



**2015**

**Annual Climate Summary**

**Fiji Meteorological Service**

Issued by

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**HIGHLIGHTS OF 2015**

**Issued  
September 30, 2016**

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- The year 2015 began with warm neutral state of the El Niño Southern Oscillation (ENSO) and a weak El Niño established in the middle of the year which intensified into one of the strongest events in the recorded history;
- The South Pacific Convergence Zone (SPCZ) was displaced to the north of its normal position through most of the year;
- Consequently, *below average* rainfall was experienced which caused meteorological drought and prolonged dry spell in parts of the country;
- Warmer day time temperatures and drier conditions prevailed in most parts of the country in 2015;
- Fiji’s mean annual total rainfall during the year was second driest in 59 years of record;
- The annual average mean temperature was 0.2°C *warmer* than *normal*;
- The annual average daytime (maximum) air temperature was 0.4°C *warmer* than *normal*;
- The annual average night-time (minimum) air temperature was 0.1°C *warmer* than *normal*;
- The cloud cover in the Fiji region was *normal* during most of the months;
- The sea surface temperatures (SST) in the Fiji region were mostly *near normal*;
- A total of forty-six (46) new climate records were established in 2015 which included thirty seven (37) temperature, eight (8) rainfall and one (1) sunshine records;
- The Trade winds over Fiji were mostly *near normal* during the year;
- Bright sunshine hours were *near normal* in 2015;
- None of the tropical cyclones directly affected Fiji during 2015. However, strong winds and heavy rain were observed in some parts of the country during the passage of TC Pam and TC Reuben;
- Sea level anomalies ranged between -10cm to -15cm in the vicinity of Fiji.

*Note: All comparisons are with respect to “Climatic Normal”. This is defined to be an average climate conditions over 30 year period, which Fiji Meterological Service is currently using 1971-2000 period as its “climatic normal”.*

## YEAR IN REVIEW

**January's** weather was mainly influenced by troughs of low pressure, frontal systems, semi-permanent ridges of high pressure and the Trade winds. On January 3<sup>rd</sup>, a trough of low pressure to the east of Fiji drew closer to the group and lingered around until the 6<sup>th</sup>. This system resulted in heavy rainfall and Suva recorded the highest 24-hr rainfall of 105.0mm on the 4<sup>th</sup>. Hot and humid conditions prevailed and Lakeba registered a new high maximum air temperature of 33.7°C on the 4<sup>th</sup>, surpassing the 1984 record of 33.5°C. The second event was on the 9<sup>th</sup> when another trough approached the country from the west and resulted in a warm and humid northeast wind flow over Fiji. Monasavu recorded a new high maximum air temperature of 34.9°C on the 9<sup>th</sup>, exceeding the year 2000 record of 30.2°C. Later in the month, Monasavu recorded a new high daily minimum temperature of 23.4°C on the 17<sup>th</sup>, breaking the 2001 record of 22.6°C. Rotuma's weather in January was mostly influenced by the SPCZ and easterly trade winds.

Troughs of low pressure were the most significant weather feature during **February**. The weather was normal as Fiji entered this new month. The Trade winds brought brief showers mainly over the eastern part of the main islands. From the 9<sup>th</sup> to the 11<sup>th</sup>, a trough of low pressure affected the country that resulted in Lautoka Mill recording the maximum 24-hr rainfall of 106.0mm on the 11<sup>th</sup>. Towards the latter part of the month, another trough affected the Group. A weak low developed along this trough and both moved over the country from the northwest. This resulted in heavy rainfall, with Nausori Airport, Tokotoko (Navua), Laucala-Bay (Suva) and Koronivia recording a 24-hr maximum rainfall of 205.0mm, 150.9mm, 112.5mm and 190.0mm on the 21<sup>st</sup>, respectively. In February, Rotuma's weather was mainly affected by the SPCZ and moist easterly wind flow.

Tropical Depressions TD11F and TD12F were the most notable weather features in **March**. On the 9<sup>th</sup>, Tropical Depression TD11F further intensified, attained TC intensity and was named 'Pam'. TC Pam tracked to the far west of Fiji posing no direct threat to the country. However, strong winds and heavy rain was observed in some parts of the country as Lakeba recorded the highest 24-hr rainfall of 169.0mm on the 11<sup>th</sup>. Furthermore, TD12F approached the group from the northeast on the 20<sup>th</sup> and moved southward, close to the Lau Group. It further strengthened to cyclone intensity near Tonga. Subsequently, strong southerly winds with heavy rain was experienced over the Lau Group. Rotuma's weather was affected by SPCZ and the easterly trade winds during the month.

**April's** weather was largely affected by troughs of low pressure, frontal systems and semi-permanent ridges of high pressure. Warm and humid conditions prevailed which caused daytime temperatures to rise to mid thirty's and a new maximum temperature record of 34.0°C was established at Tokotoko on the 13<sup>th</sup>, surpassing a record of 33.0°C set in 2008. A high pressure extended over Fiji, and directed a cool southeast wind flow easing the warmer conditions. Fine weather prevailed with clear skies at night which resulted in the night-time temperatures falling below 20°C. On the 22<sup>nd</sup>, daily minimum temperature of 17.2°C was recorded, exceeding the record of 18.4°C established in 1974. Another new high daily maximum record for April was set during the month, with Lautoka Mill recording 17.8°C on the 22<sup>nd</sup>. Exceptionally dry conditions prevailed in most parts of Fiji with rainfall ranging from *below average to well below average*. Rotuma's weather was mainly influenced by the SPCZ and the trade easterly winds.

In **May**, given that a weak El Nino had established, drier than *normal* conditions continued to persist with majority of the centers recording *below to well below* average rainfall. On the 6<sup>th</sup>, a trough of low pressure was located just to the north of Fiji and it lingered around till the 7<sup>th</sup> with Nabouwalu recording the maximum 24-hr rainfall of 45.0mm during this event. A ridge of high pressure extended over the country on the 8<sup>th</sup> and influenced weather until the 26<sup>th</sup>. A cool southeast wind flow persisted over the country with fine weather. On the 19<sup>th</sup>, Matei Airfield (Taveuni) recorded a new daily minimum temperature of 17.0°C replacing the record of 18.0°C established in 2006. On the 26<sup>th</sup>, Matuku observed another new daily minimum temperature of 16.3°C breaking the record of 16.8°C set in 1960. Rotuma recorded a new high mean minimum temperature of 25.6°C, surpassing a record of 25.5°C observed in 1998.

The weather for **June** was mainly influenced by ridges of high pressure and the southeast trade winds. The SPCZ was displaced to the north of its usual position resulting in drier than *normal* conditions in Fiji. On June 2<sup>nd</sup>, a new high daily maximum temperature of 32.6°C was recorded at Matuku replacing the record of 32.2°C established in 1999. A cool southerly wind directed by ridge of high pressure resulted in a minimum temperature falling to a new low of 14.2°C at Koronivia on the 25<sup>th</sup>. Rotuma's weather was mostly affected by the presence of the SPCZ and easterly trade winds.

## YEAR IN REVIEW

In **July**, El Niño was well established and was at moderate strength. The SPCZ remained displaced to the north of usual position and the trend of suppressed rainfall continued over Fiji. This was evident as majority of the country received *below average to well below average* rainfall. July was the driest at Viwa in its 34 years of historical record. On July 13<sup>th</sup>, a ridge of high pressure system established just to the south of Fiji allowed the southeast trade winds to settle in. The high pressure system intensified and remained slow moving causing the southeast trades to persist until month end. On the 18<sup>th</sup>, a new high daily maximum temperature of 32.5°C was established at Tokotoko, breaking the record of 31.5°C set in 2001. Later in the month, Matei Airfield established a new low daily maximum temperature of 14.0°C replacing the record of 15.5°C set in 1986. Rotuma received *average* rainfall for the month of July.

Rainfall varied significantly for the month of **August** with parts of the country receiving *well below average* and other parts of Fiji received *above average* rainfall. Rainfall in the Western Division continued to reflect typical El Niño like pattern with *below average* rainfall recorded at majority of the stations. On August 7<sup>th</sup>, an active trough of low pressure approached Fiji from the west that resulted in rain and isolated heavy falls over most parts of the group until the 9<sup>th</sup>. During this period, Udu Point recorded the maximum 24-hr rainfall of 133.0mm on the 7<sup>th</sup>, which brought some short-term relief from the dry conditions. Consequently, *above average* rainfall was recorded at Monasavu, Seaqaqa, Matei Airfield and Vanuabalavu, while more than twice the *normal* rainfall was received at Udu Point. Rotuma received *above average* rainfall during this month.

In **September**, the strong El Niño continued to exist, with the SPCZ persistently displaced to the north of its normal position. SSTs in the Fiji region were *below normal*. The weather in September was mostly affected by troughs of low pressure and frontal systems. On the 4<sup>th</sup>, a trough approached Fiji from the west, moved over and later cleared the group on the 8<sup>th</sup>. Rain and thunderstorms were observed over most places, with Nasinu recording the maximum 24-hr rainfall of 65.0mm on the 6<sup>th</sup>. Much needed rainfall was also received over the Western Division and the northern part of the country. On the 21<sup>st</sup>, two new daily high maximum temperature records were established. The first one was at Vanuabalavu with a daily maximum temperature of 32.0°C, surpassing a record of 31.5°C set in 1989. Nadi recorded a daily maximum temperature of 25.7°C, breaking a record of 25.4°C set in 1967. Less than half the *normal* rainfall was recorded at Rotuma in September.

During the month of **October**, the SPCZ remained to the north and SSTs in Fiji region were near normal. With the exception of Monasavu, the trend of extremely dry conditions continued with *below average to well below average* rainfall observed over the Fiji group. A new low rainfall record for October was established at Vanuabalavu, while the rainfall at both Lakeba and Ono-i-lau ranked 4<sup>th</sup> lowest in their historical record. Towards the middle of October, TD02F and associated trough of low pressure brought much needed rainfall to the country with Monasavu recording a maximum 24-hr rainfall of 165.0mm on the 17<sup>th</sup>. Strong winds were also reported during the passage of TD02F, especially over the Western Division. On the contrary, the rainfall received was not sufficient to completely ease the dry conditions that were affecting the deep rooted plants and large water bodies. TD02F also affected Rotuma with strong winds and heavy rain. However, Rotuma continued to experience *below average* rainfall during this month.

The weather in **November** was mainly influenced by troughs of low pressure and frontal systems, yet none was significant. The trend of serious rainfall deficiencies continued to affect crops, trees, creeks, streams, wells and rivers over majority of the Western Division, northern parts of Vanua Levu and islands in the Lau Group. A record lowest total November rainfall was observed at Lautoka Mill and Dreketi. Lautoka Mill received only 2.4mm of total monthly rainfall, breaking the 1997 record of 2.9mm, while Dreketi registered 30.0mm of rainfall, replacing the 1977 record of 45.1mm. Rotuma's weather was mostly affected by the SPCZ and the easterly trade winds. The island received *average* rainfall in November.

Fiji's weather in **December** was mostly impacted by troughs of low pressure, a frontal system and TD07F. Rainfall during this month varied across the country, ranging from *well below average to above average*. Udu Point, Matei Airfield, Savusavu Airfield, Vatukoula, Vanuabalavu, Lakeba and Ono-i-lau recorded less than half the *normal* rainfall for the month. On the other hand, Levuka, Nausori Airport, Laucala Bay, Tokotoko, Dreketi, Rarawai Mill and Yasawa-i-rara received more than 120% of the *normal* rainfall. On the 31<sup>st</sup>, TD07F and the associated weather resulted in substantial rainfall over most places. The maximum 24-hr rainfall of 233.0mm was recorded at RKS. Consequently, flooding of low lying areas was reported in several parts of the country, which led to closure of roads and bridges. Rotuma's weather was influenced by the SPCZ and the passage of tropical depression TD07F.

**LARGE SCALE CLIMATE INFLUENCES IN 2015—EL NIÑO SOUTHREN OSCILLATION (ENSO)**

Following the near-miss El Niño in 2014, one of the strongest El Niño events on record developed during 2015. The sea surface temperatures in the central and eastern equatorial Pacific Ocean was more than 2°C warmer than *normal* (Figure 1) for most of the second half of 2015, placing this El Niño event amongst the three strongest previous events since 1950 (1972-73, 1982-83, 1997-98).

Following months of weak ocean and atmosphere coupling, both oceanic and atmospheric features started to reflect El Niño like conditions from late March 2015. The El Niño conditions continued to intensify and attained moderate strength by June 2015. It further strengthened and

reached strong El Niño category during August 2015. The SSTs in the central and eastern tropical Pacific peaked in late November with values comparable to the past strong El Niño events of 1997–98 and 1982–83.

The event led to *below average* rainfall over majority of places around the country, with the Western Division and northern parts of Vanua Levu being most significantly affected. Severe rainfall deficiencies required catering of water to many rural communities on the main islands and maritime regions.

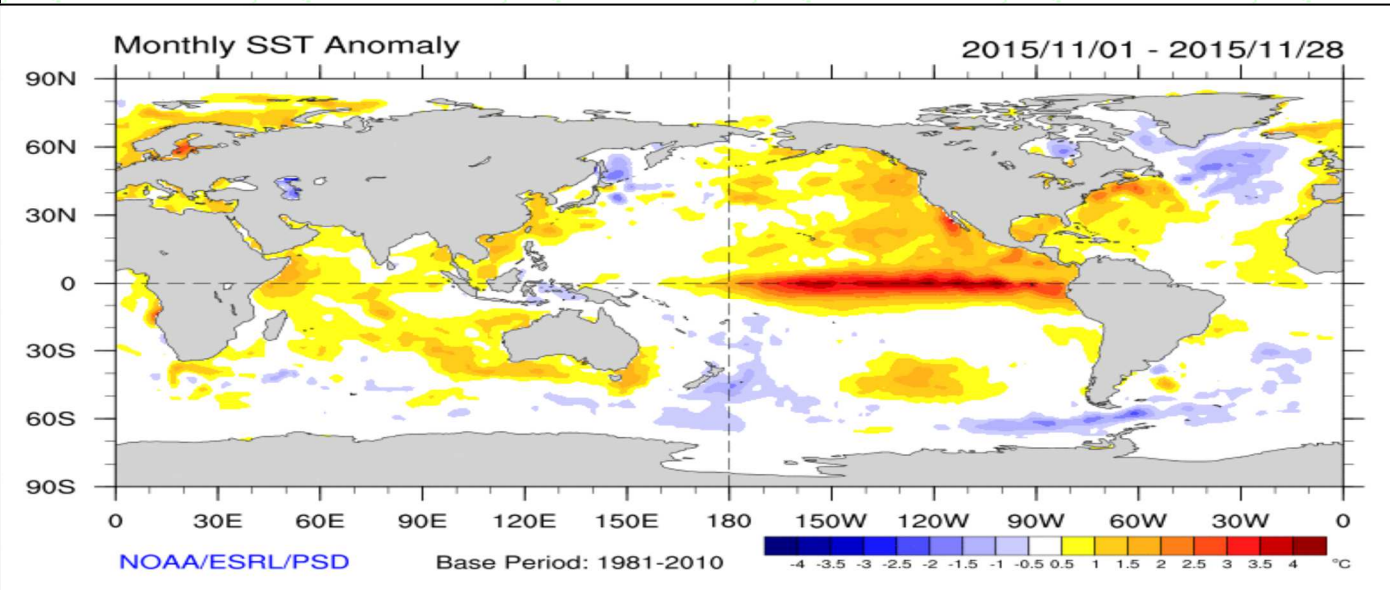


Figure 1: Sea surface temperature anomalies during November 2015. SSTs were more than 2°C warmer than normal in the central and eastern equatorial Pacific, suggesting persistence of strong El Niño conditions. Graphic Source: National Oceanic and Atmospheric Administration (NOAA).

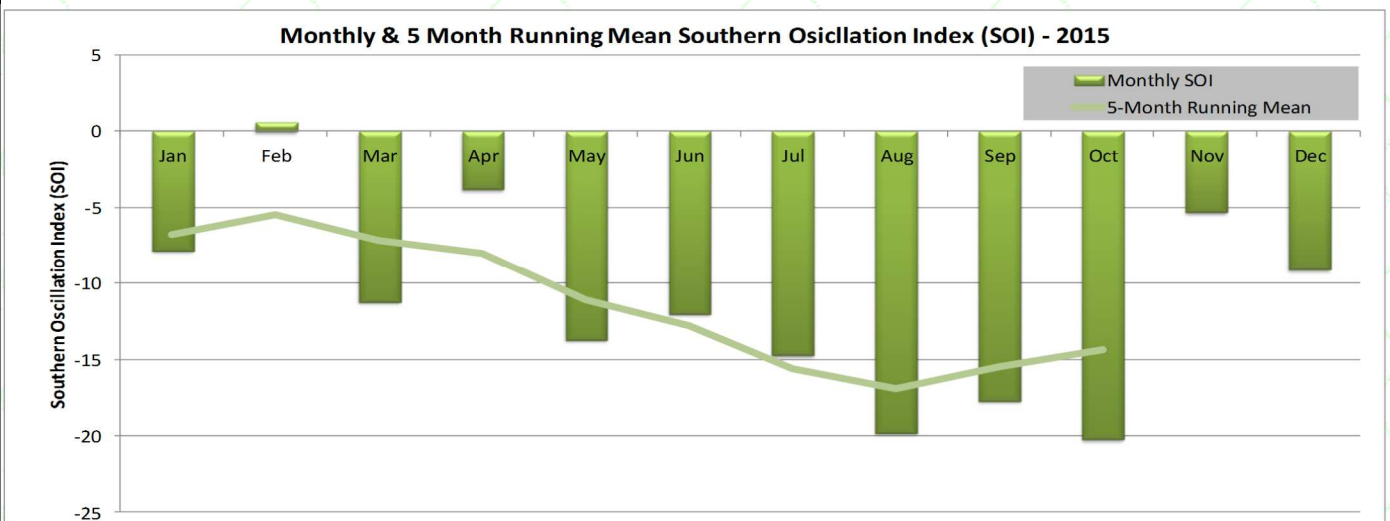


Figure 2: Southern Oscillation Index is an indicator of the persistence of El Niño conditions, with sustained negative values of the SOI below -7 typically indicating El Niño. Sustained negative values of SOI persisted during most of 2015. SOI Data Source: Bureau of Meteorology; and Graphic is FMS.

**RAINFALL IN 2015**

Rainfall during the year portrayed typical El Niño pattern, with *below average* rainfall recorded at majority of the stations. Out of the 25 rainfall monitoring sites (Figure 2a), 22 received *below average* rainfall and 3 recorded *average*.

Extremely dry conditions persisted over some parts of the country during the year. The effect was particularly evident over the Western Division, northern parts of Vanua Levu, and smaller islands in the Maritime Zones. Water sources in several areas completely dried up, having an impact on livestock and other agricultural commodities. Water was transported to several rural and maritime communities.

The national averaged rainfall during 2015 was 1380mm, which was 944mm *below* the long term average of 2324mm. This placed 2015 as the 2<sup>nd</sup> driest year in 59 years of record, with 1998 ranking the driest year on record.

Furthermore, it was the driest year on record at Dobuilevu, Koronivia, Labasa Airport and Matei Airfield, while it was 2<sup>nd</sup> driest at Laucala Bay, Matuku and Vanuabalavu. Third

driest year on record was observed at Vatukoula, Tokotoko, Lakeba, Ono-i-lau and Udu Point, with 4<sup>th</sup> driest at Penang Mill, Dreketi, Savusavu Airfield and Nausori Airport. The annual total rainfall at Viwa ranked 5<sup>th</sup> lowest on record.

The wettest location during the year was Monasavu with 4457mm of rainfall, followed by Rotuma with 2852mm and Tokotoko with 2601mm. On the other hand, the driest was Yasawa-i-rara with 985mm of annual total rainfall, followed by Labasa Airport with 993mm and Ono-i-lau with 1005mm.

The top three 1 day rainfall in 2015 were 233mm recorded at Nasinu on the February 21<sup>st</sup>, followed by 223mm at RKS (Lodoni) and 214mm at Levuka, both recorded on the December 31<sup>st</sup>.

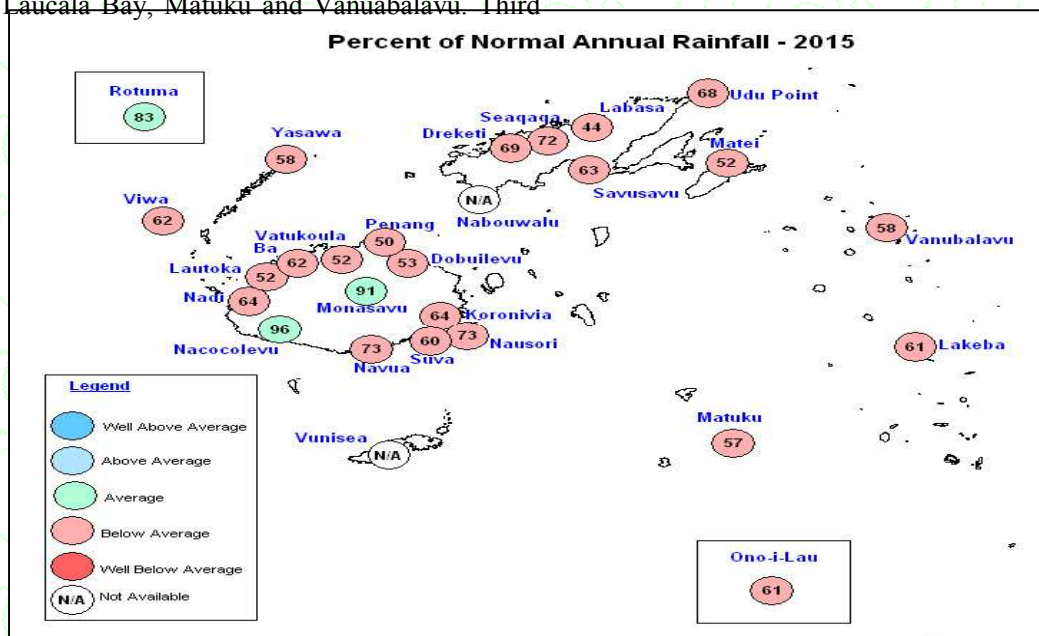


Figure 3(a): Percent of normal annual rainfall during 2015. Most of the stations registered below average rainfall.

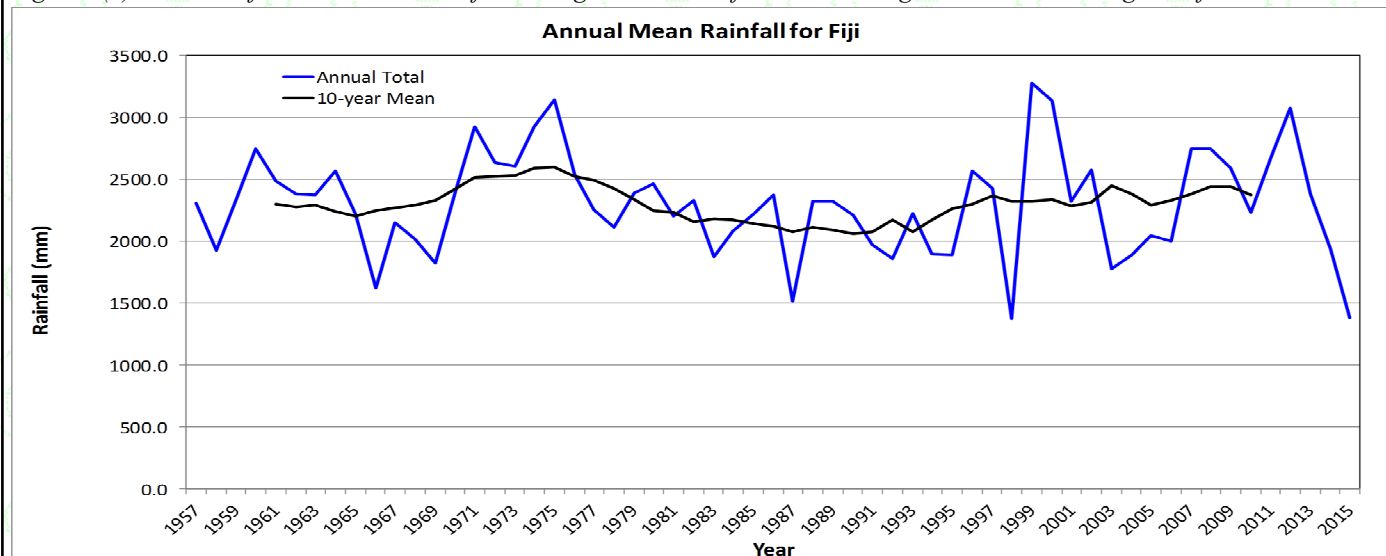


Figure 3(b): Time series of annual and 10 year mean rainfall for Fiji.

## MEAN AIR TEMPERATURE

The nationally average annual mean air temperature was 25.8°C, which was 0.2°C warmer than *normal*. This ranked 40<sup>th</sup> in 59 years of record, equaling 2004 and 2014. The warmest year on record was 2007 with a departure of +0.8°C, while the coolest was 1965 with a departure of -0.7°C.

The annual mean air temperatures in 2015 were generally *normal* in most parts of the country. For monthly mean temperatures, the highest positive departure was recorded in February (+0.9°C), followed by March (+0.7°C), while *normal* ( $\pm 0.5^\circ\text{C}$ ) temperatures were recorded during the rest of the months (Figure 4).

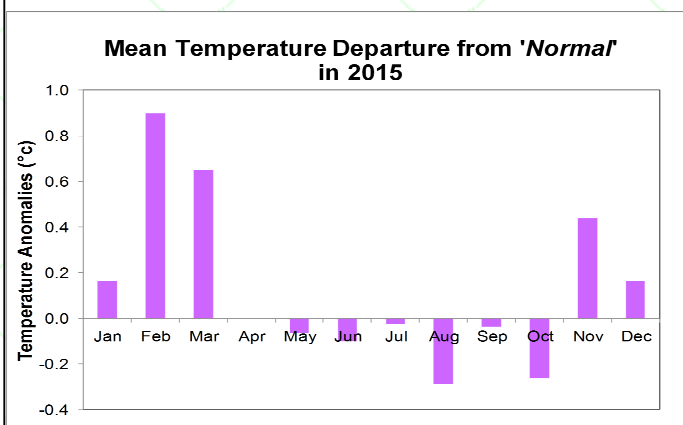


Figure 4: Monthly average mean temperature departures from normal.

At **Labasa Airport**, the annual mean air temperature was 26.1°C, which was 0.5°C warmer than *normal*. The highest negative departure from *normal* of -0.6°C was recorded in April, July and September. *Normal* ( $\pm 0.5^\circ\text{C}$ ) temperatures

were recorded during the rest of the months. There was no significant positive departure at the station.

At **Laucala Bay (Suva)**, the annual mean air temperature was 26.1°C, which was 0.4°C warmer than the *normal*. Apart from May and August (-0.6°C), the monthly mean temperatures were *normal to above normal* for the rest of the months. Notable significant positive departures ( $\geq 1.0^\circ\text{C}$ ) were recorded in February (+1.2°C) and March (+1.1°C), with November at +0.6°C. The rest of the months recorded *normal* departures.

The annual mean air temperature at **Nadi Airport** was 25.9°C, which was 0.3°C warmer than the *normal*. *Normal to above normal* departures were recorded at the station, with the highest positive departure recorded in February (+0.9°C) and other months recorded departures within the *normal* ( $\pm 0.5^\circ\text{C}$ ) range. Negative departure of -0.4°C was recorded in August and -0.3°C in October.

The annual mean temperature at **Lakeba Island** (Lau Group) was 26.0°C, which was 0.4°C *above normal*. The monthly mean temperatures at Lakeba were *normal to above normal*. Notable significant positive departures of +1.9°C was recorded in February, followed by +1.4°C in March and +0.8°C in May.

At **Matuku Island** (Lau Group), the annual mean air temperature was 25.7°C, which was 0.2°C *above normal*. The station recorded *normal* ( $\pm 0.5^\circ\text{C}$ ) temperatures for about 83% of the year, while *above normal* temperatures were recorded during the remaining months. Notable significant positive departure of +0.9°C was recorded in February, followed by +0.8°C in March.

## MINIMUM AIR TEMPERATURE

The annual average night-time (minimum) air temperature was 22.0°C, which was 0.1°C warmer than the *normal*. In comparison to the other years, 2007 and 2013 are still the warmest years with 0.9°C, while the coolest nights were observed in 1978 (-0.6°C) followed by 1968 (-0.4°C).

The monthly average night-time air temperatures ranged from 19.8°C to 24.2°C in the coastal areas. *Normal to above normal* night-time air temperatures were recorded persistently throughout the year. There were no significant ( $< -1.0^\circ\text{C}$ ) negative mean monthly temperature departures recorded during the year, but the highest positive departure of +0.6°C was recorded in February, followed by +0.5°C in November (Figure 5).

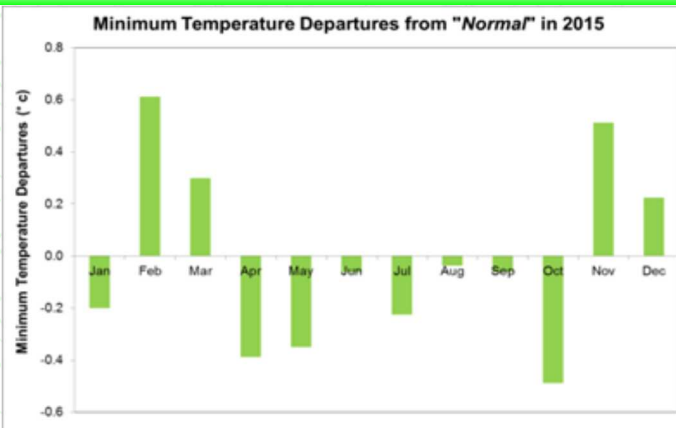


Figure 5: Monthly average night-time (minimum) temperature departures from normal.

Note: All comparisons are done against a "Climatic Normal". This is defined to be an average climate condition over a 30-year period. Fiji uses 1971-2000 as its "climatic normal" period.

### MINIMUM AIR TEMPERATURE cont'd

The annual average night-time temperature at **Laucala Bay (Suva)** was 23.0°C, which was 0.6°C warmer than *normal*. *Normal to above normal* temperatures were recorded throughout the year. Significant positive departures ( $\geq 1.0^\circ\text{C}$ ) were recorded in February (+1.4°C), March (+1.2°C), November (+1.2°C), while January, April, June, August, October and December recorded positive anomalies  $< +1.0^\circ\text{C}$  (Table 4). Negative departures were recorded during the rest of the months. The station also recorded a new low daily minimum temperature of 17.2°C on April 22<sup>nd</sup>, replacing a 41 year record of 18.4°C (Table 2).

The **Labasa Airport** annual average night-time temperature was *normal*. Significantly negative departures ( $\leq -1.0^\circ\text{C}$ ) from *normal* were recorded in May (-2.0°C), April (-1.6°C), June, July (-1.5°C), March (-1.3°C), while the rest of the months recorded  $> -1.0^\circ\text{C}$ . However, the lone positive departure of +0.1°C was recorded in November (Table 4).

At **Nadi Airport**, the annual average night-time temperature was 21.5°C, which was 0.6°C *above normal*. Significant positive departures of  $\geq 1.0^\circ\text{C}$  were recorded in February (+1.5°C), September (+1.2°C), November (+1.0°C), followed by January (+0.7°C), December (+0.6°C) and June (+0.5°C). In con-

trast, negative departures were recorded in April (-0.3°C) and October (-0.1°C) (Table 4). Nadi also recorded a new daily minimum high temperature of 25.7°C on September 21<sup>st</sup> (Table 2).

The annual average night-time temperature at **Lakeba (Lau Group)** was 22.9°C, which was 0.2°C *above normal*. Significant ( $\geq +1.0^\circ\text{C}$ ) positive anomalies were recorded in February (+1.2°C), followed by March (+0.9°C), August and December (+0.5°C). April, June, July, September and November observed  $\leq +0.5^\circ\text{C}$  anomalies. On the other hand, notable negative departures were recorded in January (-1.5°C), followed by October (-0.9°C).

**Matuku (Lau Group)** recorded annual average night-time temperature of 22.4°C, which was -0.3°C *below normal*. *Normal to below normal* night-time air temperatures were recorded at the station. Notable significant negative departures were observed in October (-1.2°C), May (-1.0°C), September (-0.8°C), November (-0.8°C), August (-0.7°C), June (-0.7°C), January (-0.6°C) and December (-0.5°C). There was no notable positive departure at the station (Table 4).

### MAXIMUM AIR TEMPERATURE

The annual average daytime (maximum) air temperature was 29.6°C, which was 0.4°C *above normal*, ranking 2015 the 10<sup>th</sup> warmest year. Apart from August to October period, the country experienced relatively warmer daytime temperatures, with significantly warmer than *normal* ( $\geq +1.0^\circ\text{C}$ ) departures recorded in February and March, while the rest of the months recorded anomalies within the *normal* range ( $\pm 0.5^\circ\text{C}$ ) (Figure 6).

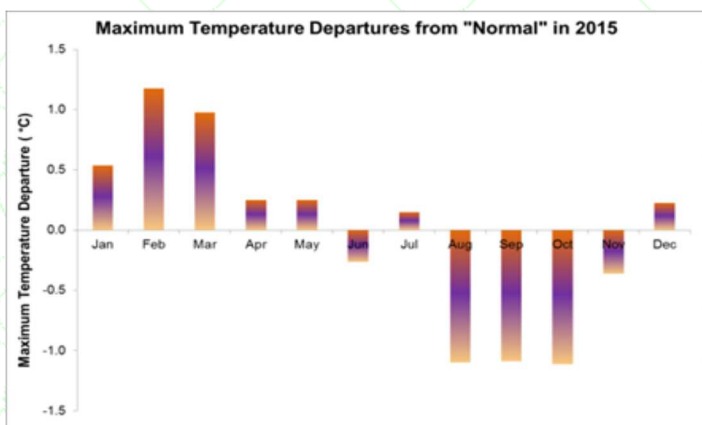


Figure 6: Monthly mean maximum temperature departures from normal.

There were eleven (11) new daily daytime (maximum) temperature records established during the year, with nine (9) new mean monthly maximum temperatures (Table 2).

The annual average daytime temperature at **Laucala Bay (Suva)** was 28.6°C, which was 0.1°C warmer than *normal*. The monthly temperatures ranged from 25.5°C to 32.2°C. February and March were the only months with *above normal* anomalies while the rest recorded *below normal* temperatures. Notable significant negative departures were recorded in June (-1.1°C), May (-1.0°C), July and September (-0.8°C) and the other months had  $> -0.5^\circ\text{C}$  (Table 3).

The annual daytime temperature at **Labasa Airport** was 31.1°C, which was 0.4°C warmer than *normal*. Generally *normal to above normal* temperatures were recorded. The mean monthly temperatures ranged from 29.6°C to 32.3°C. Notable significant positive departures from *normal* were recorded in May (+1.1°C), followed by January (+0.6°C), while the rest of the months recorded *normal* ( $\pm 0.5^\circ\text{C}$ ) anomalies (Table 3).

At **Nadi Airport**, the annual average daytime temperature was 30.2°C, which was close to the long term average of 30.3°C. November was significantly warmer than *normal* with a departure of 0.9°C, followed by March with 0.5°C. On the other hand, it was notably cooler than *normal* during August with an anomaly of -1.2°C, followed by September with -1.0°C (Table 3).

Annual average daytime temperature at **Lakeba (Lau Group)** was 28.9°C, which was 0.5°C *above normal*. The monthly daytime temperatures ranged from 26.7°C to



**MAXIMUM AIR TEMPERATURE cont'd**

33.0°C at the station. *Above normal* maximum air temperatures were recorded during most of the months with notable significant positive departure of +2.5°C in February, +2.0°C in March, +1.5°C in January and December, +1.4°C in April, +1.3°C in May, +1.2°C in November, and +1.1°C in July. August to October recorded below +1.0°C. There was no negative departure recorded at the station (Table 3).

temperatures fluctuated between 25.6°C to 32.3°C. Notable significant positive departures ( $\geq +1.0^\circ\text{C}$ ) from *normal* were recorded in February (+1.6°C), March (+1.5°C), May (+1.3°C), October and November (+0.9°C), July (+0.8°C), April (+0.7°C), while  $< +0.5^\circ\text{C}$  anomalies were recorded in January, June, September and December. There was no notable significant negative departure (Table 3).

The annual average daytime temperature at **Matuku** (Lau Group) was 0.7°C warmer than *normal*. The mean monthly

**SUNSHINE IN 2015**

The annual total bright sunshine hours were *near normal* (within 10% of annual *normal*) at Nadi Airport, while it was *below normal* at Laucala Bay. Nadi Airport recorded 2459 hours of sunshine, while Laucala Bay recorded 1697 hours (Table 1).

Nacocolevu (Sigatoka) recorded a new total monthly sunshine hours of 265.5hrs in November, replacing a previous record of 248.4hours set in 1967 (Table 2). This could be partly attributed to the presence of El Niño conditions, which usually result in less cloud cover, especially of over the leeward side of the larger islands.

The annual total bright sunshine at Laucala Bay was 88% of *normal*. The station recorded *above normal* bright sunshine hours during the March to May period, while *below normal* sunshine hours were observed in February, June, August, September and December. The highest total bright sunshine of 212.0 hours was recorded in March, while the lowest of 92.0 hours was recorded in June.

Nadi Airport registered 97% of *normal* bright sunshine hours during the year. For most of 2015, *below normal* sunshine hours were observed. However, significantly *above normal* sunshine hours was registered during March and April. The sunniest month was May with 240.0 hours and February recorded the least hours of sunshine (145.0 hours).

Location	Sunshine (hours)	% of Normal	Classification
Laucala Bay	1697	88	Below Normal
Nadi Airport	2459	97	Near Normal

Table 1: Annual sunshine hours in 2015 at Nadi Airport and Laucala Bay.

**FLOODS IN 2015**

Fiji Meteorological Service provides flood forecasting services in five major catchments namely Nadi, Ba, Sigatoka, Rewa and Labasa. Flooding in low lying areas and flash floods are common during the Wet Season. Major floods are associated with active troughs of low pressure, tropical disturbance or depression and tropical cyclones.

In 2015, the flood forecasting division monitored several systems and only one flood event was recorded during the year. This was in the Labasa Catchment at Dreketilailai station in the Qawa tributary. A total of 12 flood forecast were issued from 01 January to 31 December 2015.

Out of these 12 flood forecasts, 7 were for flood alerts and 3 were for flood warnings were issued to low lying areas down stream of Dreketilailai station from 11 to 12 February.

The flood was associated with a trough of low pressure which poured 98mm of rain in 24 hours on 12 February, causing the river levels to reach a maximum flood height of 3.83m.

*Note: All comparisons are made against a “Climatic Normal”. This is defined to be an average climate condition over a 30 -year period. Fiji uses 1971-2000 as its “climatic normal” period.*

**WIND SUMMARY - Mean Wind (10 minutes average)**

The 10-minute average wind statistics recorded at every three hour intervals at Nadi and Nausori Airports, showed that east to southeast winds were the predominant wind directions during 2015. The mean annual wind speed at two Airports were 6.3 knots and 4.2 knots, respectively.

Nadi Airport experienced calm conditions on 4.5% of the instances during the year. Easterly winds were predominant, which accounted for 28.4% of the observations, followed by southeasterly winds with 26.5%, and westerly winds with 13.6% (Figure 7(a)). The winds at Nadi Airport were generally light to moderate in strength (Figure 7(b)).

For Nausori Airport, calm conditions were observed on 40.9% of the occasions. Southeasterly wind direction was the most common and accounted for 24.0% of the statistics, followed by easterly winds with 18.2% and southerly winds with 6.7% (Figure 8(a)). The wind speeds at Nausori Airport were generally slight to moderate in strength (Figure 8 (b)).

*light air: 1-3 knots, slight breeze: 4-6 knots, gentle breeze: 7-10 knots, moderate breeze: 11-16 knots, fresh breeze: 17-21 knots, strong breeze: 22-27 knots, near gale: 28-33 knots, gale: 34-40 knots*

**ANNUAL FREQUENCY OF WIND DIRECTIONS AND SPEEDS AT NADI AND NAUSORI AIRPORTS**

Figure 7(a) Surface Wind Direction for Nadi Airport, Fiji. (WMO 91680, Latitude 17°45'35"South, Longitude 177°26'42"East, Height above MSL 22 meters)

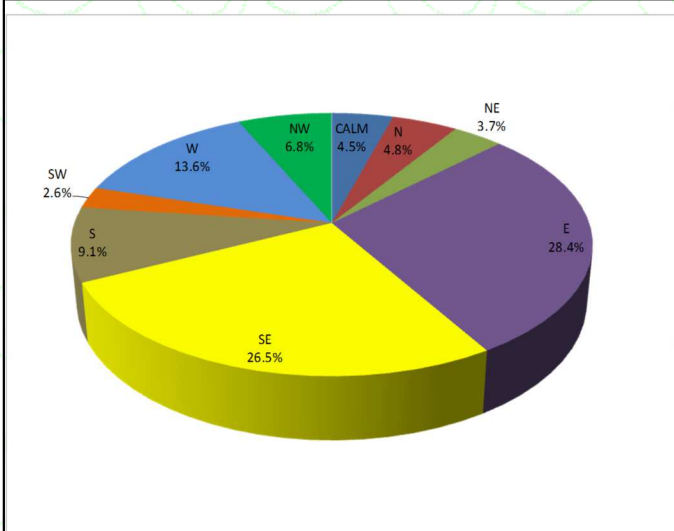


Figure 7(b) Surface Wind Speed for Nadi Airport, Fiji. (WMO 91680, Latitude 17°45'35"South, Longitude 177°26'42"East, Height above MSL 22 meters)

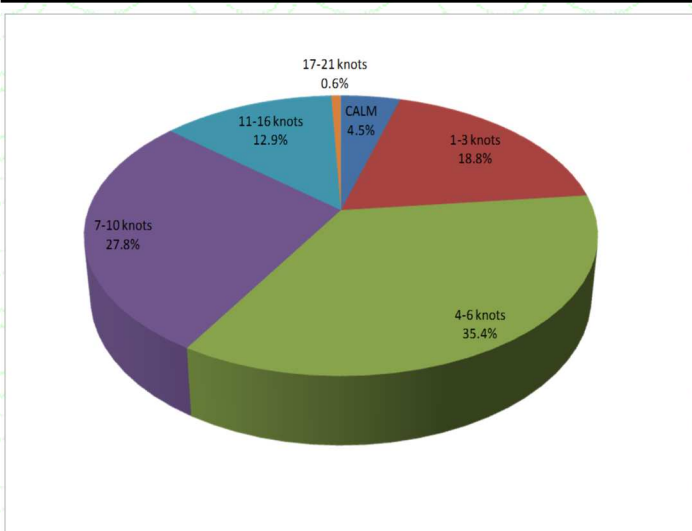


Figure 8(a) Surface Wind Direction for Nausori Airport, Fiji. (WMO 91683, Latitude 18°02'47"South, Longitude 178°33'33"East, Height above MSL 3 meters)

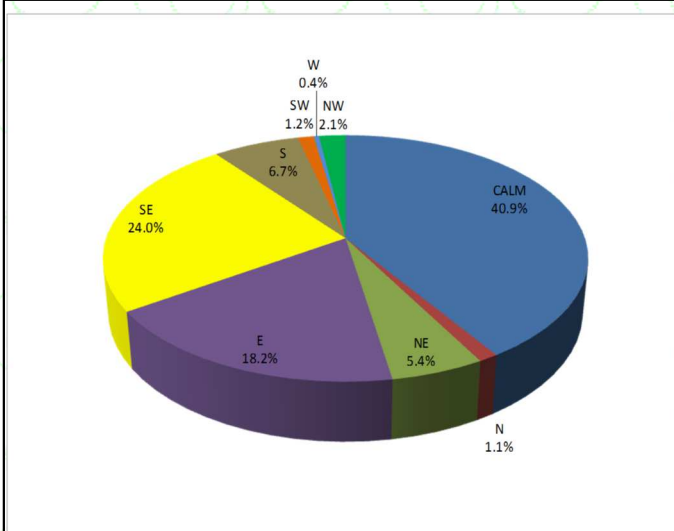
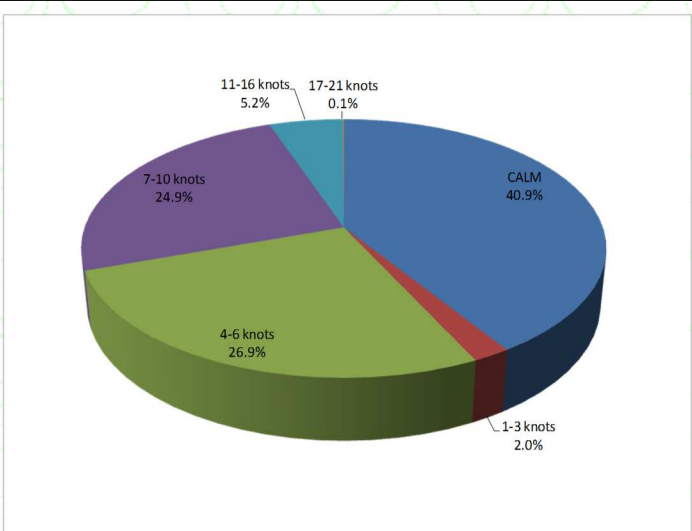


Figure 8(b) Surface Wind Speed for Nausori Airport, Fiji. (WMO 91683, Latitude 18°02'47"South, Longitude 178°33'33"East, Height above MSL 3 meters)



### NEWLY ESTABLISHED RECORDS SET IN 2015

A total of 46 new climate extremes were established in 2015. Out of these 46 new records, 37 were for temperature, 8 for rainfall and 1 for sunshine. In comparison to the last two years, there were 39 and 56 new records established in 2013 and 2014, respectively.

There were 22 new monthly records established, of which 9 maximum air temperatures, 6 minimum air temperatures, 6 rainfall and 1 sunshine record. In addition, there were 24 new daily records, which included 2 rainfall (new highs), 11 maximum temperatures (all new highs) and 11 minimum temperatures (Table 2). February recorded the highest number of records.

Table 2	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Daily Rainfall	-	1	-	-	-	-	-	1	-	-	-	-	2
Daily Maximum Temperature	2	1	1	1	-	1	1	-	1	-	1	2	11
Daily Minimum Temperature	1	-	2	2	2	1	1	-	1	-	-	1	11
Monthly Total Rainfall	-	-	-	1	-	-	1	-	-	1	2	1	6
Monthly Maximum Temperature	1	7	-	-	-	-	-	-	-	-	1	-	9
Monthly Minimum Temperature	-	3	-	1	2	-	-	-	-	-	-	-	6
Total Monthly Sunshine	-	-	-	-	-	-	-	-	-	-	1	-	1
<b>Total</b>	<b>4</b>	<b>12</b>	<b>3</b>	<b>5</b>	<b>4</b>	<b>2</b>	<b>3</b>	<b>1</b>	<b>2</b>	<b>1</b>	<b>5</b>	<b>4</b>	<b>46</b>

Table 2: Summary of new rainfall and temperature records.

### SEA LEVELS IN 2015

The sea level trend at the Lautoka SEAFRAME station for the period 1993 to 2015, is increasing at +4.7mm/year. However, the observational record is relatively short in climate terms and therefore it is still prone to the effects of shorter-term ocean variability (such as El Niño and Pacific decadal oscillations). As the data sets increase in length, the linear trend estimates will become increasingly indicative of the longer-term changes and less sensitive to large annual and decadal fluctuations. Nevertheless, similar trend values are being observed across the region (Figure 9).

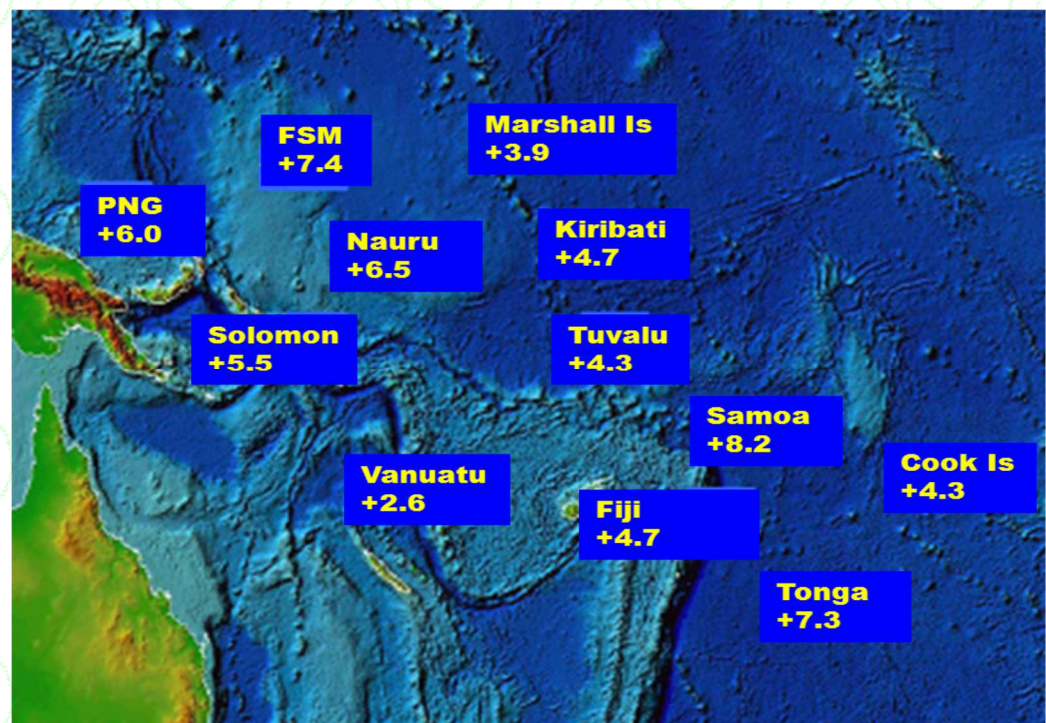


Figure 9: Sea level trend (mm/yr) in the Pacific Island region.

## SEASONAL CLIMATE FORECAST VERIFICATION

Fiji Meteorological Service used data from twenty six (26) sites around the country to monitor the climate of Fiji in 2015. The national, divisional and locality forecasts were issued seasonally (3-month period) and verified for individual locations. Overall, there were 66% of consistent forecasts or had the total observed rainfall in the predicted category, 21% near consistent forecasts, 5% inconsistent forecasts and 8% of the forecasts could not be verified (due to missing observations).

The results for consistent, near consistent and inconsistent forecast for each station are presented in Figure 10. There was a high success rate in the seasonal predictions for the Western Division (72%), followed by the Central & Northern (67%), and Eastern Divisions (58%).

The overall assessment of the model performance in 2015 is rated as good to very good compared to the total variance explained by the predictor (SST) in the Fiji region. It needs to be noted that there are other factors that drives Fiji's rainfall and the skill in the prediction can be significantly improved with dynamical modelling coupled with the skill and experience.

In total, three hundred and twelve (312) individual seasonal climate predictions were issued. Of these, two hundred and six (206) of the forecasts were consistent, sixty six (66) near consistent and sixteen (16) inconsistent forecasts, while twenty four (24) forecasts could not be verified due to unavailability of sufficient data or missing records.

During the wet season, there were 60% consistent forecasts, 27% near consistent forecasts, 6% inconsistent forecasts and 6% unverified forecasts. Similarly, during the dry season, 72% of the forecasts were consistent, 15% near consistent, 4% inconsistent and 9% unverified forecasts.

In the **Western Division**, 72% of the forecasts were consistent, 22% near consistent, 4% inconsistent and 2% unverified forecast. The dry season had a higher consistency rate (80%) compared to the wet season (65%).

In the **Central Division**, there were 67% consistent forecasts, 23% near consistent forecasts and 10% inconsistent forecasts. For Central Division, there was high consistency in the dry season prediction (83%) compared to the wet season prediction (50%).

For the **Eastern Division**, 58% of forecasts were consistent, 18% near consistent, 2% inconsistent and 22% unverified forecasts. The Eastern Division had higher consistency rate during wet season (60%) compared to dry season (57%).

In the **Northern Division**, 67% of forecasts were consistent, 21% near consistent, 1% inconsistent and 11% unverified forecasts. The Northern Division has higher consistency rate in the dry season (76%) compared to wet season (57%).

For **Rotuma**, 25% of the forecast were consistent, 25% near-consistent, 50% inconsistent and 8% of the forecast could not be verified. Rotuma had 83% consistent forecast in wet season with no consistent forecast in dry season.

## 2014/15 TROPICAL CYCLONE OUTLOOK VERIFICATION

Fiji Meteorological Service in its 2014/2015 Seasonal Tropical Cyclone Outlook predicted 6-10 tropical cyclones to occur within the RSMC Nadi AOR. Two to four (2-4) of these were anticipated to reach category 3, with 1 to 2 to reach category 4 or 5.

During 2014/15 tropical cyclone season, 16 systems developed, but only 5 systems advanced to a tropical cyclone stage, while rest of the systems remained in either a tropical disturbance or tropical depression stage. The 5 named tropical cyclones in RSMC Nadi's Area of Responsibility (AoR) were namely; Niko, Ola, Pam, Reuben and Solo (Figure 11).

As predicted, two tropical cyclones reached category three and above, and one reached category 5. Overall, TC Rueben was the only cyclone in 2015 to reach maximum intensity of Category one cyclone, TC Niko and Solo reached Category two status, TC Ola reached Category 3, while TC Pam attained a maximum intensity of Category 5.

Severe TC Pam was regarded as the most intense tropical cyclone in the Southwest Pacific and the worst natural disaster in the history of Vanuatu. Pam tracked to the far west of Fiji and did not directly affect the country. However, the associated outer rain bands brought about heavy rain and flooding to low lying areas. Strong winds were also observed in certain parts of the group.

SEASONAL CLIMATE FORECAST VERIFICATION

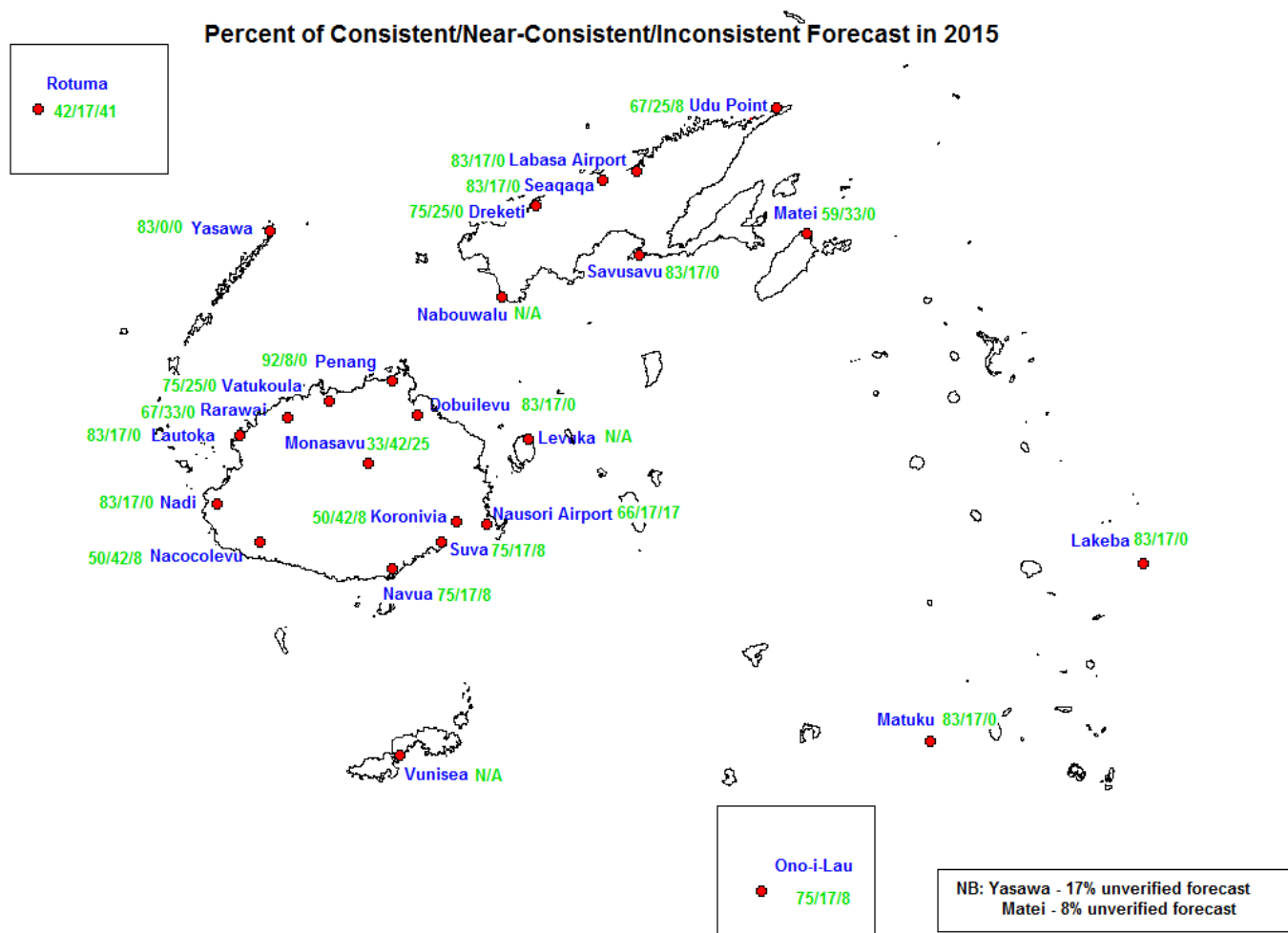


Figure 10: Percentage of consistent /near consistent and inconsistent forecasts at individual locations in 2015. Seasonal Outlook forecast could not be verified for Vunisea, Nabouwalu and Levuka due to more than 50% of missing observations.

Forecast is consistent when observed and predicted (tercile with the highest probability) categories coincide (are in the same tercile). Forecast is near-consistent when observed and predicted (tercile with the highest probability) differ by only one category (i.e. terciles 1 and 2 or terciles 2 and 3). Forecast is inconsistent when observed and predicted (tercile with the highest probability) differ by two categories (i.e. terciles 1 and 3). Forecast is unverified when forecast could not be verified due to data gap in

TROPICAL CYCLONE ACTIVITY IN THE SOUTHWEST PACIFIC REGION

The Regional Specialized Meteorological Centre (RSMC) - Tropical Cyclone Centre (TCC) Nadi Area of Responsibility (AoR) extends from the equator to 25°S and 160°E to 120°W. Six (6) tropical cyclones occurred within the RSMC Nadi - TCC AoR in 2015. These tropical cyclones were namely; Niko, Ola, Pam, Reuben, Solo and Tuni. (Figure 11). None of these tropical cyclones directly affected Fiji, however, associated outer rain bands affected some parts of the country when tropical cyclones traversed close by.

Tropical Cyclone **NIKO** (Category 1) was the first cyclone to form in RSMC Nadi - TCC AoR in 2015. It formed to the northwest of Tahiti on the 19<sup>th</sup> January and initially moved in a south-eastward direction. It was named on 21<sup>st</sup> January when it was approximately 340 kilometres north of Papeete. Niko attained storm intensity on the 22<sup>nd</sup>. At its peak, it had estimated sustained winds of 100 knots. It moved out of RSMC-Nadi TCC AoR overnight on the 23<sup>rd</sup> as a category 1 system.

Severe Tropical Cyclone **OLA** (Category 3) was the second system named in 2015. It entered as a low pressure system into the RSMC Nadi - TCC AoR on the 29 January and quickly developed into a Category 1 system within 24 hours and was named “**Ola**”. Over the next 2 days, Ola continued to develop and attained hurricane force intensity on 20 February 2015. At this point, it was 510km west-northwest of Noumea, New Caledonia. Ola moved in a general southward direction and passed to the west of New Caledonia. It moved out of RSMC Nadi - TCC AoR in the early hours on the 3 February 2015.

**TROPICAL CYCLONE ACTIVITY IN THE SOUTHWEST PACIFIC REGION –Continued**

Severe Tropical Cyclone **PAM** (Category 5) was the third system monitored and was also one of the most intense system in recorded recent history for the region. It was first analysed as a low pressure system to the north of Vanuatu on the 4 March. Initially it tracked eastward as it slowly developed. It was named on the evening of 9 March when it was still over open waters approximately 1000km north of Vanuatu. Pam rapidly intensified overnight and by midday on the 10 March, it attained hurricane force intensity. Pam continued to intensify and gradually moved south-westwards, heading directly for Central Vanuatu. Pam made landfall on some of the smaller islands in the Shepherd Group of Islands but changed its direction to a southeast, thus passing just east of Efate. It made landfall again on Erromango Island just southeast of Efate Island. Vanuatu bore the full brunt of Pam as it made landfall as an intense category 5 system with sustained winds of 230km/hr. Pam damaged infrastructures, paralysed telecommunications with costs of damages amounting to millions of dollars. A total of 14 lives were lost due to Pam. Pam continued to move south-eastward and moved out of RSMC Nadi - TCC in the early hours of 15 March.

Tropical Cyclone **REUBEN** (Category 1) was initially analysed as a low pressure to the east of Fiji on the 20 March. It slowly developed and moved south-eastward. It was named on the 22 March when it was approximately 170km south-west of Nukualofa. It spent its entire lifespan over open waters as category 1 system. It moved out of RSMC Nadi - TCC AoR overnight on the 22 March.

Tropical Cyclone **SOLO** (Category 2) formed to the east of Solomon Islands. In the initial stages, it moved in a south-westward direction, passing in between the Solomon Islands and Vanuatu. It was named on the 10 April when it was approximately 890km west-northwest of Port Vila. It maintained its initial south-westward movement, but early on the 11 April, Solo started to intensify as it changed its course and started to move south-eastward thus heading directly for New Caledonia. On the morning of 12 April, Solo was less than 50km northeast of Belep Islands. Solo maintained its south-eastward movement and caught up by the strong wind shear and quickly lost its intensity. It was declassified on the evening of 12 April upon losing its tropical cyclone characteristics.

Tropical Cyclone **TUNI** (Category 3) was the first cyclone to be named in the 2015/16 Tropical Cyclone season. On 24 November, 2015 a low pressure system was analysed to the northwest of Samoa. The system was embedded along the convergence zone so it was slow moving. On the 27<sup>th</sup>, the system was displaced to the south of the convergence zone and started to move south-eastwards. It was named in the evening of 28 November when it was 225km west-southwest of Apia. The system maintained its south-eastward track and remained over open waters but the associated trough affected Samoa. It was declassified to low pressure system on the 30 November after losing its tropical cyclone characteristics.

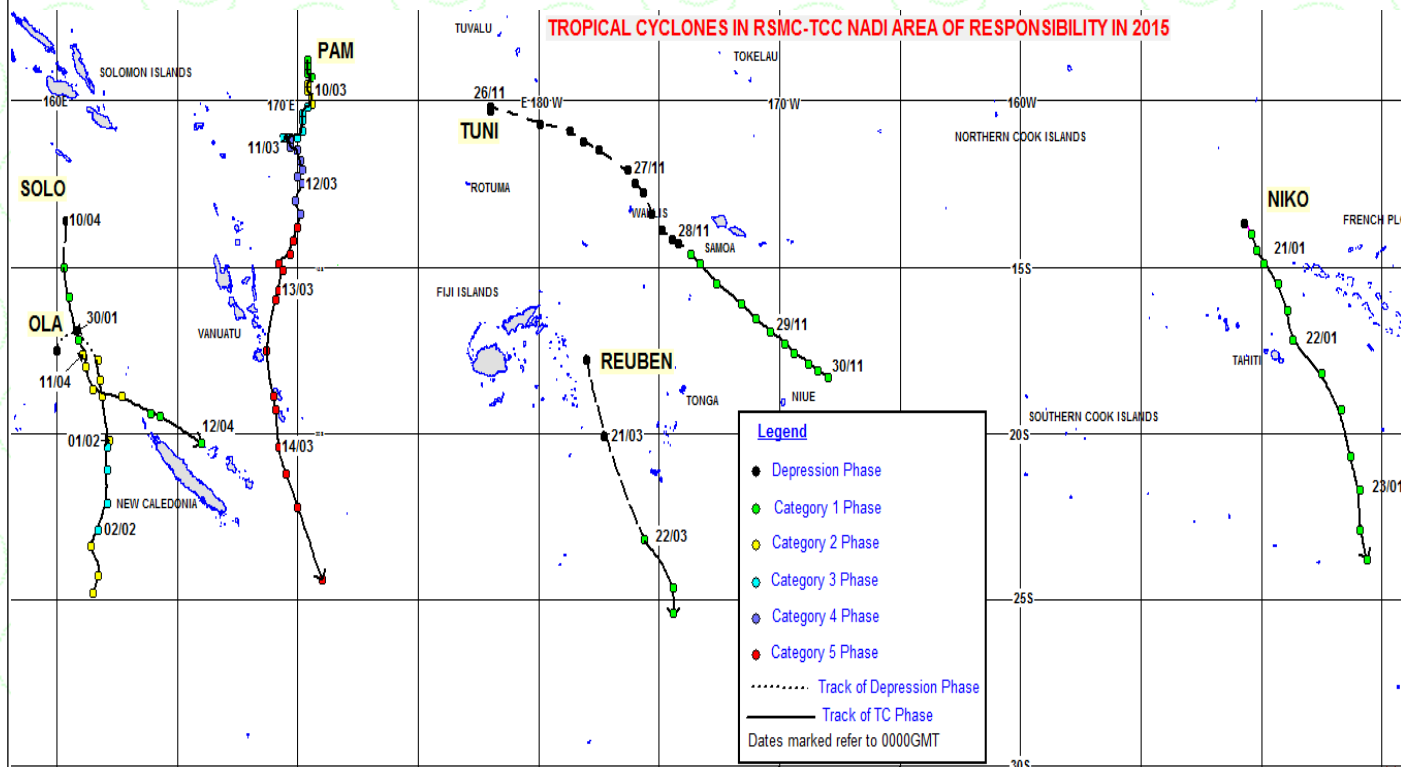


Figure 11: Tracks of TC's within the RSMC Nadi AoR in 2015

**TABLE 3: MAXIMUM AIR TEMPERATURE**

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airport	Max	32.3	32.0	32.0	31.5	31.3	30.3	29.6	29.6	29.6	30.9	31.8	32.2	31.1
	Dep	0.6	0.4	0.5	0.5	1.1	0.5	0.4	0.2	-0.5	0.1	0.4	0.5	0.4
Savusavu Airfield	Max	31.1	31.8	31.0	29.2	27.8	27.0	26.7	26.4	27.0	27.4	28.9	29.7	28.7
	Dep	0.5	1.1	0.4	-0.6	-0.7	-0.9	-0.3	-0.7	-0.4	-0.8	-0.5	-0.5	-0.3
Penang Mill	Max	31.6	32.1	32.0	30.0	28.9	27.8	27.7	27.2	28.6	28.9	31.0	30.9	29.7
	Dep	1.3	1.6	1.5	0.4	0.4	0.1	0.3	-0.2	0.6	0.0	1.3	0.6	0.6
Nadi Airport	Max	31.4	32.0	31.8	31.0	29.7	28.4	28.5	27.5	28.3	29.8	32.0	31.5	30.2
	Dep	-0.1	0.4	0.5	0.3	0.0	-0.6	-0.1	-1.2	-1.0	-0.5	0.9	0.0	-0.1
Laucala Bay	Max	30.7	32.2	31.8	29.7	27.5	26.6	26.0	25.5	26.4	27.8	29.3	30.1	28.6
	Dep	-0.1	1.0	0.9	-0.2	-1.0	-1.1	-0.8	-1.2	-0.8	-0.4	0.0	-0.2	0.1
Nausori Airport	Max	30.6	32.0	31.4	29.2	27.4	26.4	26.0	24.3	25.8	27.1	28.7	29.3	28.2
	Dep	0.2	1.2	0.9	-0.1	-0.5	-0.9	-0.3	-1.9	-0.8	-0.5	-0.1	-0.4	-0.3
Matuku	Max	30.6	32.3	31.9	29.9	28.9	27.4	26.8	25.6	26.7	28.3	29.6	30.1	29.0
	Dep	0.4	1.6	1.5	0.7	1.3	0.5	0.8	-0.2	0.3	0.9	0.9	0.4	0.7
Lakeba	Max	31.6	33.0	32.3	30.7	29.3	28.0	27.5	26.7	27.7	28.5	30.0	31.2	28.9
	Dep	1.5	2.5	2.0	1.4	1.3	0.7	1.1	0.3	0.8	0.8	1.2	1.5	0.5

**TABLE 4: MINIMUM AIR TEMPERATURE**

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airport	Min	21.8	21.7	21.0	19.7	17.9	17.4	16.6	17.7	18.5	19.1	21.3	21.2	20.5
	Dep	-0.4	-0.7	-1.3	-1.6	-2.0	-1.5	-1.5	-1.0	-0.8	-0.7	0.1	-0.5	0.0
Savusavu Airfield	Min	23.3	23.6	24.0	23.6	22.8	22.0	22.1	21.2	21.4	22.1	23.6	23.5	22.1
	Dep	-0.2	-0.1	0.4	0.4	0.5	0.4	1.1	0.4	0.2	0.2	1.0	0.5	-0.3
Penang Mill	Min	23.7	24.3	23.9	22.6	21.9	21.4	20.6	20.2	21.0	21.5	23.7	23.7	22.3
	Dep	-0.3	0.4	0.1	-0.6	-0.2	0.0	0.2	-0.5	-0.2	-0.7	0.7	0.2	-0.1
Nadi Airport	Min	23.5	24.4	23.2	21.5	20.6	19.7	18.7	19.0	20.5	20.4	22.8	23.0	21.5
	Dep	0.7	1.5	0.4	-0.3	0.4	0.5	0.3	0.4	1.2	-0.1	1.0	0.6	0.6
Laucala Bay	Min	24.8	25.4	25.1	23.4	22.0	21.7	20.5	20.9	20.9	22.2	24.0	24.2	23.0
	Dep	0.9	1.4	1.2	0.1	-0.2	0.3	-0.2	0.2	0.2	-0.1	0.3	1.2	0.7
Nausori Airport	Min	23.0	24.1	23.6	22.0	21.4	20.6	18.4	20.2	20.2	20.2	22.6	22.7	21.4
	Dep	-0.2	0.8	0.4	-0.5	0.2	0.1	-1.2	0.6	0.0	-0.7	0.6	0.1	-0.1
Matuku	Min	23.8	24.9	24.7	23.2	21.5	21.0	20.3	19.8	20.0	20.6	22.1	23.3	22.4
	Dep	-0.6	0.2	0.1	-0.7	-1.0	-0.7	-0.5	-0.7	-0.8	-1.2	-0.8	-0.5	-0.3
Lakeba	Min	22.5	25.3	24.9	24.1	22.7	22.1	21.0	21.5	21.8	21.2	23.2	24.2	22.9
	Dep	-1.5	1.2	0.9	0.3	-0.1	0.1	0.0	0.5	0.4	-0.9	0.1	0.5	0.2

**TABLE 5: SUNSHINE HOURS AND PERCENTAGE OF NORMAL**

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Nadi Airport</b>	Actual	227.7	144.8	226.4	228.0	239.8	166.4	227.9	189.1	158.0	227.2	232.4	191.4	2459.1
	%	108	77	118	115	115	81	104	82	75	96	104	84	97
<b>Laucala Bay, Suva</b>	Actual	164.3	178.5	212.4	173.0	101.6	91.6	102.7	110.3	107.3	170.5	147.7	185.5	169.7
	%	85	102	125	112	70	65	76	77	79	104	88	70	88

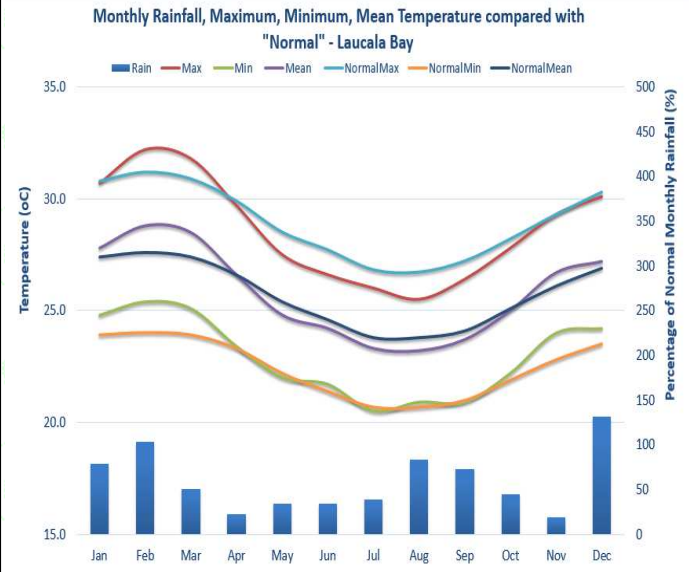
**TABLE 6: TOTAL MONTHLY RAINFALL (MM) AND PERCENTAGE OF NORMAL RAINFALL**

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
<b>Labasa Airport</b>	Actual (mm)	81.7	266.5	105.7	11.3	62.3	10.8	0.0	49.4	26.3	69.2	72.2	130.9	886.6
	%	21	77	28	5	54	16	0	104	37	56	40	54	40
<b>Savusavu Airfield</b>	Actual (mm)	204.8	347.9	168.7	134.8	37.3	135.7	14.2	80.5	94.4	85.8	106.3	94.7	1505.1
	%	74	142	60	52	19	114	15	69	71	50	57	37	64
<b>Penang Mill</b>	Actual (mm)	149.6	364.1	143.4	101.8	72.2	14.6	4.8	53.0	59.4	123.8	27.7	195.4	1309.8
	%	38	108	34	38	45	15	9	73	62	109	17	74	54
<b>Nadi Airport</b>	Actual (mm)	205.8	346.6	154.0	94.5	2.8	14.8	15.8	49.9	63.0	25.0	28.6	181.8	1182.6
	%	60	119	45	59	3	23	35	77	90	25	22	102	63
<b>Laucala Bay, Suva</b>	Actual (mm)	292.1	273.1	189.5	82.4	92.0	55.2	53.3	132.5	127.9	98.3	45.2	363.8	3323.6
	%	79	103	51	22	34	34	39	84	72	45	18	131	110
<b>Nausori Airport</b>	Actual (mm)	312.5	311.4	172.7	141.6	150.6	81.1	69.8	138.8	159.8	124.4	74.6	378.4	2115.7
	%	86	116	45	39	61	54	60	95	97	64	30	142	73
<b>Matuku</b>	Actual (mm)	98.5	221.5	149.0	58.5	52.0	55.0	29.5	129.0	102.0	29.5	35.5	115.5	1075.5
	%	36	120	58	34	34	51	36	117	106	26	28	175	59
<b>Lakeba</b>	Actual (mm)	100.0	194.5	340.0	57.0	25.5	80.0	70.0	104.5	54.5	12.5	57	81	1176.5
	%	41	86	116	28	19	99	87	102	54	10	40	45	1909.6

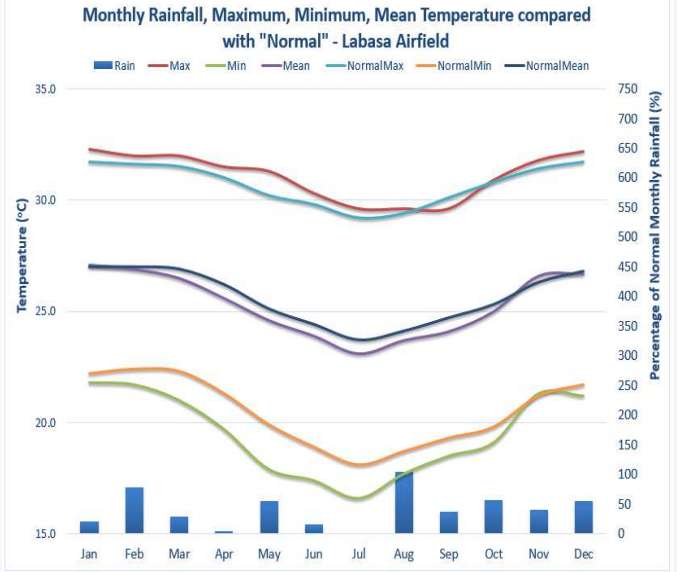


APPENDIX

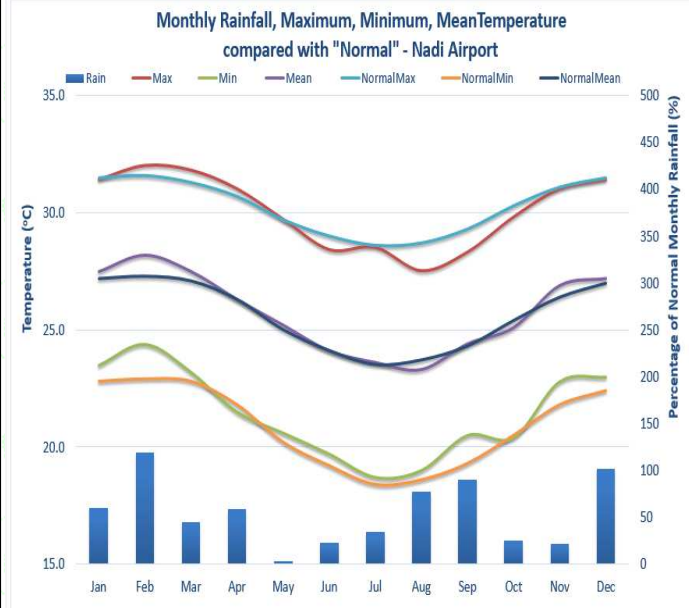
APPENDIX 1A : LAUCALA BAY, SUVA



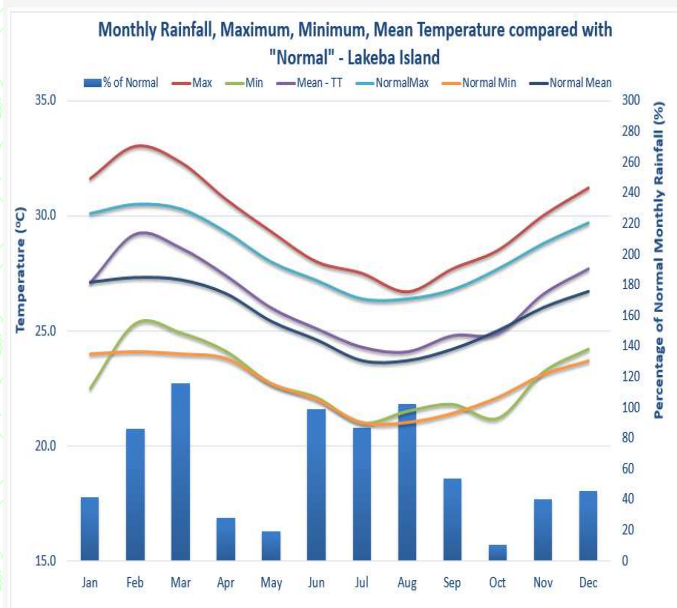
APPENDIX 1B : LABASA AIRPORT



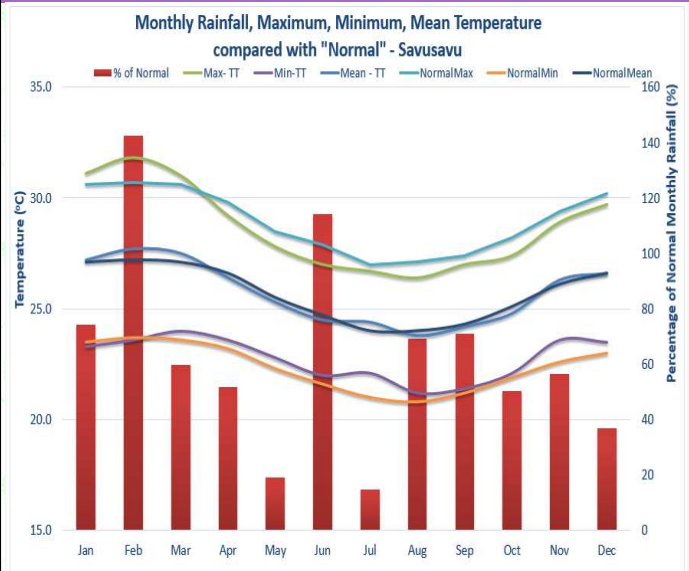
APPENDIX 1C : NADI AIRPORT



APPENDIX 1D : LAKEBA



APPENDIX 1E : SAVUSAVU AIRFIELD



APPENDIX 1F : MATUKU

