CLIMATE SUMMARY AUGUST 2015

Samoa Meteorology Division

Ministry of Natural Resources and Environment

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ISSUED : SEPTEMBER 2015

HIGHLIGHTS

- A Meteorological Drought is now in effect for Samoa **Pg 11**
- Drier than average rainfall recorded in August 2015 mainly in the northern regions of the islands. Extreme dry conditions impacts were observed for these parts. **Pg 1,2 & 4**
- Generally 'average to below average' rainfall received for the June to August 2015 period. **Pg 3**
- 12.6degC was the lowest minimum temperature for Afiamalu on August 16th. Alafua station recorded the hottest day temperature of 33.2degC on August 2nd. **Pg 7**
- The mean atmospheric pressure for Apia was below normal. **Pg 5**
- East to south easterly winds prevailed over Samoa in August. **Pg 8**
- Sea surface temperature and sub-surface temperature recorded warmer than average. Samoa ocean waters registered up to 0.5degC **Pg 9**
- EL Nino 2015 declared to be the strongest and it forecasts to continue into 2016. **Pg 10**
- 'Average to below average' rainfall is favored for the October to December 2015 period. **Pg 10**

Figure 1: SPCZ Position in August 2015

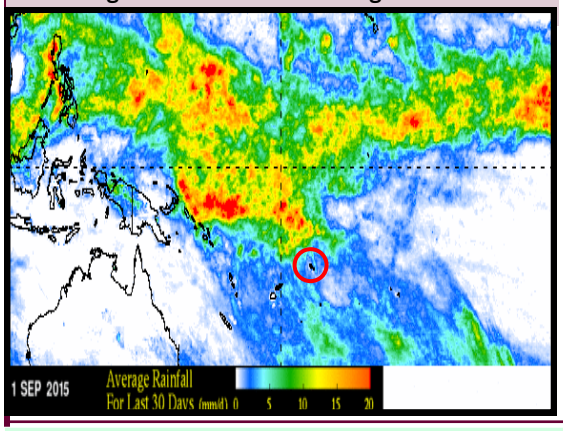
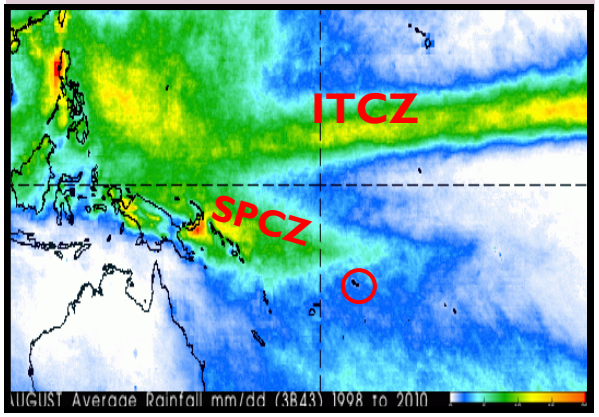


Figure 2: Average/Normal Position of SPCZ in August



The Inter-tropical Convergence Zone (ITCZ) was southward displaced and enhanced across most of the tropical north Pacific with the exception of the far west Pacific (north of New Guinea) as shown in Figure 1. The South Pacific Convergence Zone (SPCZ) was displaced northeastward extending far east and it merged with the ITCZ near the dateline. Countries in the northern Pacific received sufficient rainfall compared to the drier than normal conditions encountered by the southern pacific islands including Samoa.

Rainfall in August for Samoa was 'below average to well below average' (Table 1 pg2). Drier than normal conditions were mainly experienced in the northern parts of the islands. Rainfall deficiency was justified and indicated by the dry conditions of certain weeds and grass observed along the northern coast road from Saoluafata, Apia to Mulifanua for Upolu and from Maota to Tuasivi, Pu'apu'a to Falelima for the big island of Savaii. The northern parts of the islands received precipitation mostly on August 10th with 1-day rainfall of between 10mm to 70mm in these parts. The south and windward side of the country experienced very wet conditions with 1-day rainfall exceeding 75mm recorded on various days of the month.

Tiavea recorded the highest rainfall of 399.8mm in August for Upolu and 193.0mm recorded at Vaiaata for the big island. Both of these stations are located and situated inland of their respective islands and are exposed to the southerlies and south easterlies pushing moisture over the islands affecting the highlands and the windward side. (Topograhy Effect See page 4).

Rainfall Observations

Table 1: Rainfall Statistics in August 2015

This table displays the rainfall status of all stations in the country in August 2015

Stations	August Rainfall (mm)	August 30 Year Long Term Average	% of Average	1 day fall (mm)	Date	#of Rainy Days	Rainfall Status
UPOLU							
Faleolo	26.7	93	29	16.4	10th	6	Well Below Average
Leauva'a*	57.0	165	35	21.8	12th	12	Well Below Average
Nu'u	70.6	152	46	41.4	10th	6	Below Average
Nafanua	101.6	113	90	42.0	10th	11	Average
Afiamalu	180.8	174	104	75.6	10th	19	Average
Apia	62.5	110	57	53.1	10th	6	Below Average
Alafua	95.1	191	50	53.6	10th	8	Below Average
Laulii	86.1	151	57	44.8	10th	5	Below Average
Saoluafata	115.4	208	56	75.2	10th	17	Below Average
Saletele	81.9	286	29	81.9	8th	11	Well Below Average
Tiavea	399.8	306	131	81.4	8th	23	Above Average
Nuusuatia	201.6	259	78	75.2	2nd	14	Below Average
Matautu Lefaga	193.0	206	94	28.2	6th	24	Average
Salani	346.2	249	139	75.0	8th	20	Above Average
Lepa	285.2	233	122	69.6	8th	20	Above Average
Lotofaga	214.5	249	86	50.4	12th	11	Average
Togitogiga	358.9	335	107	79.2	3rd	30	Average
Vailoa Aleipata*	115.0	137	84	43.6	8th	12	Average
SAVAII							
Lefagaoalii	17.6	108	16	22.2	10th	5	Well Below Average
Samalaeulu	74.8	172	44	44.8	3rd	18	Below Average
Lalomalava	55.6	164	34	41.4	3rd	23	Below Average
Vaiaata	198.0	410	48	75.2	3rd	15	Well Below Average
Tuasivi*	27.6	148	19	20.4	12th	13	Below Average
Salailua*	86.4	162	53	42.0	10th	13	Below Average
Maota	121.0	171	71	112.2	1st	8	Below Average
Neiafu	27.4	68	40	21.8	12th	2	Below Average
Salelologa	50.9	152	33	30.4	12th	17	Well Below Average
Vaipouli	60.9	126	48	35.5	10th	13	Below Average

Note: Rainfall statuses are defined as follows (deviation from average (in percentage));
Well below average <40%, Below average 40-80%, Average 80-120%, Above average 120-160%, Well above average >160%

Figure 3: Rainfall Status Map in August 2015

This rainfall map is generated using data from Table 1

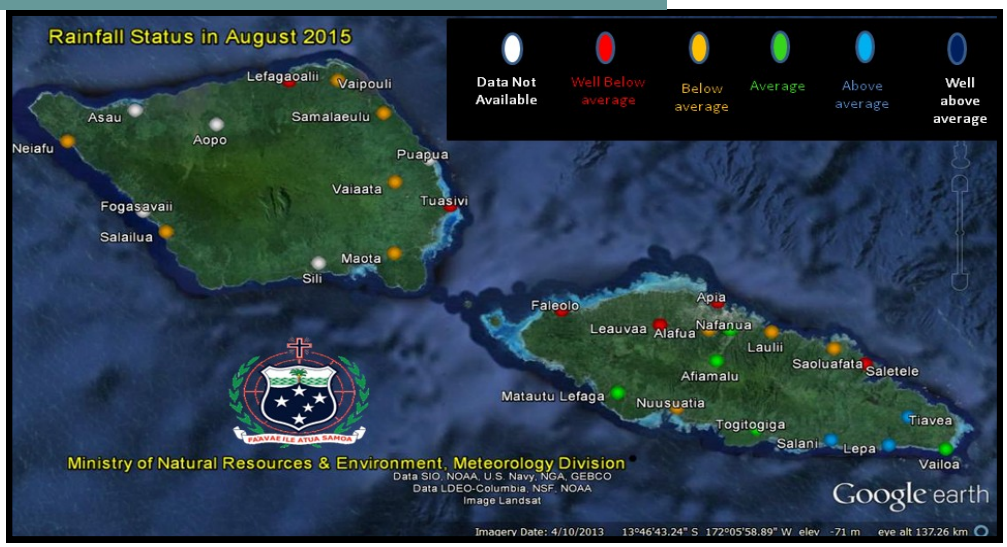


Table 2: Three Monthly Seasonal Rainfall - June to August 2015 period

This table displays the status of the rainfall in the last three months—June to August 2015 period

Stations	Three Monthly Total Rainfall	Long Term Average	% of Average	Rainfall Status
Afiamalu	532	560	95	Average
Afulilo*	1153	973	118	Average
Alafua	210	471	45	Below Average
Apia	179.5	364	49	Below Average
Faleolo	95.9	270	36	Well Below Average
Fiaga*	156.4	575	27	Well Below Average
Laulii*	242.9	437	56	Below Average
Leauvaa*	156.4	575	27	Well Below Average
Lotofaga*	745.3	809	92	Average
Nafanua	211.7	604	35	Well Below Average
Nuusuatia*	853.8	888	96	Average
Salailua	575.6	466	124	Above Average
Saletele*	456.6	917	50	Below Average
Tiavea Uta*	1153.0	973	118	Average
Tuasivi*	267.4	480	56	Below Average
Vaiaata*	610.2	1053	58	Below Average

The highest seasonal rainfall (3-months total) was recorded at Tiavea with the lowest registered at Faleolo with only 95.9mm. The rainfall received within the period June to August 2015 was generally, 'below average to well below average' for stations in the north and 'average to above average' for stations in the southern parts. Additionally, Leauvaa station recorded its all time lowest June to August accumulative rainfall of 156.4mm since establishment.

IMPACTS

Falelima

Aopo

Pu'apu'a

Bushfire at Samalaeulu

FESA working to stop the spread of fire at Samalaeulu

Fusi Safotulafai

The dry conditions endured mainly by the northern region of the islands in July continued into August. The dryness is indicated by the de-coloration and failure of certain weeds and grass species as a result of rainfall deficiency and higher than normal day time temperature. These conditions are expected in these times of El Nino phenomena. The most critical areas span from Maota to Tuasivi, Pu'apu'a to Falelima in the north western of Savaii. The north and central region of Upolu (from Faleolo, Apia to Saoluafata) is affected.

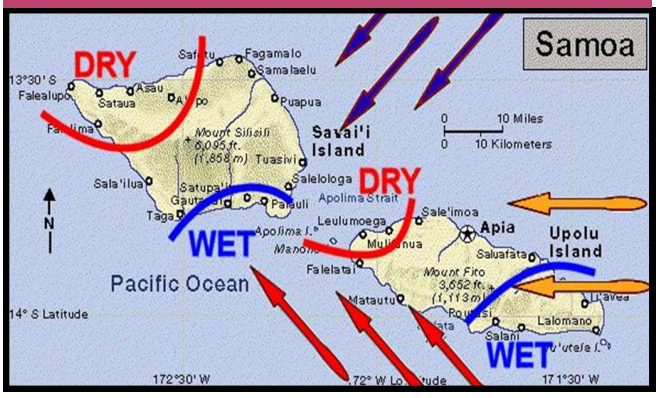
Additionally, vulnerability of the dry areas to catch fire is medium to high for the north west areas of both main islands. The public is hereby advised to discourage and refrain from burning rubbish or any related activities that may cause fire at these hotspot areas. In fact, a number of bush fires were reported recently from Samalaeulu, Tafaigata and Solosolo mainly started off due to careless acts.

WELCOME TO THE CLIMATE INFORMATION PAGE!!

Topography Effect on Rainfall Distribution

The physical landscape or topography of Samoan islands has a significant effect on its rainfall distribution. The mountains are aligned in the interior of the islands which act as barriers to the moist air brought in by the predominant south east trade winds. This side of the mountain is the windward side (southern region). As the moist air moves higher up the mountain, the moisture condenses as rainfall while the dry air rises over the mountain range and proceed to the other side; leeward side. Therefore the highlands and southern region of the islands are wetter than the north western region due to this topography impact.

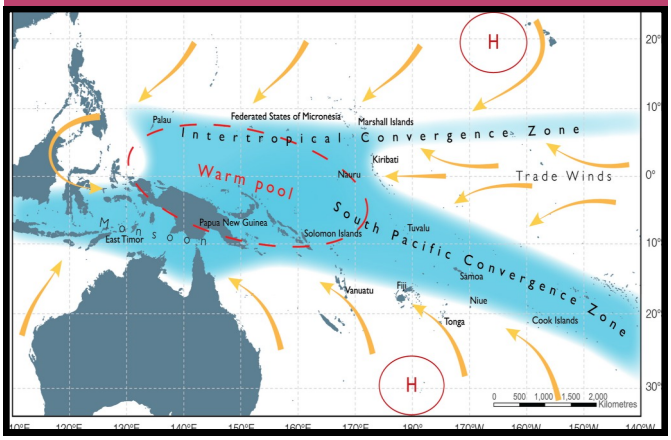
Figure 4: Topography Effect on the Distribution of Rainfall in Samoa



What is South Pacific Convergence Zone?

South Pacific Convergence Zone (SPCZ) is a band of heavy rainfall caused by the air rising over warm water where winds converge resulting in thunderstorm activity. It positions across the South Pacific Ocean from the Solomon Islands to the Cook Islands and lies between Samoa and Fiji during the wet season (November to April). This normally brings unsettled weather conditions thus; it is one of the major drivers of climate in Samoa (See Figure 5below)

Figure 5: Average position of the major climate features from November to April.



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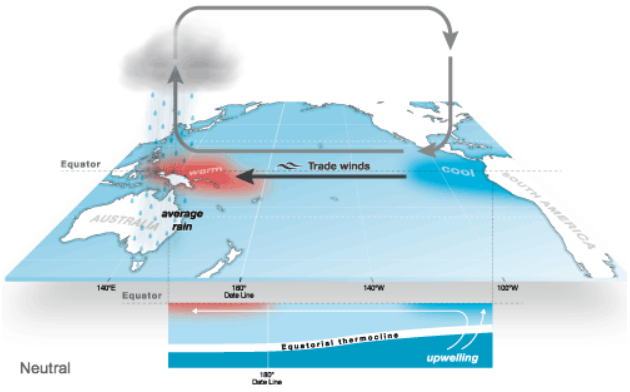
EL NINO OSCILLATION (ENSO)

ENSO is a very important variation (variability) in the Pacific Region which typically has a three to seven year cycle. It is a natural, coupled phenomenon as it involves strong interaction between the ocean and the atmosphere. ENSO affects the weather worldwide due to increase sea temperature over a large area resulting in big change to global weather patterns. It has three (3) phases : La Nina, Neutral and El Nino.

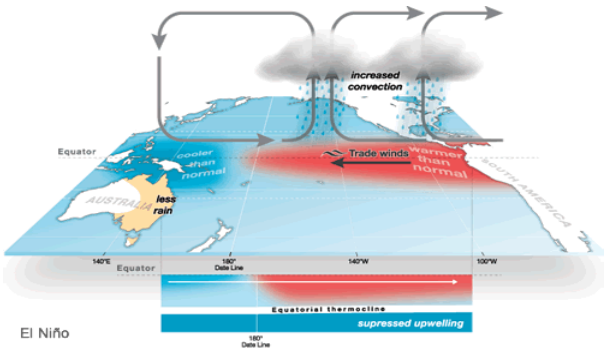
Neutral Phase

In the neutral state (neither El Niño nor La Niña) trade winds blow east to west across the surface of the tropical Pacific Ocean, bringing warm moist air and warmer surface waters towards the western Pacific and piled up in the north and keeping the central Pacific Ocean relatively cool. The thermocline is deeper in the west than the east .



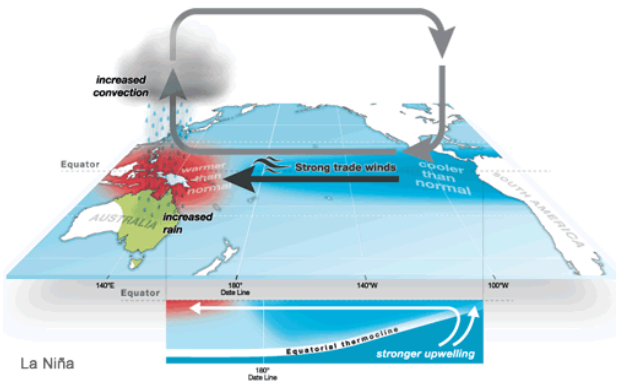
El Nino

During an El Niño event, trade winds weaken or may even reverse, allowing the area of warmer than normal water to move into the central and eastern tropical Pacific Ocean and piled up in the west coast of South America result in major weather shift.



La Nina

During a La Niña event, the trade winds blow stronger than normal results in greater convection over the western Pacific.



Source: Figures courtesy of Bureau of Meteorology, Australia (BoM)/http://www.bom.gov.au

Temperature & Atmospheric Pressure Observations

Table 3: Air Temperature Statistics

This table displays the temperature statistics recorded across stations in August 2015

Stations	Temperature (Degree Celsius)				
	Mean Daily Temperature	Extreme T Max	Date	Extreme T Min	Date
Faleolo	26.2	32.1	25th	18.4	31st
Nafanua	N/A	N/A	N/A	16.6	31st
Afiamalu	20.8	28.0	25th	12.6	16th
Apia	27.0	32.1	9th	19.1	31st
Nuu	24.9	31.4	25th	17.2	31st
Alafua	26.2	33.2	2nd	17.3	31st
Togitogiga	N/A	N/A	N/A	20.0	14th
Vaiaata	23.9	30.5	25th	16.8	16th
Saoluafata	25.7	31.8	25th	18.6	21st
N/A = Data Not Available					

August 25th recorded the hottest temperature for most climate stations. The most extreme maximum air temperature of 33.2degC was recorded at Alafua on August 2nd with the lowest maximum at Afiamalu. Afiamalu was also registered as the coolest location across the country recording a lowest minimum temperature of 12.6degC on August 16th. The other stations recorded minimum temperatures between 16.6 to 20.0degC across the month. August is slightly cooler compared to previous month. More clear days and nights have resulted in cooler conditions with Afiamalu recording the lowest mean daily temperature of 20.8degC. The highest mean temperature for Apia of 27.0degC was the highest for Upolu with Vaiaata registering a mean temperature of 23.9degC for Savaii .

Table 4: Atmospheric Pressure at Mean Sea Level (MSL)

This table displays the atmospheric statistics recorded across two stations in August 2015

Station	Highest MSL Pressure (hPa)	Date	Lowest MSL Pressure (hPa)	Date	Average MSL Pressure (hPa)
Apia	1016.5	18th	1007.7	9th	1011.8
Faleolo	1015.8	22nd	1009.8	2nd	1012.2

Apia and Faleolo recorded mean atmospheric pressures of 1011.8hPa and 1012.2hPa respectively. The mean atmospheric pressure recorded for August at Apia was below its long term average of 1013hPa.

(Note: High pressure systems associate with good weather conditions whereas low pressure systems associate with bad weather conditions)

Wind Observations

Figure 6: Wind Speed and Directions

The following diagrams show the different wind speed and direction that recorded across the country in August 2015

Figure 6a : Apia Station

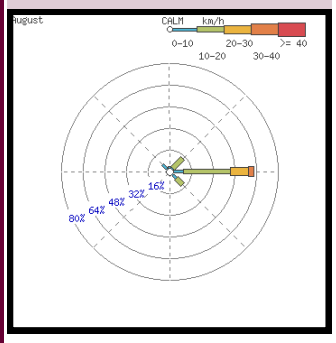


Figure 6b: Faleolo Station

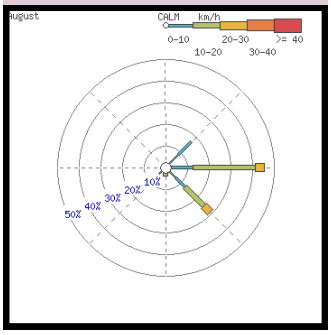


Figure 6c: Afiamalu Station

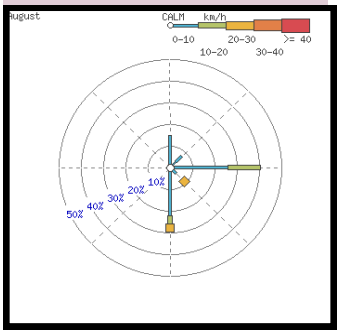


Figure 6d: Salailua Station

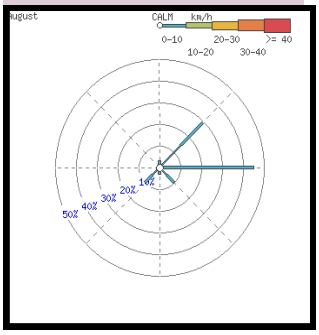


Figure 6e: Nafanua Station

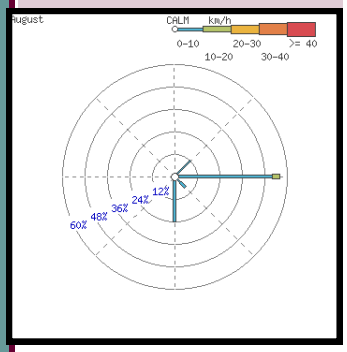


Figure 6f : Togitogiga Station

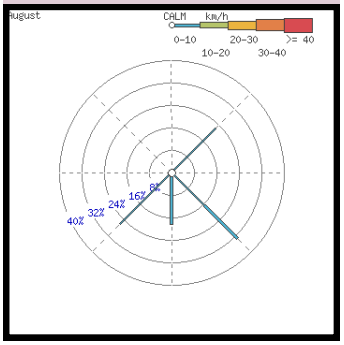


Figure 6g : Vaiaata Station

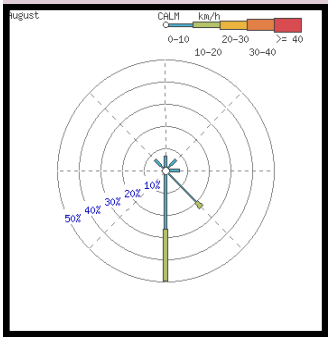
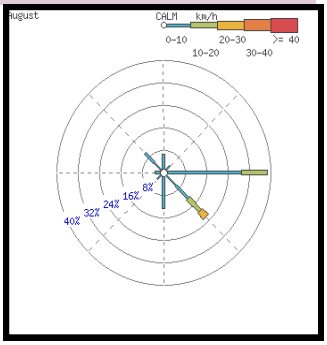


Figure 6h: Nuu Station



The prevailing east to south east trade winds occupied most of Samoa in August. Similarly, the common wind speed that was experienced most of the time were travelling at 0-10km/hr (light wind) and 10-20km/hr (gentle breeze) across all stations. Moderate winds of 20-30km/hr were registered at Apia, Faleolo and Afiamalu for a brief time directing from east to south east direction.

(N.B: It is expected for Samoa to experience high wind and cooler nights during this time of year as it is mainly due to the displacement of the subtropical ridges northward of their normal position (i.e closer to the south of Samoa). This belt of subtropical ridges direct cool southerly winds over Samoa).

Sea Surface & Sub-surface Temperature Observations

Figure 7: Sea Surface Temperature in August 2015

The sea surface temperature anomaly in August 2015 adapted from Bureau of Meteorology, Australia

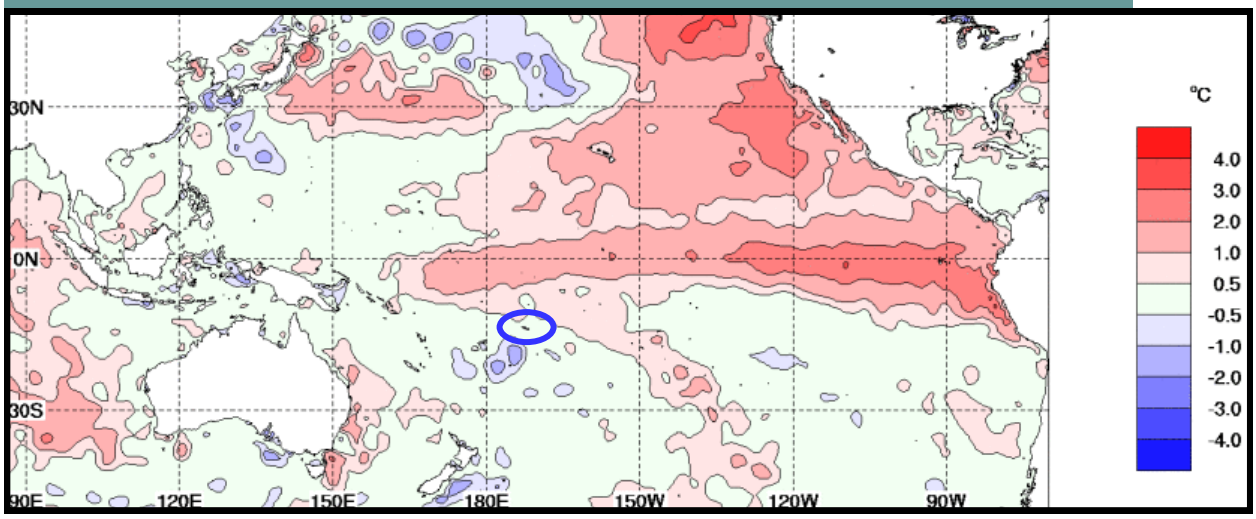


Figure 8: Sub Sea Surface Temperature in August 2015

The sub surface temperature anomaly in August 2015 adapted from Bureau of Meteorology, Australia

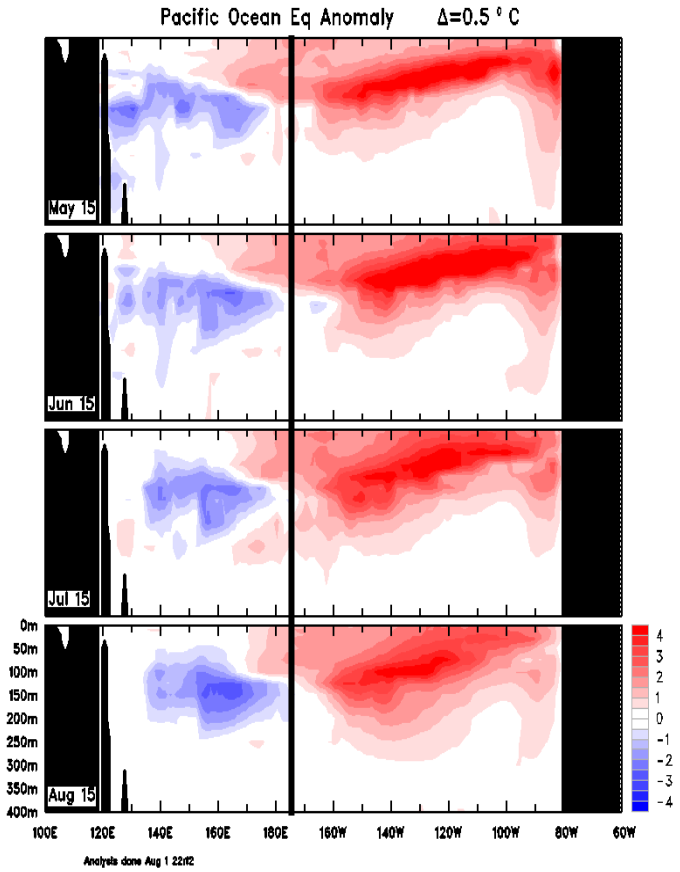
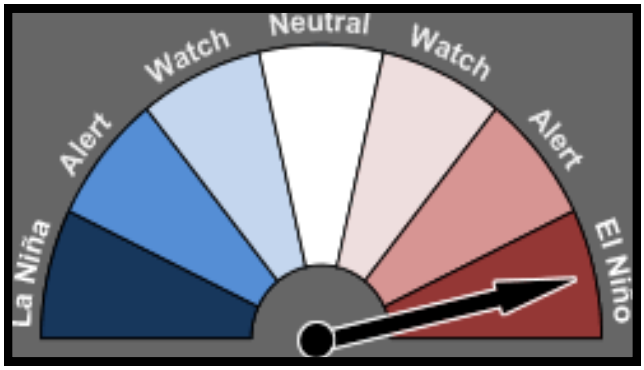


Figure 7 shows warmer than average sea surface temperature recorded in the central and very extreme at the eastern equatorial region along side the Southern American coast. This warmer sea water extended west of the international dateline. Some positive anomalies registered south west of Samoa about –1.0 to –2.0degC. Samoan waters recorded 0– 0.5degC at the end of August.

Figure 8 displays the four-month sequence of sub-surface temperature anomalies starting from May. A continuous pattern of migrating of warmer anomalies to the east along with positive anomalies recorded at the west. Substantial warming is sustained and extended down to a depth of 250m at the eastern region. Samoan sub surface water temperature is indicated by the black line, it shows that Samoan water is warmer do a depth of 100m at about 0-1degC.

Source: Figures courtesy of Bureau of Meteorology, Australia (BoM)/ http://www.bom.gov.au

El Nino Southern Oscillation (ENSO) Status



"The 2015 El Nino is now declared the strongest since 1997-1998 event".

The ocean and the atmosphere are strongly and fully coupled hence why El Nino 2015 has been declared as the strongest event ever. At the end of August, the sea surface temperature (SST) registered well into El Nino thresholds in the central and eastern equatorial region as evidently shown in the table below :

Index	July	August
Nino 3	+1.9 degC	+2.0 degC
Nino 3.4	+1.5 degC	+1.9 degC
Nino 4	+1.1 degC	+1.1 degC

A sustained negative Southern Oscillation Index (SOI) of –17.7 was also observed and the substantial warming of the sub-surface temperature in the eastern equatorial region which fuels the strength and the duration of the El Nino.

The Samoa Meteorology Division (SMD) with the assistance of overseas meteorology offices continue to monitor El Nino characters closely through climate models. These models forecast above 90% chance El Nino will persist through 2015 and into the beginning of 2016

IMPACTS OF EL NINO IN SAMOA

- Below normal rainfall receive which may lead to drought and forest fires.
- Higher than normal day time temperature over the country
- Decrease sea level and increase possibility of coral bleaching in the marine environment
- Increase numbers of tropical cyclones

The following sectors could be severely impacted as a consequence of rainfall deficit:

- Water
- Agriculture
- Health
- Energy (Hydro Power),
- Tourist (Accommodation Facilities)
- Forestry

SEASONAL RAINFALL OUTLOOK FOR OCTOBER TO DECEMBER 2015 PERIOD

"Average to Below Average" rainfall is predicted and forecast by the Seasonal Climate Outlook Prediction (Statistical) Model (SCOPIC) alongside with POAMA model rainfall over Samoa for the next 3 month period—October to December 2015.

(Refer to detailed discussion in the Seasonal Rainfall Outlook Report for October to December 2015 period)

DROUGHT MONITORING & ANALYSIS

Table 5: Monthly rainfall status observed from June to August 2015 period, drought status and forecast

This table displays the status of rainfall in each month of the previous three monthly period (June to August 2015) and using their status to determine their drought status as well as the rainfall forecast for the next three months.

Climate Stations	Rainfall Observed			Current drought status and warning	Rainfall Forecast for October to December 2015 period
	June	July	August		
Faleolo					
Leauvaa					
Nuu					
Nafanua					
Afiamalu					
Apia					
Alafua					
Laulii					
Tiavea					
Nuusuatia					
Salani					
Lotofaga					
Togitogiga					
Vailoa Aleipata*					
Lefagaoalii					
Samalaeulu					
Vaiaata					
Lalomalava					
Tuasivi*					
Salailua*					
Maota					
Neiafu					

KEY FOR DROUGHT	Normal/Not in Drought	Drought Watch	Meteorological Drought	Drought Easing
KEY FOR RAINFALL	Drier than Normal	Normal	Wetter than Normal	

Based on rainfall outlook, areas that are in **Meteorological Drought** will remain in dry conditions for the next three months. **Drought watch** and **Drought easing** areas have a high possibility of moving into Meteorological Drought. However, **Normal/Not In Drought** areas have little or no possibility to move into drought conditions.

"Meteorological Drought" is declared when rainfall is below average (drier than normal) for three consecutive months. **"Meteorological Drought Watch"** is issued when the last two months of three monthly period receive below average rainfall. "**Drought Easing"** happens when the first and second month of the three monthly period are below average, but the third month is either normal or wetter than normal. **"Normal/Not in Drought"** is when two or more months receive normal to wetter than normal conditions.

Additional Information

Meteorological drought is defined usually on the basis of the degree of dryness (in comparison to some "normal" or average amount) and the duration of the dry period. Meteorological drought is the first of four levels of severity or definitions. The more severe drought definitions are Agricultural Drought, Hydrological Drought and Socio-economic Drought.

Agricultural Drought

Agricultural drought links various characteristics of meteorological (or hydrological) drought to agricultural impacts, focusing on precipitation shortages, differences between actual and potential evapo-transpiration, soil water deficits, reduced groundwater or reservoir levels, and so forth.

Hydrological Drought

Hydrological drought is associated with the effects of periods of precipitation (including snowfall) shortfalls on surface or subsurface water supply (i.e., stream flow, reservoir and lake levels, groundwater). The frequency and severity of hydrological drought is often defined on a watershed or river basin scale. Although all droughts originate with a deficiency of precipitation, hydrologists are more concerned with how this deficiency plays out through the hydrologic system. Hydrological droughts are usually out of phase with or lag the occurrence of meteorological and agricultural droughts. It takes longer for precipitation deficiencies to show up in components of the hydrological system such as soil moisture, stream flow, and groundwater and reservoir levels. As a result, these impacts are out of phase with impacts in other economic sectors.

Socioeconomic Drought

Socioeconomic definitions of drought associate the supply and demand of some economic good with elements of meteorological, hydrological, and agricultural drought. It differs from the aforementioned types of drought because its occurrence depends on the time and space processes of supply and demand to identify or classify droughts. The supply of many economic goods, such as water, forage, food grains, fish, and hydroelectric power, depends on weather. Because of the natural variability of climate, water supply is ample in some years but unable to meet human and environmental needs in other years. Socioeconomic drought occurs when the demand for an economic good exceeds supply as a result of a weather-related shortfall in water supply.