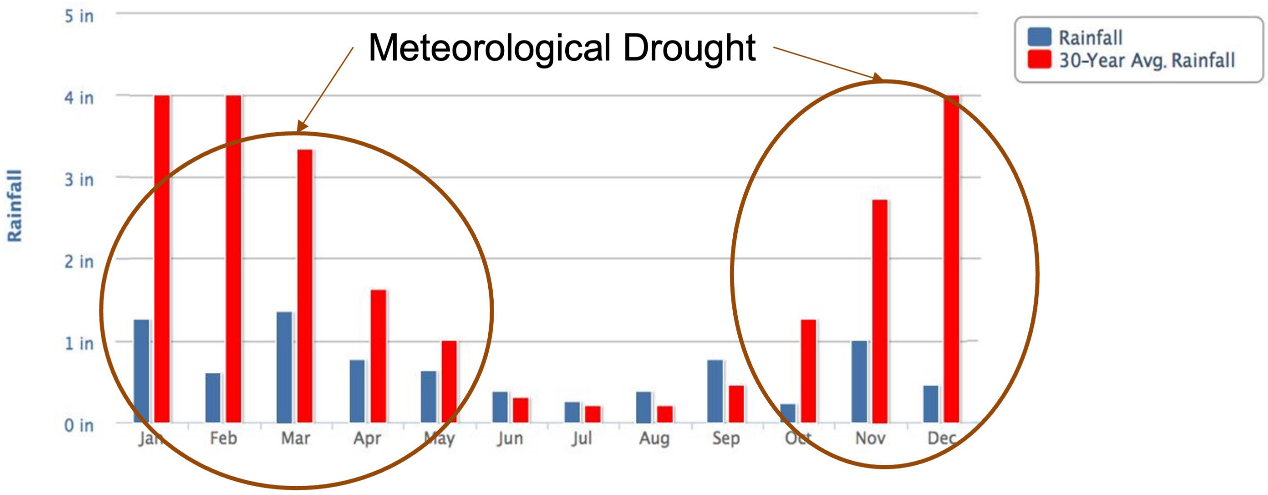
Meteorological Drought

Meteorological drought occurs when rainfall is below normal for a season or a longer period.

Meteorological drought is region specific. There is no universal minimum value for the rainfall shortage or minimum duration of the dry period. It is defined by how dry a region is compared to normal for that region, and how long the dry period lasts.

This graph shows this location experienced meteorological drought from January to April – circled when rainfall (in blue) was less than the normal (i.e. 30-year average)

Usually the time period used for drought monitoring is 3-month, 6-month and 12-month



Agricultural Drought

Agricultural drought occurs when there is not enough water in soils to support crop production.

Left: Drought affecting soil quality (Photo: DARD),
Right: The creek that used to be Imaio villagers' water supply in Tanna (Photo: ABC: Liam Fox)

Agricultural drought also depends on factors such as precipitation, groundwater and reservoir levels, and evapotranspiration.

It should be noted that not all crops will be effected it depends on the severity of the drought and the type of crop.

For example, 1 month of no rain will affect the growth of lettuce but may not have any impact on mangoes.

Here different drought definitions can be used for different types of crops.

- 3-month of low rainfall can affect pastures, banana, cassava, yams, cabbage, lettuce etc.
- 6-month of low rainfall can affect rice, sugarcane, wheat etc.
- 12-month of low rainfall can affect coconuts, mango, guava etc.

Hydrological Drought

Hydrological drought usually occurs when water supplies become affected after an extended period of reduced rainfall. Groundwater, lake, and reservoir levels can be significantly reduced during hydrological drought.

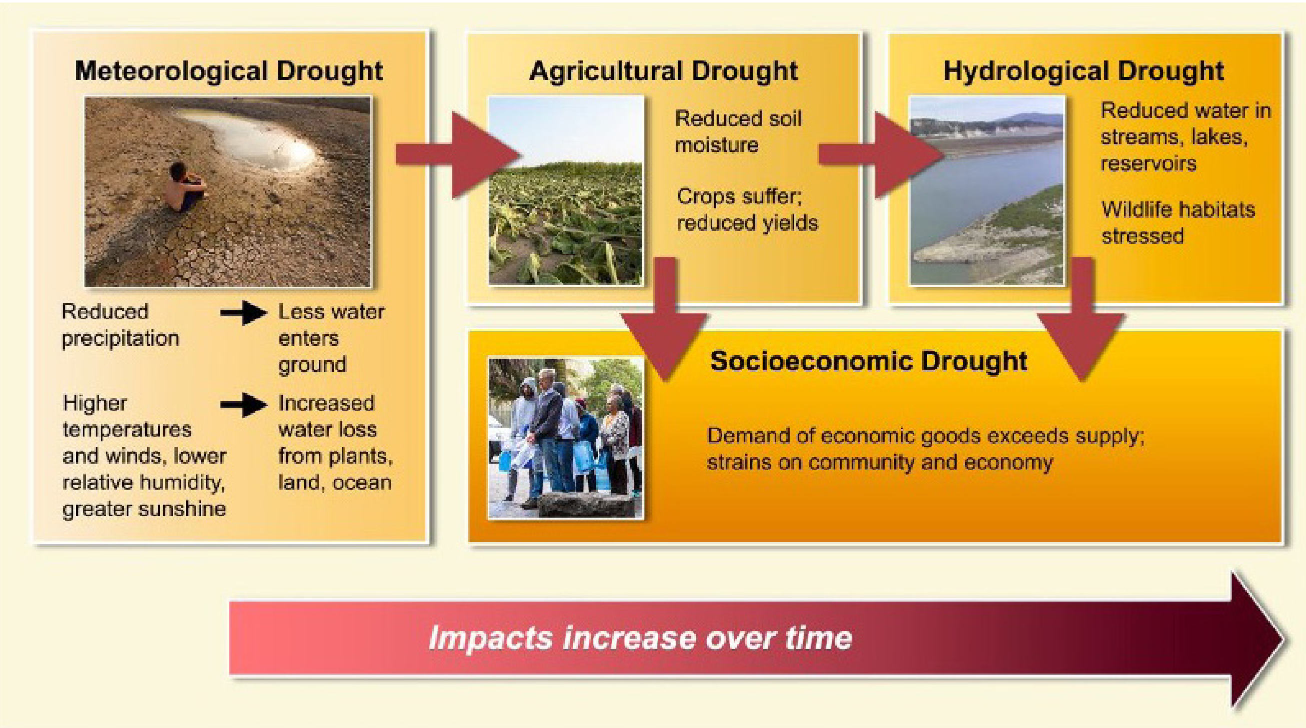
- 3-month of low rainfall can affect domestic wells, water tanks, small rivers
- 6-month of low rainfall can dam, bores, wetlands, medium rivers, rainwater catchments etc.
- 12-month of low rainfall can groundwater supply, large rivers etc.

Socio-economic Drought

Socioeconomic drought occurs when the demand for economic goods and services (such as energy, food, and drinking water) exceeds supply as a result of weather-related water shortage.

A good example of a socio-economic drought - in 1998, drought in Fiji resulted in significantly reduced sugar yield – the sugarcane industry faced a major loss. In order to meet their overseas export quota, they exported all local sugar to Europe and imported sugar from Australia to meet the local demand. This led to a price increase in sugar in Fiji.

Cascading Effect



This diagram illustrate that over time, meteorological drought results in changes to the soil and stresses on crops that affect agricultural production. Eventually, water levels in lakes and rivers become visibly reduced as hydrological drought ensues. The impacts of drought on the economy, society, and environment cascade and deepen as drought persists.

It should be noted that occurrance of a meteorological drought may not lead to other types of droughts. Also, some sectors may be affected and some not.

Also, the longer the duration of the drought, the longer the recovery time will be.

The other key point to note is that unlike tropical cyclones, the impact of the drought is often not obvious until a few months down the track, and it may take longer to recover from a severe drought.

How do we measure the severity of a drought?

Intensity – what was the rainfall deficit?

Duration – how long did the drought lasted for?

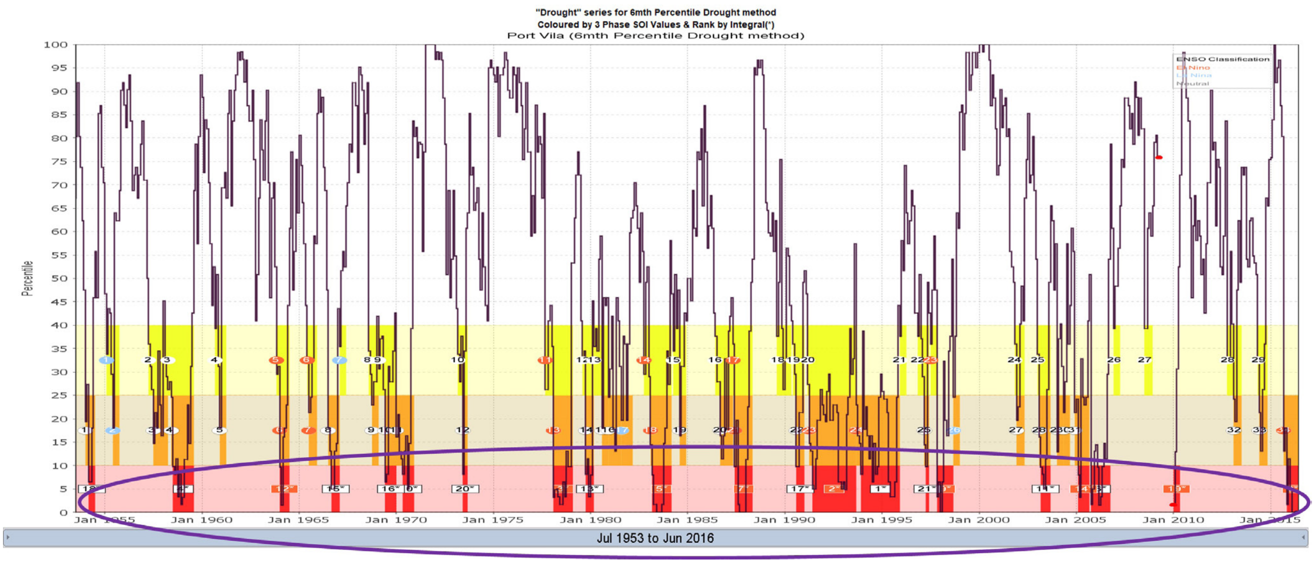
Spatial extent – what was the size of the area that affected?

Drought severity is measured by assessing its intensity, duration and spatial area but in this training workshop we will only focus on the drought intensity and duration.

VMGD uses SCOPIC to monitor the meteorological drought which can monitor drought using different indices.

Drought indices are a means to define, identify and compare droughts at different times and in different locations. They are typically a transformation of some type of agronomic, climatic or hydrologic time-series, depending on the type of drought that is being considered (e.g. an agricultural drought, hydrological drought, etc.).

VMGD uses 3-month, 6-month and 12-month indices.



This 6-monthly "drought" series is derived from SCOPIC. This graph shows rainfall received in Port Vila from 1953 to 2016. This graph shows the past drought events. If your rainfall data is up-to-date, this drought series will then indicate the current rainfall status.

In the area where it is circled in purple, you will see the number of times meteorological drought occurred in Port Vila over the six months period.

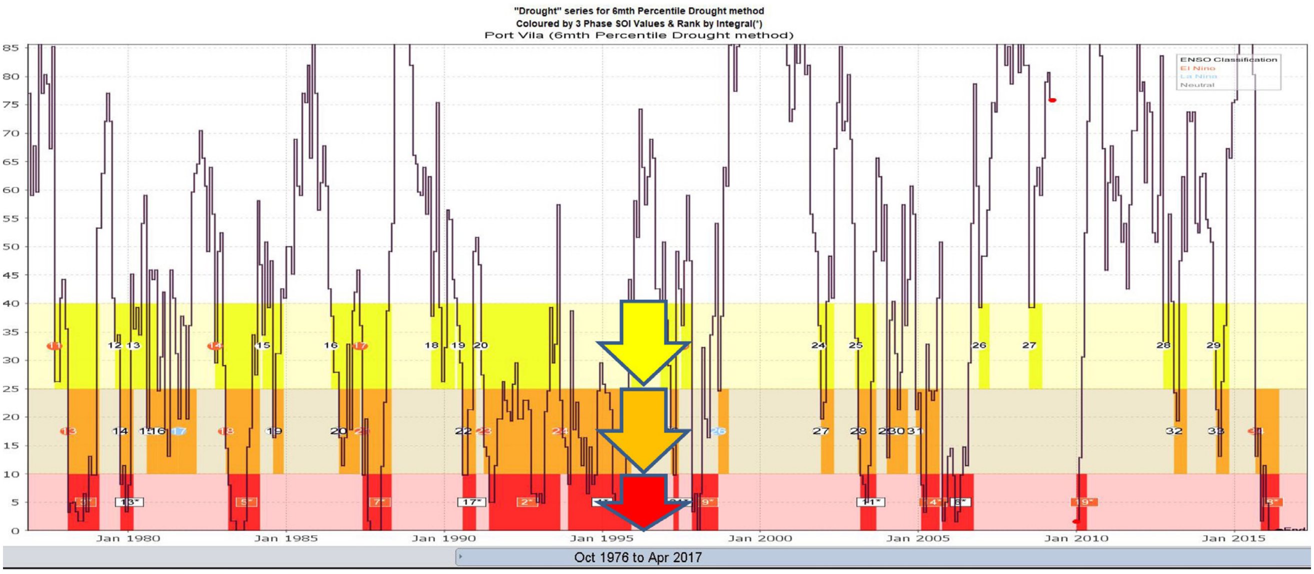
1976 to 2017 drought series

There are three status that can be used to issue drought advisory: Watch; Warning and Declaration.

The yellow area indicates when the situation is in Watch status.

The orange area indicates when the situation is in Warning status

The red area indicates when the situation is in meteorological drought



Now if you look at the top ten most severe droughts to occur in Port Vila, you will note that 6 of these events occurred during an El Niño event (highlighted in orange).

But it should be noted that there were a number of severe droughts that occurred during neutral phase (circled in red). Interestingly, most of these droughts occurred after an El Niño event

Port Vila (Jan 1953 to May 2016)
6mth Percentile Drought method
ENSO States defined using 3 Phase SOI Values (Assigned at Drought Start)

Rank*	Drought Period	Drought Length	Drought Peak	Drought Integral
1	Dec 1993 to Nov 1995	24mths	3.3%	552.0
2	Jun 1991 to Aug 1993	27mths	4.8%	551.4
3	Feb 1978 to Jan 1979	12mths	1.6%	377.8
4	Jul 1958 to Jul 1959	13mths	1.6%	342.7
5	Mar 1983 to Feb 1984	12mths	0.0%	332.4
6	Oct 2005 to Sep 2006	12mths	1.6%	325.7
7	Jun 1987 to Apr 1988	11mths	0.0%	296.3
8	Nov 2015 to May 2016	7mths	0.0%	262.0
9	Nov 1997 to Aug 1998	10mths	0.0%	203.3
10	May 1970 to Nov 1970	7mths	4.9%	143.3
11	Mar 2003 to Aug 2003	6mths	4.9%	139.5

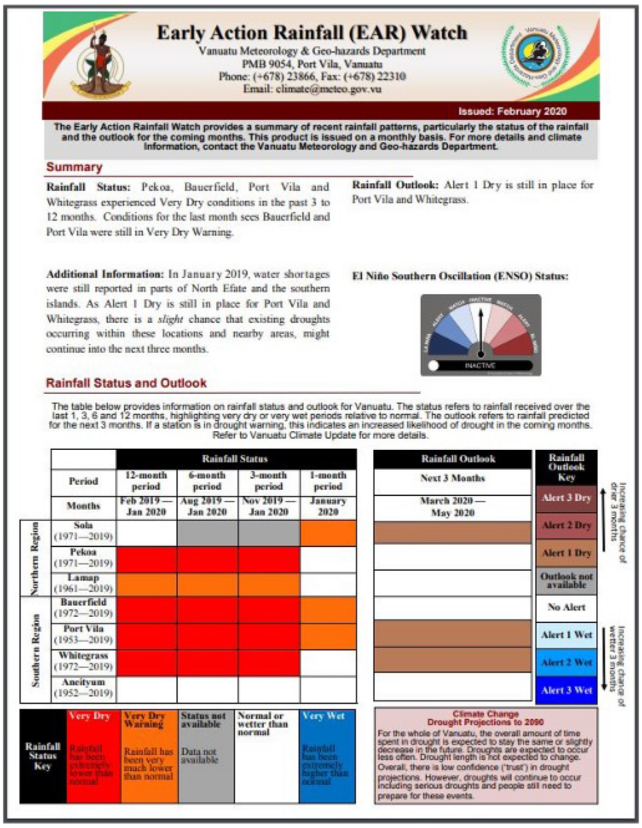
Early Action Rainfall Watch

The current rainfall status and rainfall outlook can be used in combination to indicate the possible rainfall deficit for the upcoming months. This information can be used by different sectors in planning and managing the current situation. We will talk more about this in session 7.

VMGD issues an Early Action Rainfall Watch (EAR Watch) which provides you with the latest ENSO status, rainfall status for the 12 months, and the rainfall outlook for next three months for 7 locations across Vanuatu.

This bulletin has some useful information:

This tables shows the current status of rainfall in each of the labelled location for over the past 1, 3, 6 and 12 months by colour coding for extremely high to extremely low rainfall. The rainfall status is determined by the amount of deficit or surplus rainfall that has been received at a location over the last 12 months.



Early Action Rainfall (EAR) Watch

Vanuatu Meteorology & Geo-hazards Department
PMB 9054, Port Vila, Vanuatu
Phone: (+678) 23866, Fax: (+678) 22310
Email: climate@meteo.gov.vu

Issued: February 2020

The Early Action Rainfall Watch provides a summary of recent rainfall patterns, particularly the status of the rainfall and the outlook for the coming months. This product is issued on a monthly basis. For more details and climate information, contact the Vanuatu Meteorology and Geo-hazards Department.

Summary

Rainfall Status: Pekoa, Bauerfield, Port Vila and Whitegrass experienced Very Dry conditions in the past 3 to 12 months. Conditions for the last month sees Bauerfield and Port Vila were still in Very Dry Warning.

Rainfall Outlook: Alert 1 Dry is still in place for Port Vila and Whitegrass.

Additional Information: In January 2019, water shortages were still reported in parts of North Efate and the southern islands. As Alert 1 Dry is still in place for Port Vila and Whitegrass, there is a *slight* chance that existing droughts occurring within these locations and nearby areas, might continue into the next three months.

El Niño Southern Oscillation (ENSO) Status:

Rainfall Status and Outlook

The table below provides information on rainfall status and outlook for Vanuatu. The status refers to rainfall received over the last 1, 3, 6 and 12 months, highlighting very dry or very wet periods relative to normal. The outlook refers to rainfall predicted for the next 3 months. If a station is in drought warning, this indicates an increased likelihood of drought in the coming months. Refer to Vanuatu Climate Update for more details.

		Rainfall Status				Rainfall Outlook
	Period	12-month period	6-month period	3-month period	1-month period	Next 3 Months
	Months	Feb 2019 — Jan 2020	Aug 2019 — Jan 2020	Nov 2019 — Jan 2020	January 2020	March 2020 — May 2020
Northern Region	Sola (1971—2019)					
Northern Region	Pekoa (1971—2019)					
Northern Region	Lamap (1961—2019)					
Southern Region	Bauerfield (1972—2019)					
Southern Region	Port Vila (1953—2019)					
Southern Region	Whitegrass (1972—2019)					
Southern Region	Aneityum (1952—2019)					

Rainfall Outlook Key
Alert 3 Dry
Alert 2 Dry
Alert 1 Dry
Outlook not available
No Alert
Alert 1 Wet
Alert 2 Wet
Alert 3 Wet

Increasing chance of drier 3 months

Increasing chance of wetter 3 months

Rainfall Status Key	Very Dry	Very Dry Warning	Status not available	Normal or wetter than normal	Very Wet
	Rainfall has been extremely lower than normal	Rainfall has been very much lower than normal	Data not available		Rainfall has been extremely higher than normal

Climate Change Drought Projections to 2090

For the whole of Vanuatu, the overall amount of time spent in drought is expected to stay the same or slightly decrease in the future. Droughts are expected to occur less often. Drought length is not expected to change. Overall, there is low confidence ('trust') in drought projections. However, droughts will continue to occur including serious droughts and people still need to prepare for these events.

In this case, 4 locations are experiencing very dry conditions over the last 12 months. Some degree of uncertainty may apply due to the island size, topography, geology and soil type.

The EAR Watch also has the rainfall outlook for the next 3 months for each location.

It should be noted that this table provides an ALERT for locations which have more than 38% chance of below normal or above normal rainfall.

The alert level is based on the probability of receiving rainfall in Tercile 1 and Tercile 3 and the confidence level of that outlook

The Alert level increases with the probability and the confidence level.

In this case, Sola, Port Vila and Whitegrass are at Alert 1 which means they have a low chance of having drier than normal rainfall.

		Rainfall Status				Rainfall Outlook	Rainfall Outlook Key
	Period	12-month period	6-month period	3-month period	1-month period	Next 3 Months	Alert 3 Dry
	Months	Feb 2019 — Jan 2020	Aug 2019 — Jan 2020	Nov 2019 — Jan 2020	January 2020	March 2020 — May 2020	
Northern Region	Sola (1971—2019)						Alert 2 Dry
Northern Region	Pekoa (1971—2019)						Alert 1 Dry
Northern Region	Lamap (1961—2019)						Outlook not available
Southern Region	Bauerfield (1972—2019)						No Alert
Southern Region	Port Vila (1953—2019)						Alert 1 Wet
Southern Region	Whitegrass (1972—2019)						Alert 2 Wet
Southern Region	Aneityum (1952—2019)						Alert 3 Wet

Increasing chance of drier 3 months

Increasing chance of wetter 3 months

Rainfall Status Key	Very Dry	Very Dry Warning	Status not available	Normal or wetter than normal	Very Wet
	Rainfall has been extremely lower than normal	Rainfall has been very much lower than normal	Data not available		Rainfall has been extremely higher than normal

Time Period and Impacts

EAR Watch provides examples of impacts that can result from droughts of 1, 3, 6 and 12 month periods.

These are some of the examples of impacts of droughts.

In Session 7, we will at look some examples of applying climate information into sectors, i.e. what actions can be taken to minimise or eliminate some of the possible impacts. Actions can also be taken to maximise benefits based on the climate outlook.

Sector/ Department	12-month period	6-month period	3-month period	1-month period
Water	Large water sources e.g. large rivers, lakes. Groundwater supply systems affected, water level drops, hand dug wells dry up and groundwater sources become saline.	Dams, bores, industrial tanks, wet lands, medium rivers. Rainwater catchments will be heavily affected including large rainwater tanks, surface water affected with reduced water level. Water quantity and water quality is further reduced.	Small to medium water tanks, small rivers. Rainwater catchments will be affected & water level reduced.	Water quality in wells and tanks reduced in small islands and west side of large islands.
Agriculture and freshwater fisheries	Large fruit trees, (e.g. coconuts, coffee, mango, guava, orange, mandarin), wild yam.	Rice, sugarcane, banana, wheat, root crops affected e.g., mature yam, Fiji taro, manioc.	Banana, cassava, new yam, water taro, English potato, kumala, vanilla, young kava, apple banana, aquaculture.	Small vegetables (e.g. tomato, lettuce, Chinese cabbage) and island cabbage on small islands and drier side of larger islands (W to N). Pasture will also be affected.
Livestock		Loss of large livestock (pigs, goats and cattle), farmed and wild freshwater fish and prawns.	Loss of small livestock (poultry).	
Forestry	Bushfire, insect pests and Diseases.	Loss large trees (due to increase spread and intensity of insect attacks) Loss of forest canopy affects quality and quantity of water, bushfire.	Loss of small trees (spread of insects and diseases attacks), sandalwood seedlings, bushfires.	
Environment	Loss of habitat, migration of endemics/species, degradation of landscape quality, loss of biodiversity/vegetation (extinction), introduction of alien/ invasive species, secondary impacts, e.g., resettlements (2015)	Streams/lakes & any water bodies affected, introduction of alien/ invasive species, landsides on new volcanic slopes.		Grassland
Health	Health - further deterioration in human health (e.g. cases of cholera appear, severe unbalance diet leading to death, cough & staunting, mental stress, diarrhoea, increased cases of skin diseases. Education - school close. Socio-economic - less income/ less production of local produces, bush fires destroying building, reduced river transport on large rivers, women migrating to get water. Increased chances of traditional houses burn down, reduced building materials.	Health - Increase in migration due to water and food shortages. Deterioration in adult human health (poor lactation, malnutrition, cases of typhoid, dengue, malaria, increase in skin, respiratory and eye diseases). Education - Affect education and children attendance, increase in social disruptions (e.g. reduced school hours) unbalance diet (relying on rice, tin fish & noodles), mental stress, diarrhoea, increased cases of skin diseases. Socio-economic - Increase in social disruptions (e.g. financial stress, assets being sold, crime). Social obligations being postponed. less income/less production of local produces, bush fires destroying building.	Health - Deterioration in young and old human health (malnutrition, poor lactation, dehydration, skin disease and diarrhoea cases). Education - affects schools for children due to reduced water supply e.g. schools close half day. Socio-economic - Unbalance diet/ less vegetables, additional labor on children & women, traveling distance to collect water, increase in psychological/mental stress, stealing. Food prices increase, reduced income. Some negative social disruption but also some positive impacts e.g. formation of women's networks.	Increase in gender based violence, malnutrition in children, increase non-communicable diseases. Disable persons due to higher water needs, increase discrimination.
Tourism Accommodation: Toilet/Shower, Swimming Pool, Restaurants, Flower/ garden, Water, Activities, Snorkeling, Kayaking, Water, Picnic, Waterfall	Airline & transport industry affected, agriculture and fishermen activities affected as well as duty free shops.	Drop in visitor numbers, reducing employment, reduce in income for business owners. Increase water temperature affecting snorkeling, reduce in the water level affect visitors to river activities, drier river level, reduced in income, reduced number of visitations.	Poor quantity and quality supply of water, inconsistency supply, affect availability of vegetables and others for hotels, flowers and plans drying up.	
Infrastructure	Road works thrive on drought as rainfall disturbs & damages roads & infrastructure (bridges & culverts)			
Energy	Infrastructure that depends on water in hydro-power, during drought, river/water level drops, affects generation of electricity. Sola energy companies thrive on droughts.			

EXERCISE: PAYING FOR PREDICTIONS

This participatory activity aims to support experiential learning and dialogue on the concept of climate-based disaster risk reduction, which is becoming more salient in the face of climate change. In this table game, players become Disaster Risk managers, who face changing risks. They must make individual and collective decisions, with consequences. (Source: IFRC)

Why this game?

- Climate forecasts are underutilized for several reasons, some of which include:
- These forecasts are not always disseminated to the appropriate decision makers in the movement.
- People often do not understand the forecasts.
- If the forecasts are understood, people are often unclear on what types of action could be taken in preparation for a potential disaster.
- People fear "acting in vain", i.e.: taking disaster preparedness measures when a disaster does not manifest itself.
- Funding is often not available until after the disaster has already occurred.
- Playing this game is one step towards helping publicize the potential value of these forecasts and helps break down some of these barriers to their effective use.

Paying For Predictions - Drought Version

Developed by Pablo Suarez and Janot Mendler de Suarez of Red Cross International. Adapted by COSPPac, Bureau of Meteorology. Further adapted by Pacific Science Solutions (2020).

Materials for the Game:

- 13 Paper clips per player
- 6 sided die x2 per group (1 for the regional centre and 1 for individuals in the group to use)
- 8 sided die
- Score sheet
- Pen
- Cup
- Divide players into 3 groups

MATERIALS	REAL LIFE REPRESENTATION
Paper Clips	Resources; financial resources / equipment etc..
Provincial Center Die (6-sided)	Forecast
Provincial Center Die (8-sided)	
Individual / local area Die	Observed outcome ; Drought or no drought

Each individual is a Disaster Managers in a local area or each group represents your provincial office. Paper Clips represents the resources (finances / budget). Die represents your local area rainfall as well as the provincial area rainfall. (1 being a lot of rainfall and 6 being a few drops of rainfall)

How to Play

1. Roll the die once for the provincial centre. (Don't look at it until the local area die has been rolled)
2. Roll the die for each local area in the group.
3. Record all the die numbers. Add each local area die number to the provincial centre die number. Record the numbers on the scoresheet for each round. If the total is 10 or more you have a drought, if it's less than 10 there is no drought and you are fine.
4. With each round new rules are added to make the game more interesting.
5. Follow the instructions for each round as you progress in the game.

Rules of the game:

SCORE	CONDITION	COST
10+	Drought	Pay 4 Paper clips
	Paid 1 paper clip for Drought Preparation	No payment required
-10	No Drought	No Payment required

4 possible outcomes of the game:

	DROUGHT	NO DROUGHT
Prepared (Paid 1)	'Worthy Action!' You're a Hero!	Better safe than sorry. Ready for next time!
Not Prepared	'Fail to Act' Avoidable Loses (Pay 4 Paper clips)	You got lucky this time…

LET US BEGIN…

The game is played in rounds:

- **Round 1:** Practice
- **Round 2:** Preparation for drought (Short Term)
  - » Teams bid using their paper clips for the chance to see the provincial centre die number (forecast). Highest bidder is allowed to see the forecast for the whole game. Losing teams get their paper clips back but never see the provincial center "forecast".
  - » Winning team is able to see the regional die (rainfall forecast) before deciding on preparing.
- **Round 3:** Long term Disaster Risk Reduction
  - » Teams bid on long term disaster risk reduction. 2 Highest bidders will only have to pay 2 paper clips instead of 4 for the cost of drought (scoring 10 or more).
- **Round 4- 6:** continue with playing the game
  - » If you have a drought and have fewer paperclips than you need to respond to the drought, then you must pay all of your paperclips and receive a penalty: a humanitarian crisis!
  - » You can keep playing until the end of the 10 rounds, but every time you experience a drought, you accumulate another humanitarian crisis.
- **Round 7:** Introduce Climate Change (replace the 6-sided die with an 8-sided die)
  - » Continue playing the game.
  - » The individual WINNER is the person with the most paperclips.
  - » The team WINNER is the team with fewest total humanitarian crises. If there is a tie the team with most total paperclips combined is the team winner.

Discussion Round: What did we learn?

Score sheet.

SEASON	LOCAL RAIN	REGIONAL RAIN	TOTAL	DID YOU PREPARE? Y/N
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				

Bidding for the forecast

Did your team bid for the forecast?...

How much did you personally bid?...

How much did your team bid?...

Did your team win the bid?...

Disaster Risk Reduction

Did your team bid for the forecast?...

How much did you personally bid?...

How much did your team bid?...

Did your team win the bid?...

Climate and Ocean Support Program in the Pacific (COSPPac)
Regional Early Action Rainfall Watch

Seasonal Rainfall Watch: March – May 2020

Alert Level

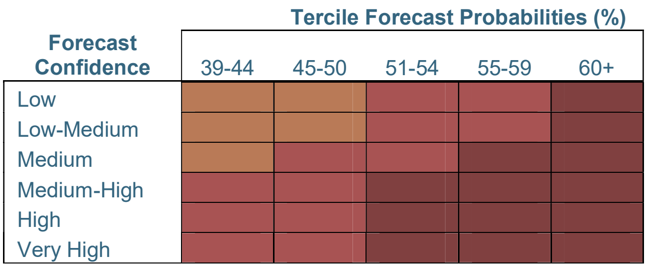
Alert Level	Divisions with <u>Below</u> Normal Rainfall favoured in the coming 3 months	Alert Level	Divisions with <u>Above</u> Normal Rainfall favoured in the coming 3 months
	Palau, FSM (C), Marshall Is., PNG (M), Solomon Is. (C), Vanuatu (All), Fiji (N, E, W), Niue, Cook Is. (S)		PNG (H), Tuvalu (S), Cook Is. (N)
	FSM (Y), PNG (S), Solomon Is. (E)		Kiribati (E, C), Tuvalu (N)
			Kiribati (W)

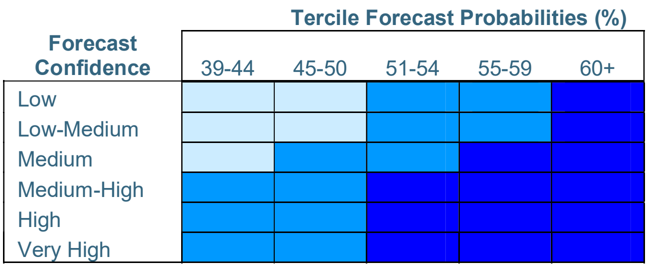
List of Divisions:

- Cook Is. (Northern – N)
- Cook Is. (Southern – S)
- Fiji (Western Div. – W)
- Fiji (Central Div. – C)
- Fiji (Eastern Div. – E)
- Fiji (Northern Div. – N)
- Fiji (Rotuma – R)
- FSM (Yap – Y)
- FSM (Chuuk – C)
- FSM (Pohnpei – P)
- FSM (Kosrae – K)
- Kiribati (Western Is. – W)
- Kiribati (Central Is. – C)
- Kiribati (Eastern Is. – E)
- Marshall Is.
- Niue
- Palau
- PNG (Momase Region – M)
- PNG (New Guinea Is. – Is.)
- PNG (Southern Region – S)
- PNG (Highlands – H)
- Samoa
- Solomon Is. (Western Region – W)
- Solomon Is. (Central Region – C)
- Solomon Is. (Eastern Region – E)
- Tuvalu (Northern – N)
- Tuvalu (Southern – S)
- Vanuatu (Northern Region – N)
- Vanuatu (Southern Region – S)

No alert for this region   Outlook unavailable for this region

<u>Rating Scale: Below Normal and Above Normal</u>





E.g. If a region has a forecast probability for **above normal** rainfall of **45%** [17/38/45 – below normal/normal/above normal] with a **Medium-High** Confidence, it would give a **Mid-Blue** Alert Rating. Similarly if a region has a forecast probability for **below normal** rainfall of **45%** [45/38/17 – below normal/normal/above normal] with a **Medium-High** Confidence, it would give a **Mid-Brown** Alert Rating.

Rainfall Status: as of 31 January 2020

Alert Level	3-month period
Seriously wet (90%)	Tuvalu (S)
Near or wetter than normal	FSM (C, P), Marshall Is., PNG (Is., S, H), Vanuatu (N), Kiribati (W, E), Fiji (R), Tuvalu (N), Samoa, Niue, Cook Is. (S)
Warning (25%)	Palau, Solomon Is. (C, E), Fiji (W, C, E, N)
Seriously dry (10%)	FSM (Y, K), PNG (M), Solomon Is. (W), Cook Is. (N)
Severely dry (5%)	Vanuatu (S)
Status not available	Kiribati (C)

List of Divisions:

Cook Is. (Northern – N)
Cook Is. (Southern – S)
Fiji (Western Division – W)
Fiji (Central Division – C)
Fiji (Eastern Division – E)
Fiji (Northern Division – N)
Fiji (Rotuma – R)
FSM (Yap – Y)
FSM (Chuuk – C)
FSM (Pohnpei – P)
FSM (Kosrae – K)
Kiribati (Western Is. – W)
Kiribati (Central Is. – C)
Kiribati (Eastern Is. – E)
Marshall Is.
Niue
Palau
PNG (Momase Region – M)
PNG (New Guinea Is. – Is.)
PNG (Southern Region – S)
PNG (Highlands – H)
Samoa
Solomon Is. (Western Region – W)
Solomon Is. (Central Region – C)
Solomon Is. (Eastern Region – E)
Tuvalu (Northern Region – N)
Tuvalu (Southern Region – S)
Vanuatu (Northern Region – N)
Vanuatu (Southern Region – S)

Three-month total rainfall is typically used for monitoring grasslands, shallow rooted plants and small water body (e.g. small water tanks, streams) mositure deficits. Allow for uncertainty associated with island size, topography, geology and soil type.

Rainfall Status

- Estimates of moisture/water stress are based on recent rainfall compared with historical observations using the Percentile (Decile) Index. A division is listed once at the highest station alert within that division.

Seasonal Rainfall Watch

- Information provided gives an indication of predicted total rainfall over the next three months, not how intense the rain may be in any one event, nor how it may vary from month to month.
- Information provided has been given on a divisional scale as Pacific Island Countries can experience a high range of rainfall variability within country. It is possible to have forecasts which simultaneously favour above and below normal rainfall in different parts of the one country.
- Starting at 39%, the alert levels indicate increasing chances of either below or above normal rainfall, as defined below. A measure of confidence, based on historical model performance, also plays a role in the rating level.
- The alerts are based on the highest station probabilities within a country or division.
- Definitions: “Below Normal Rainfall” = rainfall total below the 33rd percentile for that location and season; “Above Normal Rainfall” = rainfall total above the 67th percentile for that location and season.
- Local Met Services should be contacted for detailed information and outlooks. This product is not to be distributed to the public or other organisations.

Australian Government
Bureau of Meteorology

SPREP
Secretariat of the Pacific Regional Environment Programme

Published by COSPPac/BOM

Vanuatu Klaemet Infomesen blong Redy, Adapt mo Protekt

Van-KIRAP

SPREP 2023