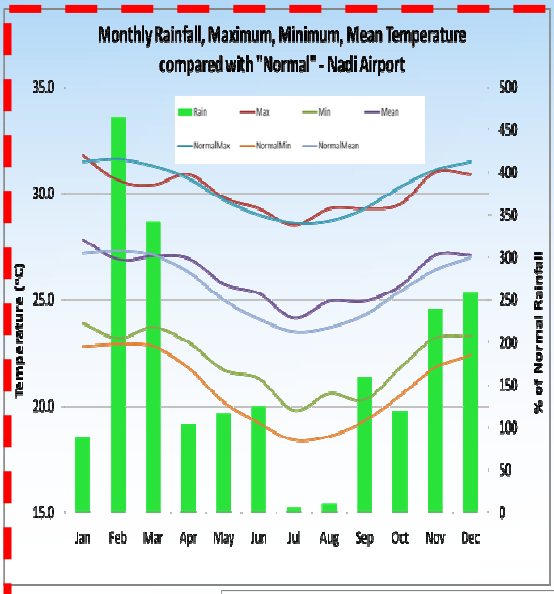
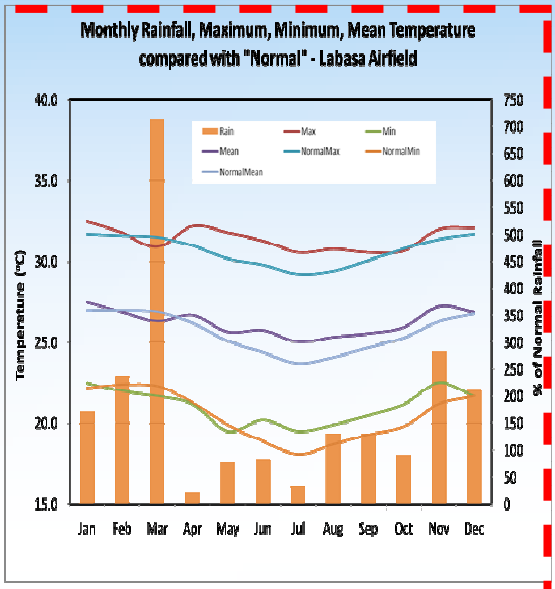
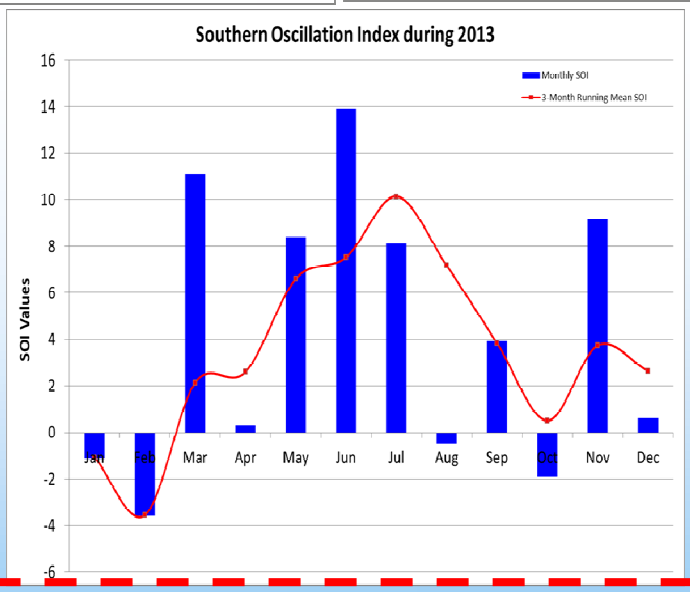
ANNUAL CLIMATE SUMMARY 2013







Fiji Meteorological Service

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In this Issue

HIGHLIGHTS OF 2013

- *The weather and climate of Fiji was generally influenced by the troughs of low pressure, tropical depressions and disturbances, frontal systems, ridges of high pressure and east to southeast wind flow;*
- *Neutral El Niño Southern Oscillation (ENSO) conditions prevailed throughout the year, thus neither El Niño nor La Niña condition prevailed;*
- *The SPCZ remained close to its mean position for most of the year, thus influencing rainfall at Rotuma;*
- *Average cloudiness were experienced in the Fiji region;*
- *The Sea Surface Temperatures (SST) were normal to above normal for most of the year in the Fiji region;*
- *A total of 39 new climate extremes (8 rainfall and 31 temperature) were established;*
- *Fiji's mean annual rainfall was close to long term average, however considerable variation in rainfall from one month to another was experienced;*
- *The average mean temperature was 0.7˚C warmer than normal ranking second highest on record;*
- *The annual average daytime (maximum) air temperature was 0.6˚C warmer than normal ranking 7th warmest on historical record;*
- *The annual average night-time (minimum) air temperature was 0.9˚C warmer than normal ranking the warmest and equivalent to 2007 record;*
- *The Trade Winds over Fiji were near normal during the wet season and enhanced in the dry season, which are typically experienced during a neutral season;*
- *Bright sunshine hours were normal to below normal around the country;*
- *There were no cyclones that directly affected Fiji in 2013, but indirectly, parts of the country experienced strong wind and heavy rain;*
- *Sea level anomalies of 0cm to 5cm persisted in the Fiji region for most of the months;*

Note: All comparisons are with respect to "Climatic Normal". This is defined to be an average climate conditions over 30 year period. Fiji uses 1971-2000 period

WEATHER PATTERNS

The weather and climate of Fiji was generally influenced by the troughs of low pressure, tropical depressions and disturbances, frontal systems, ridges of high pressure and east to southeast wind flow. While there was no significant extreme weather event recorded in 2013, there were occasions when some parts of the country experienced localized flooding and dry spells. Subsequently, thirty-nine (39) new rainfall and temperature records established.

January was generally drier than *normal* over most parts of the country despite being influenced by two tropical depressions (TD08F and TD11F) and a trough. The country experienced rainfall over most places resulting from a trough until the 8th. Following the trough, a tropical depression (TD08F) moved towards the Group from the northeast on the 11th and aided hot and humid conditions over most parts of the country between 12th to 18th. Four new daily temperature records were established during this period. A ridge of high pressure extended onto the country and directed southeast wind flow until the 25th with brief showers over the eastern parts of the country. A second tropical depression (TD11F) developed to the south of Ono-i-Lau on the 26th and lingered to the south directing strong winds over Fiji waters. Consequently, a strong wind warning was issued for the whole of the Fiji waters till the end of the month. The SPCZ remained in the vicinity of Rotuma resulting in rainfall over the island on most of the days.

Rainfall in **February** was *average* to *above average*, as moist trade wind flow, troughs of low pressure and a tropical depression dominated the weather pattern. During the first two weeks, a trough lay over Fiji that brought rain and thunderstorms over most places. As the trough moved away, a moist south to southeast wind flow covered the group. On the 14th, another tough affected the country which brought occasional rain over most places and cleared on the 15th giving way to a moist trade flow to set in for a brief period. Following this, a trough drifted onto the country from the north between 18th and 19th. On the 20th, an embedded tropical depression (TD15F) was located to the west of the country and remained slow moving till the 23rd before tracking southeast on the 24th. Subsequently, the system brought significant heavy rainfall over the western parts of the country from the 21st to the 24th, leading to localised flooding in some areas. On the 21st, Lautoka Mill, Penang Mill and Nadi Airport recorded 118.2mm, 106.0mm and 98.4mm of rainfall, respectively. Rotuma recorded *below average* rainfall in February.

The weather in **March** was dominated by southeast wind flow, troughs of low pressure and two tropical disturbances (TD16F and TD20F). During the 1st week, a trough with an embedded tropical depression (TD16F), affected the country. During this period, heavy rainfall was experienced throughout the Fiji Group, with majority of the stations recorded 24 hour rainfall in excess of 100mm. Following the passage of the depression, a ridge of high pressure extended onto the country and directed northeasterly wind flow till the 15th. Following this, a trough moved onto the group from the south which caused rain over most places and later on the 18th, a ridge of high pressure extended onto the country, displacing the trough to the east. Trade flow prevailed from the 19th to the 23rd. During the last week, tropical depression (TD20F), approached the country from the northwest and caused widespread rain with isolated heavy falls and thunderstorms. Rotuma received most of its rainfall from SPCZ and moist easterly wind flow.

April was characterised by the trade southeasterly wind flow, troughs of low pressure and a tropical disturbance. These systems did not produce much rainfall over the country which resulted in two third of the stations recording *below average* to *well below average* rainfall. The most significant rainfall episode was during the last week of the month when an active trough of low pressure moved on to the country from the west on the 27th and a tropical disturbance (TD22F) developed along the trough on the 28th. The systems produced widespread rainfall and squally thunderstorms over the country till the end of the month. Rotuma experienced *below average* rainfall during the month.

The first half of **May** was generally dominated by the trade southeasterly winds, while the second half was influenced by eastward-moving fronts and mobile ridges of high pressure systems. First week was marked by fine weather and cool nights with overnight temperatures falling below 15°C in the highlands. An intense high pressure system in the Tasman Sea directed heavy southerly swells over the Fiji waters from the 7th until the 10th. Trade showers were experienced during this period. In the second week, a frontal system moved across and brought showers to the eastern parts of the country. A ridge followed the frontal system and sustained southerly winds until the 19th. A convergence zone drifted onto the country from the north and brought some showers before moving away from the group on the 25th. Over the last week, an active trough drifted over the group on the 26th that brought widespread rainfall, squally thunderstorms and strong winds. Consequently, a heavy rain and swell warning was issued for most parts of Fiji during this period. At Rotuma, rain was experienced on majority of days due to close vicinity of the SPCZ and trade easterly wind flow.

June was influenced by troughs of low pressure, a frontal system and semi-permanent ridges of high pressure. Warmer than normal condition were experienced over most places, with four new high air temperature records established during the month. In the first week, widespread rain and thunderstorms were experienced resulting from a slow moving trough over the group. Following the trough, a ridge of high pressure extended over the country while a frontal systems swept from the south causing showers about the eastern and interior parts of the country from 6th to 8th. Trade southeasterly wind flow prevailed till the 10th. Over the next three days, moist easterly wind flow became dominant as a trough moved closer to Fiji. Showers were experienced over most places during this period. A deep low

pressure system over Tasman Sea on the 21st generated damaging heavy swells which affected the southern low-lying coastal areas of the Fiji until the 23rd. Strong southeast winds persisted till the 25th and trade showers were experienced till the end of the month. Rotuma experienced wet condition on majority of the days due to moist trade easterly winds and the presence of the SPCZ.

In **July**, the weather was influenced by troughs of low pressure interspersed by semi-permanent ridges of high pressure systems and cooler and drier southeast winds. Rainfall varied considerably across the Fiji Group with the leeward side of the country being considerably drier than normal. Majority of the stations received *below average* to *well below average* rainfall. On the other hand, the windward side was wetter than normal with all the four stations in the Central Division recorded more than 120% of normal rainfall in July. Rotuma's weather was largely influenced by the SPCZ and associated moist easterly wind flow during the month.

August was influenced by troughs of low pressure, interspersed by mobiles ridges of high pressure and associated broad southeasterly wind flow. As the troughs approached Fiji, it weakened and did not produce much rainfall, however some trade showers were experienced on the windward side of the group. The prevailing pattern resulted in considerable variation in rainfall across the country ranging from *well below average* to *well above average*. Following form July, most parts of the Western Division continued to experience *drier than normal* conditions. The cool southeasterly winds maintained cool nights in most places with overnight temperatures falling to 10.8°C on the 6th at Monasavu. The SPCZ in the vicinity of Rotuma resulted in rainfall on a number of days.

September's weather was also influenced by troughs of low pressure, interspersed by ridges of high pressure and southeasterly wind flow. Similar to previous month, rainfall during this month also varied considerably across the country ranging from *well below average* to *well above average*. A trough of low pressure resulted in widespread rainfall across the country on the 22nd, resulting in significant fall of 152mm recorded at Vunisea over the 24 hour period. Rotuma's weather during the month was influenced by the SPCZ and associated easterly wind flow.

The weather in **October** was dominated by mobile ridges of high pressure, interspersed by a series of troughs of low pressure. In the first week, cool and dry southeasterly prevailed over the country. In the second week, a trough drifted over Fiji and brought rain over the Northern Division followed by fine weather conditions. From 16th to 17th, the country experienced rainfall from a trough with trade showers returning from the 18th. An active trough of low pressure with associated moist easterly wind flow produced heavy rainfall especially over Vanua Levu and northern Viti Levu. Subsequently, a flood alert was issued for the area and parts of Labasa were flooded. Rotuma was largely influenced by the SPCZ and moist easterly wind flow.

November's weather was dominated by broad moist easterly wind flow, troughs of low pressure and ridges of high pressure systems. In the first week, cloud and rainfall associated with a slow moving trough of low pressure brought some rain to the southern parts of the group, while moist east to northeast wind flow caused rainfall in the eastern and interior parts of the country. From 12th to 19th, moist easterly wind flow prevailed over the country that brought showers to the windward side of the group, while afternoon showers and thunderstorms were experienced elsewhere. Another trough of low pressure affected the country in the third week. On the afternoon of the 23rd, an intense thunderstorm developed in the interior of Viti Levu and drifted to the east which produced hailstorms over the Nasinu area. This activity was triggered due to heating and enhancement favored by the trough and moist easterly wind flow. Despite these weather systems, the month was considerably *warmer than normal* for most parts of the country. Hot and humid conditions saw several new high air temperature records being established. Rotuma received *below average* rainfall during the month.

Fiji's weather in **December** was dominated by troughs of low pressure system, two tropical disturbances [TD05F & TD06F] and semi-permanent ridges of high pressure systems. A trough of low pressure moved over the country from the east and produced occasional rain and squally thunderstorms during the first week. Between 8th and 10th, another trough of low pressure affected the group from the west with TD05F embedded within this trough. Rain and thunderstorms were experienced over most places with isolated heavy falls. During this event, Tokotoko recorded 181.5mm of rain within 24 hour period on the 9th. A ridge of high pressure displaced the trough on the 12th and directed southeast wind flow till the 16th. Following this, an active trough of low pressure gradually moved over the country from the west on the 17th and remained until the 20th. Widespread rain with isolated heavy falls and squally thunderstorms were experienced over most places. Ono-i- Lau recorded the highest fall of 142.3mm within 24-hours on the 18th. Tropical Depression [TD06F] developed to the northwest of Fiji on the 25th, however, the associated trough remained to the north of the group and had minimal effect on the country. Rainfall was experienced on most of the days at Rotuma due to SPCZ and trade easterly wind flows.

El Niño Southern Oscillation (ENSO)

The ENSO indicators in the Pacific fluctuated within the neutral range throughout 2013, thus neither El Niño nor La Niña conditions were present.

However, on occasions, the ENSO indicators swung towards La Niña conditions, but could not sustain for long as the atmosphere failed to support the oceanic change. For example, in January and February, sea surface temperatures (SST) approached a borderline La Niña level. Although the atmospheric characteristics of La Niña appeared briefly, the ocean-atmosphere system as a whole did not remain in a La Niña state for long enough to sustain a weak La Niña event. Moreover, from May to September, the SST's were cooler than average in the far eastern tropical Pacific (Figure 1). However, these cold sea surface temperatures were positioned too far to the east to be considered indicative of a basin-wide La Niña episode. Since then, the SST's have warmed and have been near average till the end of the year. The sub-surface temperatures (between 100 to 150 meters) remained generally near average for first half and slightly warmer than average for the second half of the year.

The trade winds also fluctuated within the neutral range, while the tropical cloudiness near the date line were *below normal* from September to December period.

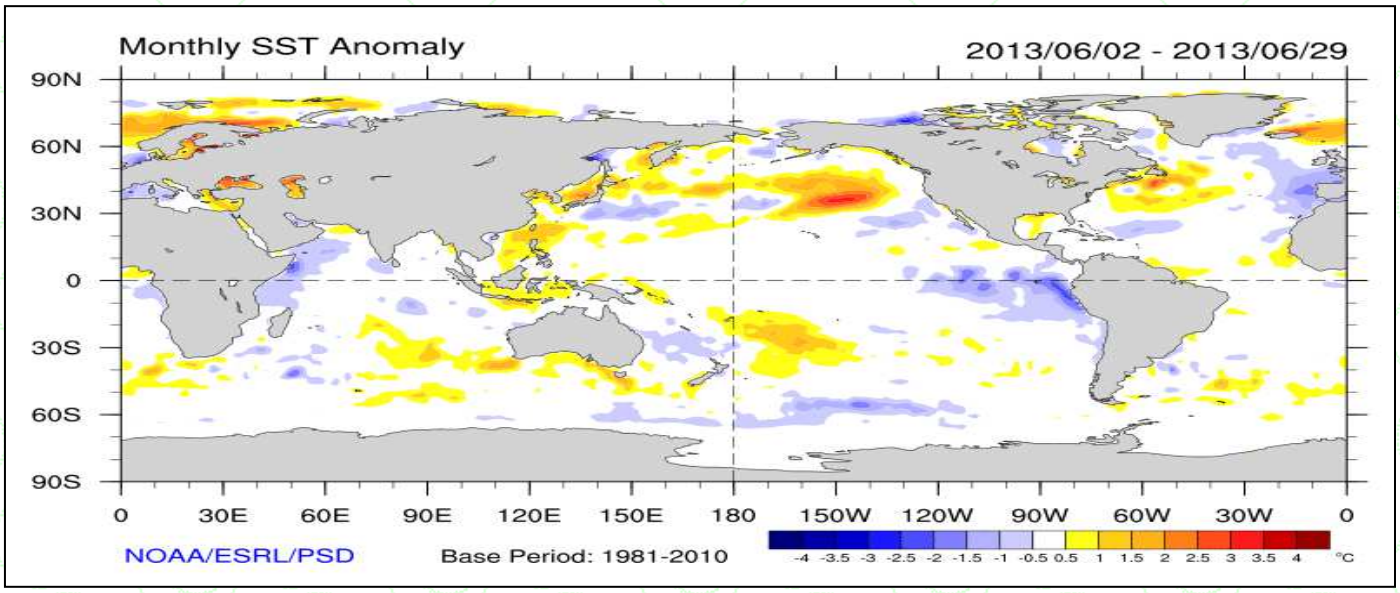


Figure 1: SST anomalies during June 2013 were cooler than average in the far eastern tropical Pacific. Source: http://www.cdc.noaa.gov/map/images/sst/sst.anom.month.gif

The Southern Oscillation Index (SOI) is the measure of the atmospheric strength of ENSO, varied around *normal* values for most of the year apart from March, June and November when the SOI was positive with the highest value of 13.9 attained in June (Figure 2).

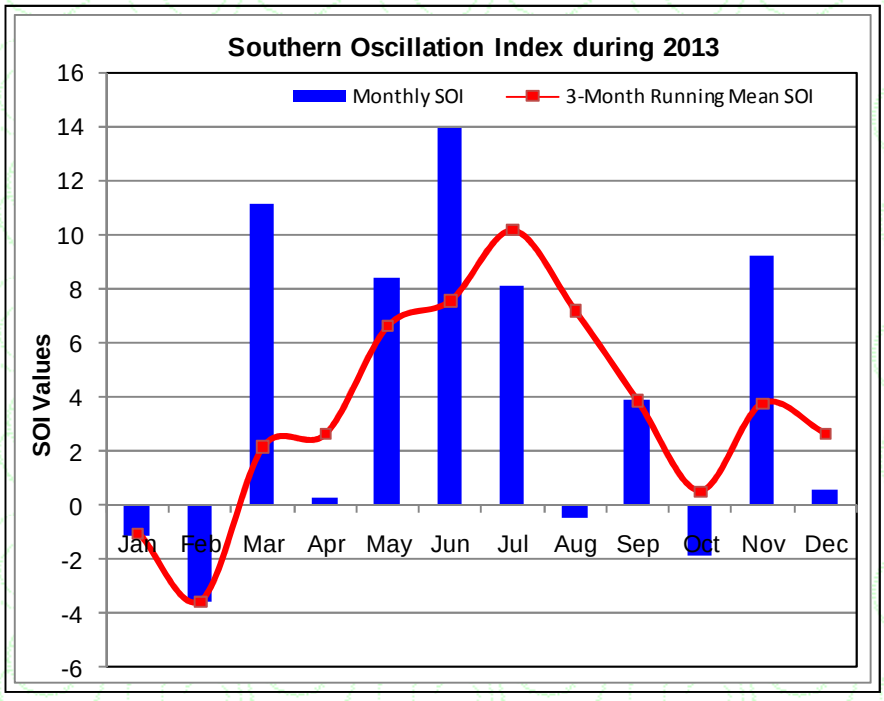


Figure 2: Variation of monthly SOI with the three-month moving average (red). Source: Bureau of Meteorology

RAINFALL IN 2013

Fiji's rainfall was generally influenced by the prevailing south-east trade flow, existence of series of troughs of low pressure and tropical disturbances. A total of eight Tropical Depressions (08F, 11F, 15F– 16F, 20F, 22F) affected Fiji from January to April and two (2) 5F and 6F in December.

Neutral ENSO conditions (neither El Niño nor La Niña) existed within the region which contributed to the absence of a clear trend in the seasonal or the annual rainfall pattern observed at most of the stations during the year. The movement of the South Pacific Convergence Zone (SPCZ) contributed a lot to Rotuma's rainfall, but not on the rest of the country.

Fiji's annual rainfall was 101% of *normal*. Apart from February, March, July and December, which recorded *above normal* rainfall, the rest of the months recorded *normal* to *below normal* rainfall (Figure 3). The 1998 remains the driest year on record followed by 1987 and 1966. In contrast the wettest years were 1975, followed by 1999 and 2012.

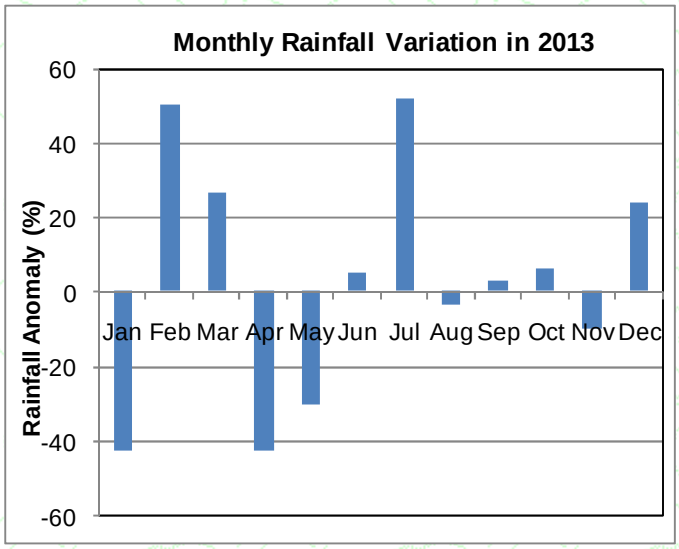


Figure 3: Departures from mean monthly rainfall for Fiji. Negative departures were recorded in January, April, May, August and November.

The annual rainfall ranged from 96% to 108% in the Western Division, 100% to 111% in the Central Division, 81% to 98% in the Northern Division and 99% to 118% in the Eastern Division.

Monthly rainfall was 151% of normal in February, 127% in March, 105% in June, 152% in July, 103% in September, 106% in October and 124% in December. The rest of the months recorded less than *normal* rainfall.

During the wet season, 69% of the annual rainfall was recorded, while the rest was recorded during the dry season. Penang Mill and Labasa Airfield recorded more than half (63% and 52% respectively) of their annual total rainfall in the first four months of the year.

For the dry season, rainfall ranged from 69% to 152% with July being wettest at majority of the locations.

At **Laucala Bay (Suva),** (Central Division), the annual rainfall was *normal* (100%). However, much *wetter than normal* conditions were experienced in February (164%) and July (176%). *Normal* conditions prevailed in March (119%), June (86%), August (98%), September (98%) and October (113%) while *drier than normal* conditions were experienced in January (51%), April (66%), May (53%) and November (63%) (Table 5).

Rainfall at **Labasa Airfield** (Northern Division) varied considerably during the year. March, June, August, September and November recorded *wetter than normal* (124% to 276%) conditions, while January, February, April, May, July, October and December received *normal to below normal* rainfall (Table 5). The highest total monthly rainfall of 714.4mm was recorded in March, followed by 283.3mm in November (Appendix 1B). In contrast, the lowest of 21.8mm was recorded in April.

Nadi Airport (Western Division), experienced *wetter than normal conditions* in February, May, June, September, November and December. Extremely wetter than normal conditions prevailed during September (228%), followed by June (197%), November (181%) and February (159%). The driest month was during July which received 14%, followed by August (17%) and January (26%) (Table 5).

Lakeba (Lau) experienced *normal* rainfall during the year, receiving 118% of total annual rainfall. Notably, more than 150% of *normal* rainfall were recorded in February, March, July and December. Twice the *normal* monthly rainfall (234%) was recorded in July at the station (Table 5). The highest monthly rainfall of 503.0mm was recorded in March and the lowest of 52.5mm was recorded in May (Appendix 1D).

The annual rainfall at **Matuku (Lau)** was *normal* (99%). The station recorded *below normal* rainfall in the months of January, April, May, August and September ranging from 26% to 66%. On the other hand, February, March, July and December received *above normal* rainfall, ranging from 145% to 193% (Table 5). The highest total monthly rainfall of 445.8mm was recorded in February, while the lowest total monthly of 48.5mm was recorded in June (Appendix 1E).

From July to October, there was no observations from **Rotuma**. For the remaining months, *above normal* to *well above normal* rainfall were recorded in the months of January, March, May, June November and December. The highest monthly rainfall of 659.6mm was recorded in March, followed by 470.9mm, while the lowest of 201.0mm was recorded in June. (Appendix 1F).

MEAN AIR TEMPERATURE

The annual mean air temperature was 26.2˚C, which was 0.7˚C warmer than *normal* ranking 2nd warmest year on record. The warmest annual mean air temperature was observed in 2007.

The annual mean air temperature in 2013 was *normal* to *warmer* than *normal* in most parts of the country. With the exception of October, the monthly mean temperatures were persistently 0.5˚C *warmer than normal* from April to December period (Figure 4). Comparatively, mean air temperatures were warmer than 2011 and 2012.

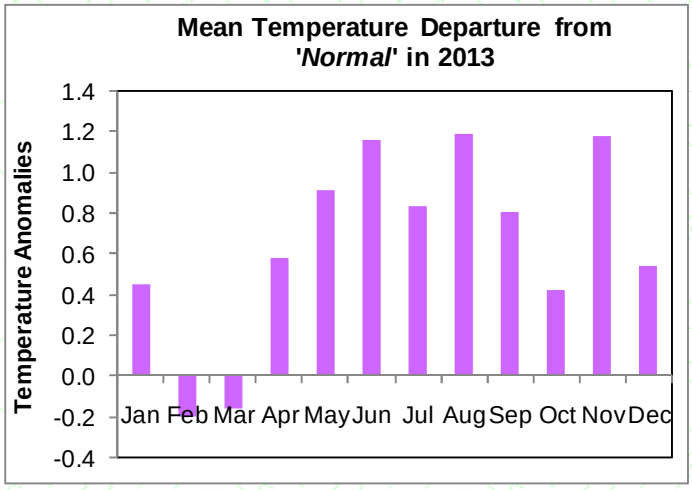


Figure 4: Monthly average mean temperature departure from normal.

At **Laucala Bay (Suva),** the annual mean air temperature was 26.9˚C which was 1.2˚C *warmer than normal.* Significant positive departures from *normal* (>1.0˚C) of +1.7˚C were recorded in August and November, followed by +1.6˚C recorded in June and July, +1.5˚C in September, +1.4˚C in May and +1.3˚C in April. There were no negative departures recorded at the station.

At **Labasa Airfield**, the annual mean air temperature was 26.9˚C, which was 0.6˚C warmer than the *normal*. Apart from March (-0.6˚C), the monthly mean temperatures were *normal* to *above normal* during the year. Notable significant positive departures (≥1.0˚C) were recorded in June and July (+1.4˚C), followed by May (+1.3˚C). Other positive departures (≥+0.5˚C) were recorded in January, April, May, September, October and November.

The annual mean air temperature at **Nadi Airport** was 26.1˚C, which recorded 0.5˚C warmer than *normal*. Positive departures from *normal* were recorded for most of the months, with significant positive (≥1.0˚C) departures being recorded in August (+1.3°C) and June (+1.2˚C). Negative departure of -0.4˚C was recorded in February while March was normal.

The annual mean temperature at **Lakeba Island (Lau Group)** was 26.5˚C, which was 0.9˚C *above normal*. The monthly mean temperatures at Lakeba were persistently warmer than *normal* except for March, which recorded departures within the *normal* range. Notable significant positive departures of +1.4˚C was recorded in May, followed by +1.3˚C in June and November and +1.1˚C in August.

At **Matuku (Lau Group)**, the annual mean air temperature was 25.7˚C, which was 0.2˚C *above normal*. The station recorded *normal* to *below normal* temperatures during the first quarter and generally *above normal* during the rest of the year. Notable significant positive departure of +1.2°C was recorded in May, followed by +1.1°C in August and November (Appendix 1C). Significant negative departures of -1.4°C were recorded in February and March.

MINIMUM AIR TEMPERATURE

The annual average night-time (minimum) air temperature was 22.6˚C, which was 0.9˚C warmer than the *normal* ranking equal warmest with 2007 and 0.4˚C warmer than 2012. The coolest nights were observed in1978 followed by 1968.

The annual average night-time air temperatures ranged from 21.1˚C to 24.0˚C across the country. *Normal* to *above normal* night-time air temperatures were recorded persistently from April to December. Significant (>+1.0˚C) positive departures were recorded during June (+1.4˚C), August (+1.4˚C) and September (+1.4˚C), followed by November (+1.3˚C) and July (+1.1˚C) (Figure 5).

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.

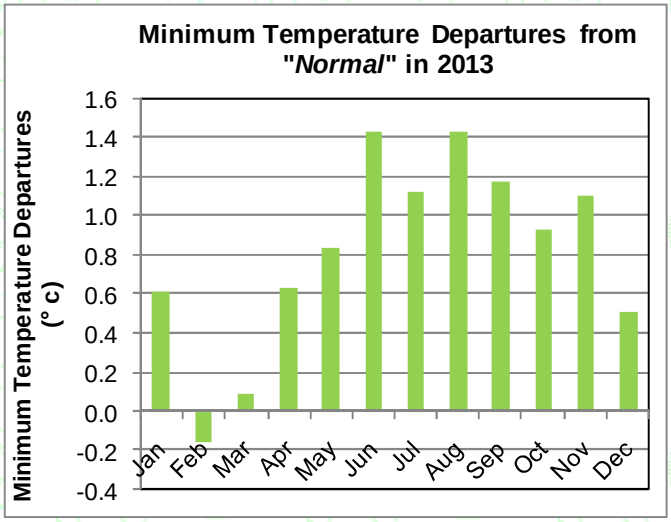


***Figure 5**: Night-time (minimum) temperature departure from normal with significantly warmer period from May to November.*

MINIMUM AIR TEMPERATURE cont'd

A total of four (4) daily and ten (10) new mean monthly night-time air temperature records were established around the country during the year (Table 1).

The annual average night-time temperature at **Laucala Bay (Suva)** was 24.2˚C, which was 1.7˚C warmer than *normal*. With the exception of February (+0.6˚C), significant positive departures (≥1.0˚C) were recorded during the rest of the months at the station. The highest positive departure of +2.3˚C were recorded in June and August, followed by +2.2˚C in July, September and October. The rest of the months recorded departures between 1.0˚C to 1.9˚C (Table 3). One (1) new daily minimum and four (4) new mean monthly minimum temperature was established at the station in 2013 (Table 1).

The **Labasa Airfield** annual average night-time temperature was 0.6˚C warmer than *normal*. Significant positive departures from normal were recorded from June to November period that ranged from 1.2˚C to 1.4˚C. However, negative departures ranging from –0.1˚C to –0.6˚C were recorded from February to May period. (Table 3).

At **Nadi Airport**, the annual average night-time temperature was 22.3˚C, which was 1.3˚C above *normal*. Significant positive departures of (≥1.0˚C) were recorded in January and from April to November period. In contrast, no negative departure was recorded at the station (Table 3).

The annual average night-time temperature at **Lakeba (Lau Group)** was 23.8˚C, which was 1.1°C *above normal*. Significant (≥1.0˚C) positive anomalies were recorded in January (+1.7°C), May (+1.4°C), June(+1.6°C), July (+1.3), August (+1.4°C), September (+1.5°C), October (+1.3°C) and November (+1.0°C). Notably, there were no negative departure recorded at the station (Table 3).

Matuku (Lau Group) recorded annual average night-time temperature of 23.0˚C, which was 0.3˚C *above normal*. Apart from February and March, *normal* to *above normal* night-time air temperatures were recorded at the station. Notable significant positive departures were recorded in September (+1.1˚C) and November (+1.4˚C), while negative departures were recorded in February (-1.2˚C) and March (-1.1˚C) (Table 3)

MAXIMUM AIR TEMPERATURE

The annual average daytime (maximum) air temperature was 29.6˚C, which was 0.6˚C *above normal* ranking 2013 the 7th warmest. The country experienced relatively warmer daytime temperatures in January, between April and August and November to December periods (Figure 6). In contrast, the months of February, March, September and October were *normal to cooler than normal* at majority of the locations. The monthly mean maximum temperature was significantly (≥1.0˚C) warmer than *normal* in May, August and November.

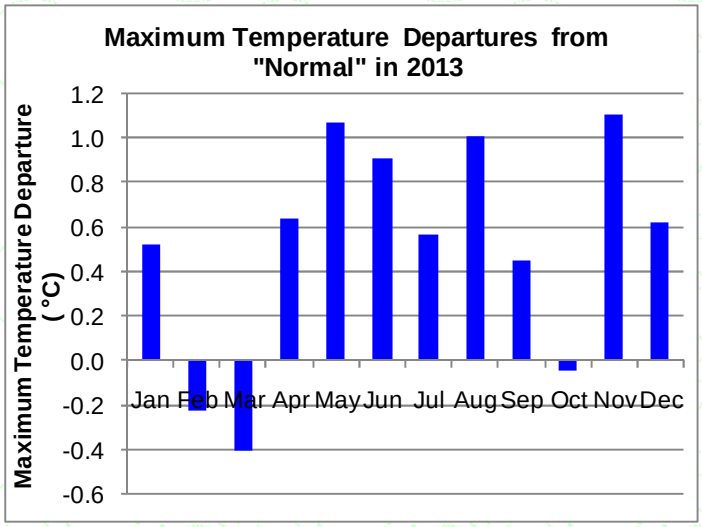


Figure 6: Monthly average day-time (maximum) temperature departure from normal with warmer than normal period from April to August and November to December.

There were ten (10) new daily high daytime (maximum) temperature recorded, with seven (7) new mean monthly high maximum temperatures (Table 1). In January, four (4) new daily max temperatures were recorded, with the highest of 35.5˚C recorded at Koronivia.

The annual average daytime temperature at **Laucala Bay** (Suva) was 29.6˚C, which was 0.7˚C *warmer than normal*. The monthly temperatures ranged from 27.8˚C to 31.2˚C. With the exception of February, the station recorded *normal* to *warmer than normal* daytime temperatures. Notable significant positive departures (≥1.0°C) from *normal* were recorded in November (+1.6°C), August (+1.2°C), May (+1.0°C) and July (1.0°C) (Table 2).

The annual daytime temperature at **Labasa Airfield** was 31.4˚C, which was 0.7˚C warmer than *normal.* The mean monthly temperatures ranged from 30.6˚C to 32.5˚C, with the highest of 32.5˚C recorded in January. April to August was relatively warmer period with significant positive departures (≥1.0˚C) recorded in May (+1.6˚C), June (+1.5˚C), July (+1.4˚C), August (+1.4˚C) and April (+1.2˚C) (Table 2).

At **Nadi Airport**, the annual average daytime temperature was 30.1˚C, which was 0.2˚C *cooler than normal*. The monthly temperatures ranged from 28.5˚C to 31.8˚C. Notable negative departures –1.0, –0.9˚C and –0.8˚C were observed in February, March and October respectively. On the other hand, only notable positive departure of +0.6˚C was recorded in August (Table 2).

MAXIMUM AIR TEMPERATURE cont'd

Annual average daytime temperature on **Lakeba Island** was 29.2˚C, which was 0.8˚C above *normal*. The monthly daytime temperatures ranged from 27.0˚C to 31.3˚C at the station. Apart from January, March, September and October, *warmer than normal* temperatures were recorded during the rest of the months. Positive departure of +1.6°C was recorded in November, followed by +1.4°C recorded in May and +0.9°C recorded in June and December (Table 2).

The annual average daytime temperature at **Matuku** (Lau Group) was 0.2˚C warmer than *normal*. The temperatures fluctuated between 26.7˚C to 30.1˚C. Apart from January(-0.1˚C), February(-1.6˚C), March (-1.7˚C) and October (-0.2˚C), which recorded negative departures, positive departures were recorded for the rest of the year. The significant positive departure of +1.6˚C was recorded in May, followed by +1.4˚C in August (Table 2).

SUNSHINE IN 2013

The total annual bright sunshine hours at **Laucala Bay** was 1715 hours (89% of *normal*). With the exception of January, April and December, *below normal* sunshine hours were recorded in the other months. The longest hours of bright sunshine was recorded in December (213 hours), while the lowest was in October (98 hours) (Figure 7).

Nadi Airport recorded 2365 hours (93% of *normal*) of bright sunshine during the year. *Below normal* total monthly sunshine hours were recorded throughout the year with only exception of January and August. The percent of *normal* sunshine hours for Nadi ranged from 74% to 119%. The longest duration of bright sunshine was experienced in January (252 hours), while the shortest was in March (148 hours) (Table 4).

The bright sunshine hours at **Koronivia** varied throughout the year ranging from 72% to 108% of *normal* sunshine hours. *Above normal* sunshine hours were recorded in January (104%), May (106%) and December (108%), *normal* in November (99%) while the rest of the months recorded *below normal* sunshine hours. The longest duration of bright sunshine was experienced in December (182 hours), while the shortest was in June (104 hours) (Table 4).

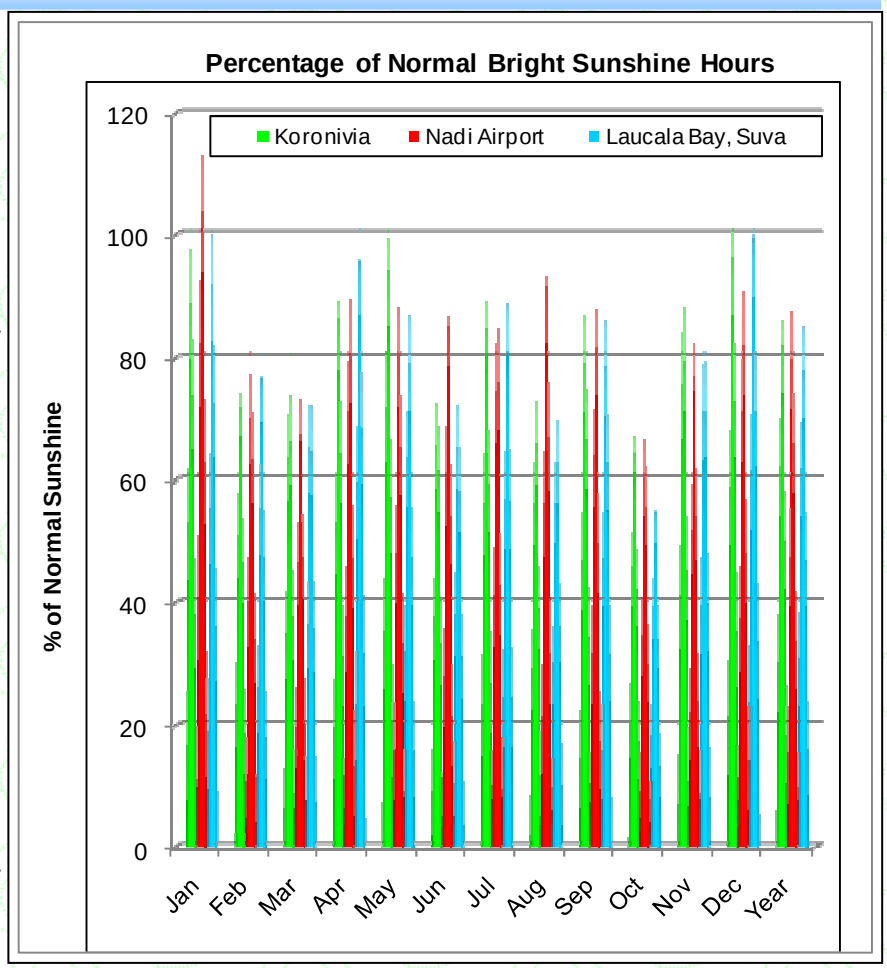


Figure 7: Percent of normal monthly & annual bright sunshine hours at Koronivia, Laucala Bay and Nadi Airport.

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 hourly intervals at Nadi and Nausori Airports, showed that east to southeast winds were the predominant wind directions during 2013. The mean annual wind speed at Nadi Airport and Nausori Airport were 5.2 knots and 3.5 knots, respectively.

Nadi Airport experienced calm conditions on 19.9% of the instances during the year. Southeast winds were predominant and accounted for 21.3% of the observations, followed by easterly winds with 17.8%, and westerly winds with 11.7% (Figure 8(a)). The winds at Nadi Airport were generally light to moderate in strength (Figure 8(b)).

Calm condition was predominant at Nausori Airport, accounting for 50.9% of the three hourly statistics. Easterly winds were the most common and accounted for 21.3% of the observations, followed by southeasterly winds with 11.2% and northeasterly winds with 6.8% (Figure 9(a)). The wind speed at the station was generally slight to moderate in strength (Figure 9(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: 22-27knots, near gale: 28-33 knots, gale: 34-40 knots

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

Figure 8(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)

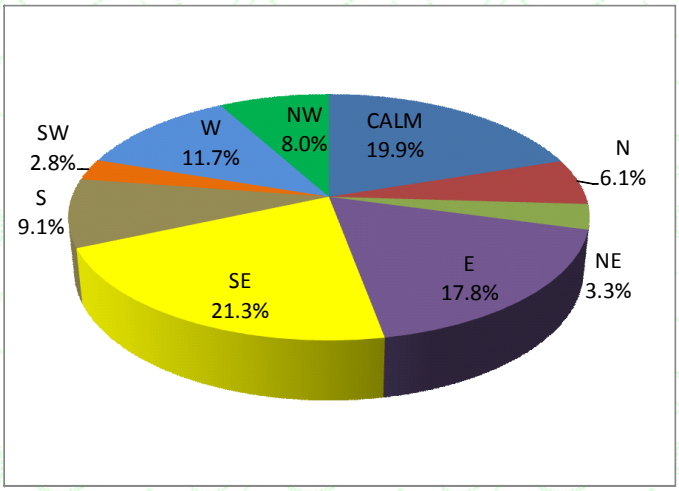


Figure 8(b) Surface Wind Speed for Nadi Airport, Fiji. (WMO 91680 Latitude 17°45'35" South Longitude 177°26'42" East Height above MSL 22 meters)

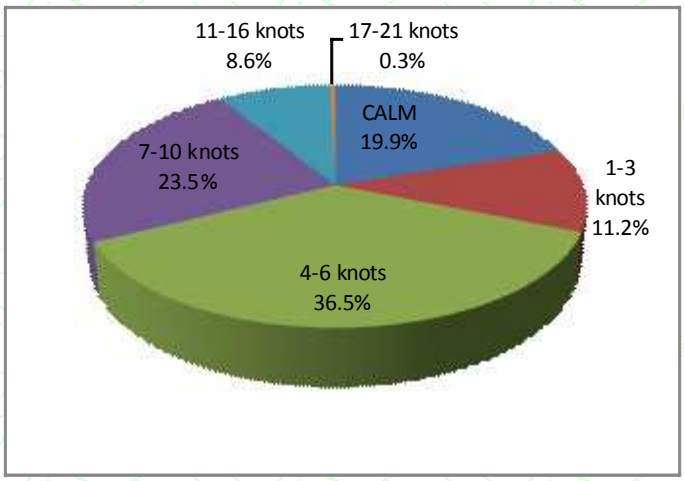


Figure 9(a) Surface Wind Direction for Nausori Airport, Fiji. (WMO 91683 Latitude 18°02'47" South Longitude 178° 33'33" East Height above MSL 3 meters)

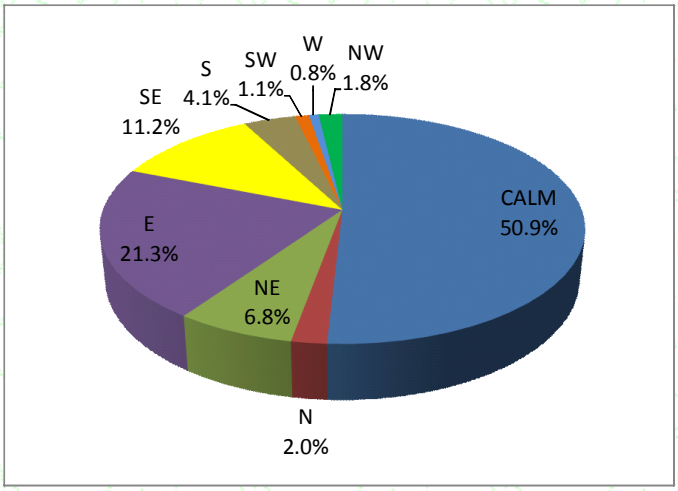
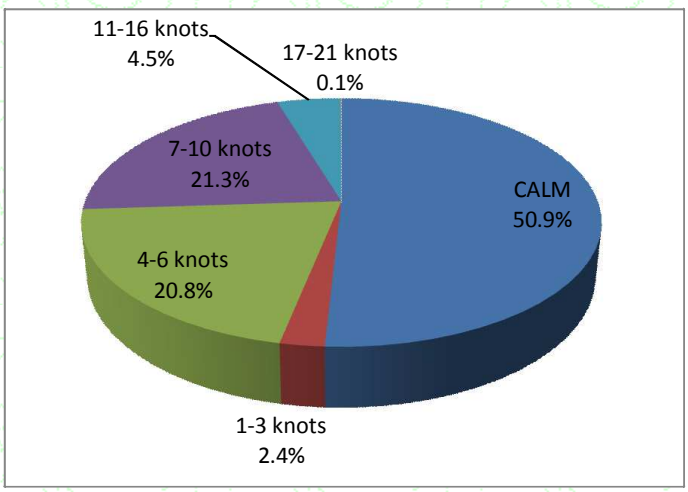


Figure 9(b) Surface Wind Speed for Nausori Airport, Fiji. (WMO 91683 Latitude 18°02'47" South Longitude 178°33'33" East Height above MSL 3 meters)



NEW RECORDS

A total of thirty-nine (39) new climate extremes were established in 2013, which included fifteen (15) daily and twenty-four (24) monthly records. Of these, thirty-one (31) were temperature and eight (8) rainfall new records. In contrast, there were twenty-seven (27) and sixty-four (64) new records established in 2012 and 2011 respectively.

There were twenty-four (24) new monthly records established around the country, of which seven (7) were maximum air temperature records, ten (10) minimum air temperature records and seven (7) rainfall records. In addition, there were fifteen (15) new daily records, which included one (1) rainfall (new highs), ten (10) maximum temperatures (all new highs) and four (4) minimum temperatures (all new highs) (Table 1). Majority of the new records were set in the months of January and November.

Table 1	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Daily Rainfall	-	-	-	-	-	-	-	-	-	-	-	1	1
Daily Maximum Temperature	4	1	-	-	-	1	2	1	-	-	1	-	10
Daily Minimum Temperature	-	-	-	-	-	-	2	-	1	-	1	-	4
Monthly Total Rainfall	-	2	1	-	-	-	1	1	-	1	-	1	7
Monthly Maximum Temperature	1	-	-	-	1	2	1	-	-	-	1	1	7
Monthly Minimum Temperature	2	-	-	1	-	1	-	1	-	1	4	-	10
Total	7	3	1	1	1	4	6	3	1	2	7	3	39

Table 1: Summary of new rainfall and temperature records established across the country in 2013.

SEA LEVELS IN 2013 (LAUTOKA AND SUVA SEAFRAME STATIONS)

The mean sea level during the year at Lautoka SEAFRAME station was 1.30 meters, with a maximum of 2.52 meters in January and a minimum of 0.079 meters in June (Figure 10).

The mean sea level at Suva SEAFRAME station was 1.22 meters, with a maximum of 2.21 meters in January and a minimum of 0.15 meters in June.

The Intergovernmental Panel on Climate Change (IPCC) in its Fourth Assessment Report (IPCC AR4, 2007), states sea level change is an important consequence of climate change, both for communities and the environment. The sea level trend at the Lautoka SEAFRAME station for the period 1993 to 2013 is +5.6mm/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 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.

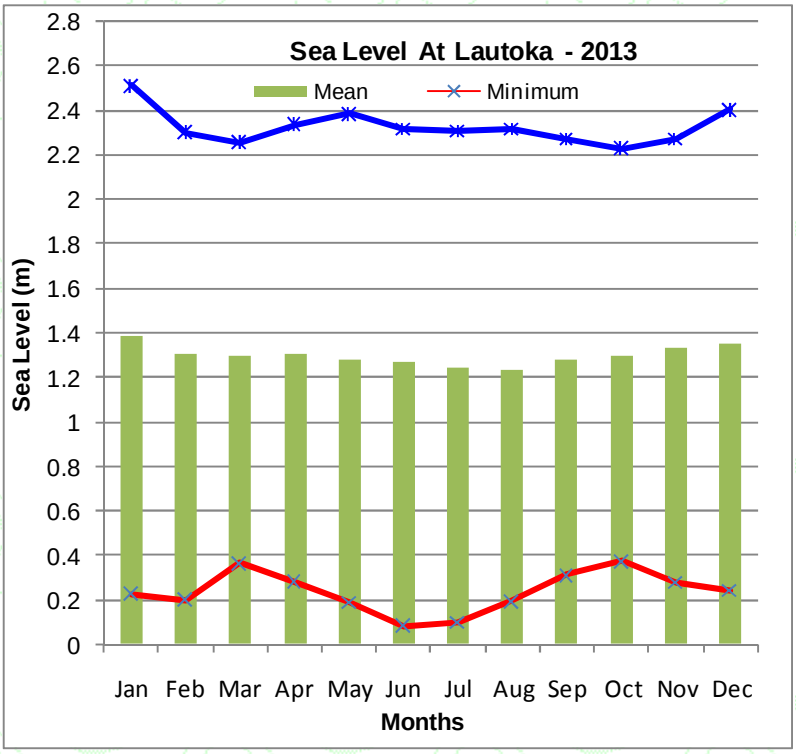


Figure 10: Sea level observed in 2013 at Lautoka tide gauge.

SEASONAL CLIMATE FORECAST VERIFICATION

Fiji Meteorological Service used data from twenty six (26) sites around the country to monitor the climate of Fiji in 2013. The national, divisional and locality forecasts were issued seasonally (3month periods) and verified for individual locations. There were 32% of consistent forecasts or had the total observed rainfall in the predicted category, 52% near consistent forecasts, 7% inconsistent forecasts and 9% of the forecasts could not be verified (due to missing observations). The results for consistent forecasts are presented in Figure 11. There was a high success rate in the seasonal predictions for the Central (40%) followed by the Northern (32%), Western (31%) and Eastern Divisions (27%).The overall assessment of the model performance in 2013 is rated as good to very good compared to the total variance explained by the predictors (SOI and 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, ninety nine (99) of the forecasts were consistent, one hundred and sixty three (163) near consistent and twenty two (22) inconsistent forecasts, while twenty eight (28) forecasts could not be verified due to unavailability of the data or missing records. During wet season, there were 34% consistent forecasts, 54% near consistent forecasts, 6% inconsistent forecasts and 6% unverified forecasts. Similarly, during dry season, 29% consistent forecasts, 51% near consistent, 8% inconsistent and 12% unverified forecasts.

FORECAST VERIFICATION

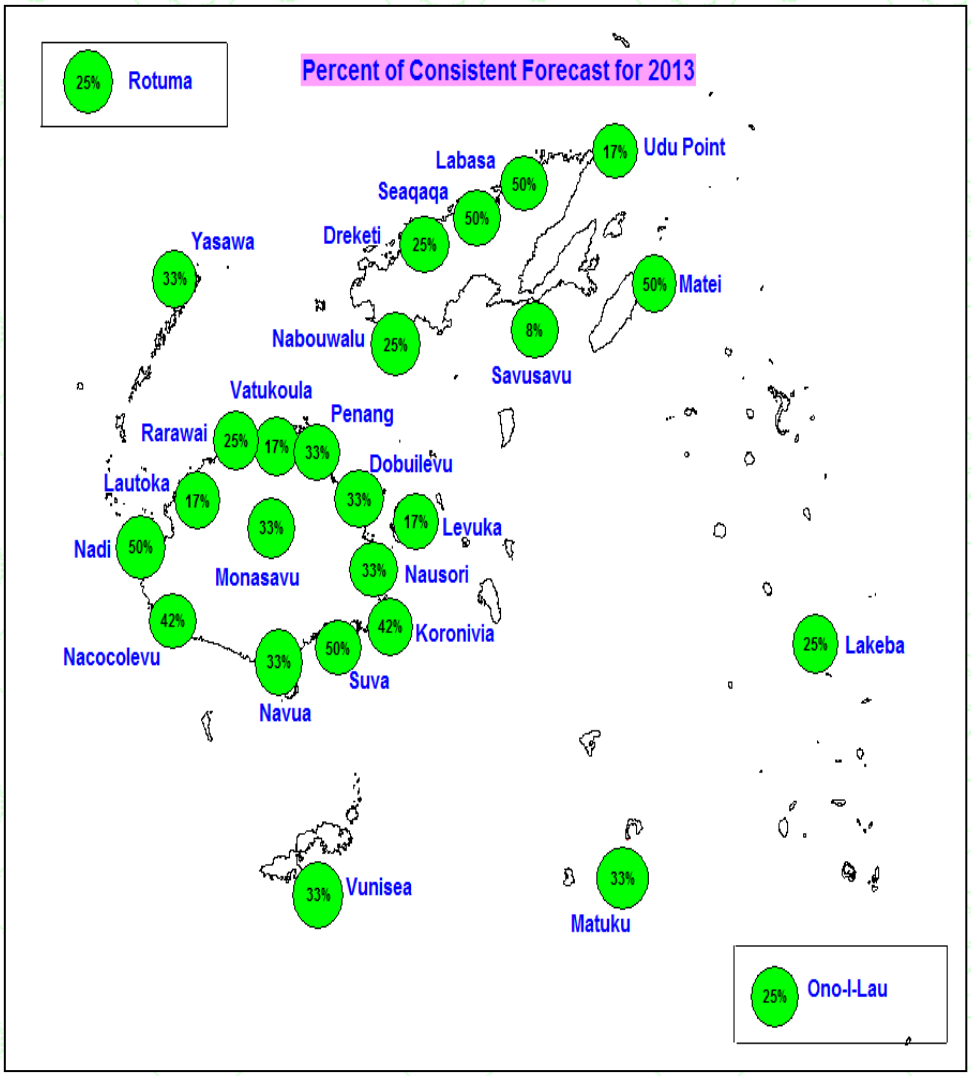


Figure 11: Percentage of consistent forecasts at individual locations in 2013.

In the **Western Division**, 31% of the forecasts were consistent, 50% near consistent, 10% inconsistent and 8% unverified. The wet season had a higher consistency rate (39%) compared to the dry season (24%).

In the **Central Division,** there were 40% consistent forecasts and 60% near consistent forecasts. For Central Division, there is slightly high consistency in the dry season prediction (42%) compared to the wet season prediction (38%). There was no inconsistent forecast for the Central Division.

For the **Eastern Division**, 27% of forecasts were consistent, 52% near consistent, 5% inconsistent and 17% unverified forecasts. The Eastern Division had same consistency rate (27%) in the dry season and the wet season.

In the **Northern Division**, 32% of forecasts were consistent, 56% near consistent, 8% inconsistent and 4% unverified forecasts. Slightly higher consistency rate was observed during the dry season (33%) compared to wet season (31%).

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 the forecast period.

TROPICAL CYCLONES ACTIVITY IN FIJI AND THE SOUTHWEST PACIFIC REGION

The Regional Specialized Meteorological Centre (RSMC) - Tropical Cyclone Centre (TCC) Nadi Area of Responsibility (AoR) extends from the equator to 25ºS and 160ºE to 120ºW. Four (4) tropical cyclones occurred within the RSMC Nadi - TCC AoR in 2013. These tropical cyclones were namely; Freda, Garry, Haley and Sandra. (Figure 12). None of these four tropical cyclones directly affected Fiji however, associated outer rain bands affected some parts of the country.

Although TC Freda formed in December 2012, its lifespan continued till the 1st of January 2013. Freda developed from a TD05F located north of Port Vila (Vanuatu) on the December 26th. The system rapidly intensified and was named a category 1 cyclone on the 28th. Freda tracked south-southwest and subsequently moved into Brisbane AoR, for a brief period, before re-entering Nadi's AoR. Freda peaked as a category 4 hurricane on the 30th. By the 31st, it began to weaken rapidly and was later downgraded into a tropical depression to the far southwest of Fiji. The cyclone affected the Solomon Islands, Vanuatu and New Caledonia. It did not pose any threat to Fiji.

Tropical Cyclone (TC) Gary was the second cyclone in Fiji's AoR during the 2012/13 TC season. It developed as a tropical depression on 21st January, developed rapidly and transformed into category 1 cyclone within hours. Gary reached a maximum intensity of a category 3 system with the maximum sustained winds of 80 knots and gusts up to 110 knots in open waters between Suwarrow and Palmerston Island in the Southern Cook Islands. Gary passed through Samoa and American Samoa waters and at the closest point, it came within 97 miles northeast of Apia and 103 miles north of Pago Pago. Gary finally weakened into an extra-tropical low around 270900UTC due to strong vertical wind shear and cooler sea surface temperatures.

Haley developed from tropical depression 14F which was first located east of Suwarrow Island in the Northern Cooks on the 7th February. The depression gradually intensified into a tropical cyclone and was named "Haley" on the 9th February at 2300UTC by RSMC Nadi. Haley took a south-easterly track and passed between Southern Cooks and French Polynesia as a category 1 cyclone, with estimated sustained winds of 35 knots close to its centre. Haley then got caught in a northwest deep layer mean wind flow, weakened and de-classified into a Tropical Depression on 11th February at 0300UTC just before moving south of 25°S latitude.

Sandra evolved from a tropical disturbance which was first identified on the 5th March in the Queensland region which was later named TC "Sandra" on the 8th March by Brisbane TCWC . Sandra continued to intensify and entered Nadi RSMC's area of responsibility as a Severe Tropical Cyclone (category 3 system) on the 10th March. Sandra entered Nadi RSMC's AoR and had an estimated sustained wind of 80 knots close to its centre. Sandra intensified to Category 4 six hours later and reached its peak intensity on March 10th at 1200UTC, with an estimated sustained wind speed of 100 knots near the centre with maximum gusts of up to 140 knots. Sandra continued on a southerly track and downgraded to Category 3 at 111200TUC and Category 2 at 121200UTC. On the 13th March, Sandra moved further south and crossed into the Wellington AoR at 0845UTC as Category 1 cyclone with estimated mean wind speed of 40 knots.

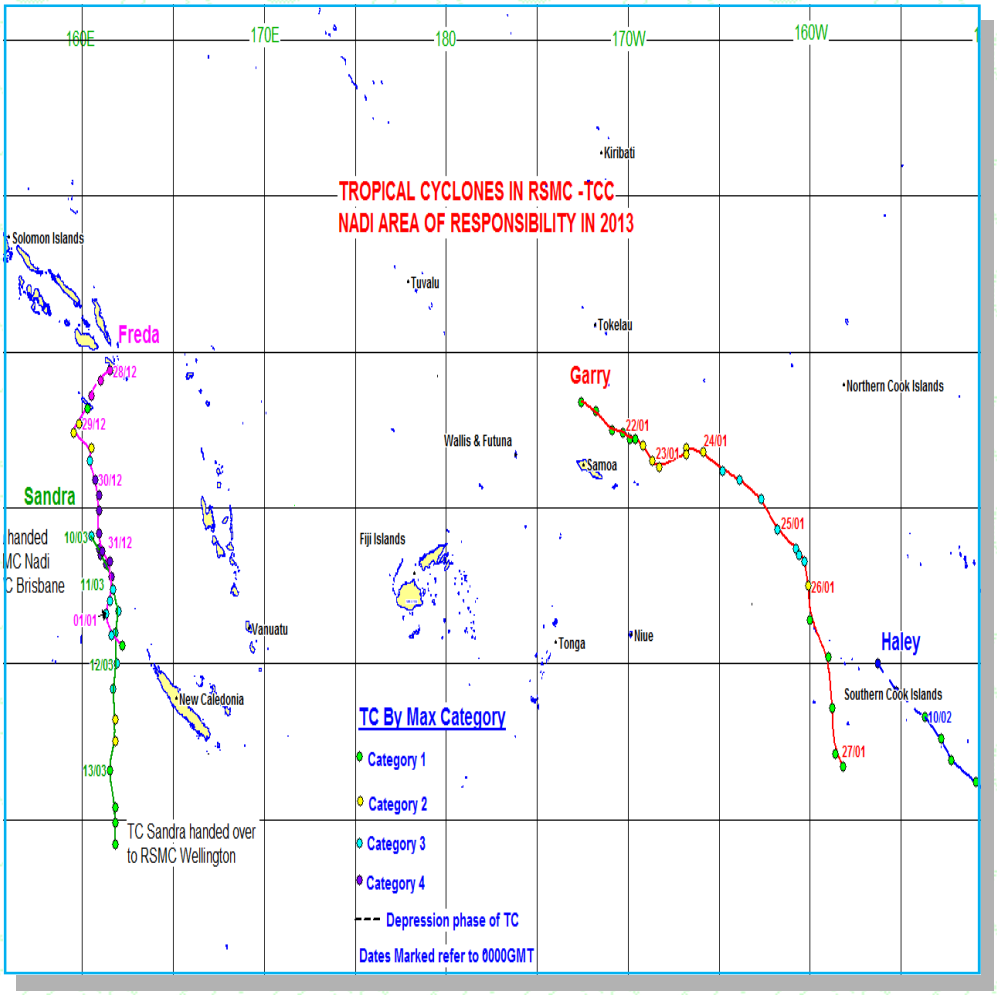


Figure 12: Tracks of TC's within the RSMC Nadi AoR in 2013.

TABLE 2: MAXIMUM AIR TEMPERATURE

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airfield	Max	32.5	31.8	30.9	32.2	31.8	31.3	30.6	30.8	30.6	30.7	32.0	32.1	31.4
	Dep	0.8	0.2	-0.6	1.2	1.6	1.5	1.4	1.4	0.5	-0.1	0.6	0.4	0.7
Savusavu	Max	31.2	30.8	30.3	29.6	29.3	28.6	27.0	27.5	27.6	27.9	30.7	31.2	29.3
	Dep	0.6	0.1	-0.3	-0.2	0.8	0.7	0.0	0.4	0.2	-0.3	1.3	1.0	0.4
Penang Mill	Max	31.6	30.6	30.6	30.6	29.5	29.2	27.9	29.0	28.9	29.5	31.4	31.5	30.0
	Dep	1.3	0.1	0.1	1.0	1.0	1.5	0.5	1.6	0.9	0.6	1.7	1.2	0.9
Nadi Airport	Max	31.8	30.6	30.4	30.9	29.8	29.3	28.5	29.3	29.3	29.5	31.0	30.9	30.1
	Dep	0.3	-1.0	-0.9	0.2	0.1	0.3	-0.1	0.6	0.0	-0.8	-0.1	-0.6	-0.2
Laucala Bay, Suva	Max	31.2	30.8	30.9	30.8	29.5	28.6	27.8	27.9	27.9	28.2	30.9	31.2	29.6
	Dep	0.4	-0.4	0.0	0.9	1.0	0.9	1.0	1.2	0.7	0.0	1.6	0.9	0.7
Nausori Airport	Max	30.8	30.8	30.5	30.1	28.9	27.9	26.7	26.9	27.1	27.5	30.3	30.8	29.0
	Dep	0.4	0.0	0.0	0.8	1.1	0.7	0.4	0.7	0.5	-0.1	1.5	1.1	0.6
Matuku, Lau	Max	30.1	29.1	28.7	29.6	29.2	27.7	26.7	27.2	26.7	27.2	29.4	29.8	28.5
	Dep	-0.1	-1.6	-1.7	0.4	1.6	0.8	0.7	1.4	0.3	-0.2	0.7	0.1	0.2
Lakeba	Max	30.6	31.3	30.4	30.1	29.4	28.1	27.0	27.2	27.3	28.2	30.4	30.6	29.2
	Dep	0.5	0.8	0.1	0.8	1.4	0.9	0.6	0.8	0.5	0.5	1.6	0.9	0.8

TABLE 3: MINIMUM AIR TEMPERATURE

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airfield	Min	22.5	22.0	21.7	21.2	19.5	20.2	19.5	19.9	20.5	21.2	22.5	21.7	21.0
	Dep	0.3	-0.4	-0.6	-0.1	-0.4	1.3	1.4	1.2	1.2	1.4	1.3	0.0	0.6
Savusavu	Min	24.2	23.6	23.3	24.0	23.1	23.0	21.9	22.7	22.2	22.2	22.7	23.3	23.0
	Dep	0.7	-0.1	-0.3	0.8	0.8	1.4	0.9	1.9	1.0	0.3	0.1	0.3	0.6
Penang Mill	Min	24.2	23.1	23.9	24.0	21.9	22.5	21.2	21.6	21.7	22.4	23.6	23.5	22.8
	Dep	0.2	-0.8	0.1	0.8	-0.2	1.1	0.8	0.9	0.5	0.2	0.6	0.0	0.3
Nadi Airport	Min	23.9	23.2	23.7	23.0	21.7	21.3	19.8	20.6	20.3	21.8	23.2	23.3	22.3
	Dep	1.1	0.3	0.9	1.2	1.5	2.1	1.4	2.0	1.0	1.3	1.4	0.9	1.3
Laucala Bay, Suva	Min	25.2	24.6	24.9	25.0	24.1	23.7	22.9	23.0	23.2	24.1	24.6	24.8	24.2
	Dep	1.3	0.6	1.0	1.7	1.9	2.3	2.2	2.3	2.2	2.2	1.8	1.3	1.7
Nausori Airport	Min	23.2	23.2	23.3	22.8	22.0	21.6	20.5	20.5	20.9	21.0	23.1	23.0	22.1
	Dep	0.1	-0.1	0.1	0.3	0.9	1.1	0.9	0.9	0.9	0.1	1.3	0.4	0.6
Matuku, Lau	Min	23.9	23.5	23.5	23.6	23.3	22.3	20.9	21.4	21.9	22.5	24.3	24.3	23.0
	Dep	-0.5	-1.2	-1.1	-0.3	0.8	0.6	0.1	0.9	1.1	0.7	1.4	0.5	0.3
Lakeba, Lau	Min	24.8	24.6	24.6	24.5	24.1	23.6	22.3	22.4	22.9	23.4	24.1	24.4	23.8
	Dep	1.7	0.5	0.6	0.7	1.4	1.6	1.3	1.4	1.5	1.3	1.0	0.7	1.1

TABLE 4: SUNSHINE HOURS AND PERCENTAGE OF NORMAL

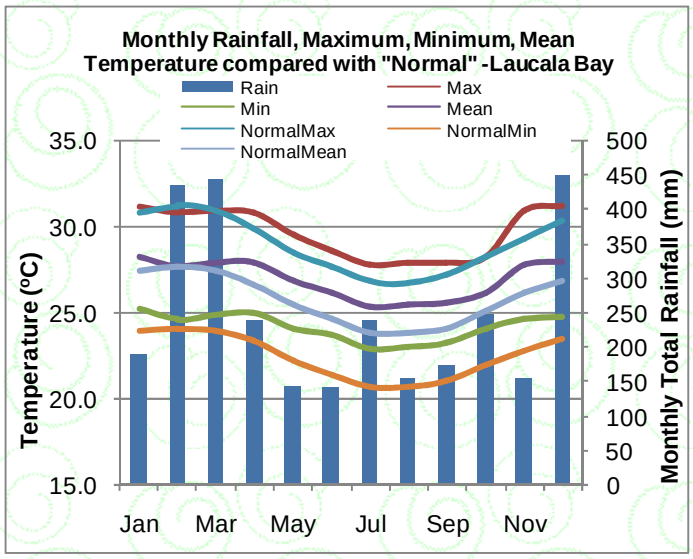
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Koronivia	Actual	176.7	130.2	136.6	143.3	145.6	103.9	116.7	107.5	114.8	105.7	145.8	181.5	1608.3
	%	104	80	83	96	106	81	95	78	93	72	99	108	92
Nadi Airport	Actual	251.6	159.6	148.1	191.8	194.0	192.1	209.6	231.6	195.5	173.6	193.7	224	2365.2
	%	119	85	77	97	93	94	96	101	93	74	87	98	93
Laucala Bay, Suva	Actual	202.0	147.8	140.4	161.8	131.3	110.5	125.2	109.3	122.5	98	153.6	213	1715.4
	%	105	84	83	105	91	79	93	76	90	60	91	109	89

TABLE 5 : TOTAL MONTHLY RAINFALL (MM) AND PERCENTAGE OF NORMAL RAINFALL

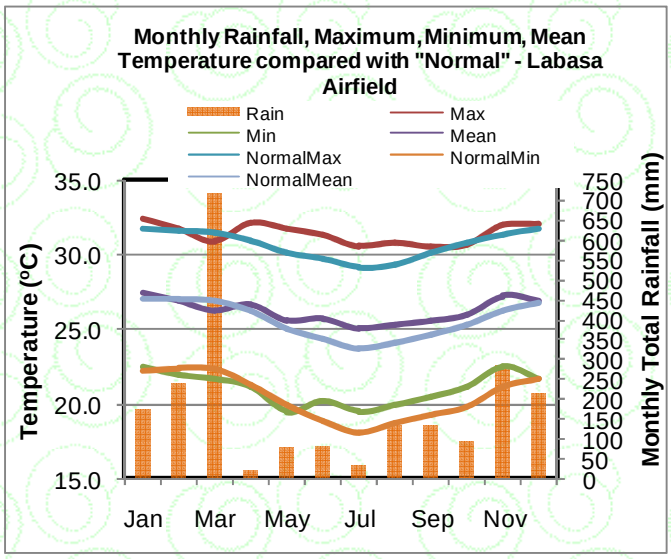
		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airfield	Actual (mm)	172.0	238.5	714.4	21.8	77.7	82.4	33.2	131.4	131.7	90.9	283.3	211.0	2188.3
	%	45	69	192	9	68	124	61	276	184	74	155	88	98
Savusavu Airfield	Actual (mm)	213.9	343.6	256.9	93.1	262.3	41.0	67.4	97.1	161.3	94.5	122.1	145.0	1898.2
	%	78	141	91	36	133	34	70	84	121	55	65	56	81
Penang Mill	Actual (mm)	311.4	462.4	414.2	289.6	139.5	102.6	61.5	30.9	37.2	124.9	115.1	253.4	2342.7
	%	79	138	97	108	86	103	111	42	39	109	72	96	96
Nadi Airport	Actual (mm)	87.9	464.8	341.7	104.1	116.5	124.9	6.3	10.7	159.3	118.7	239.2	257.6	2031.7
	%	26	159	100	65	130	195	14	17	228	117	181	144	108
Laucala Bay, Suva	Actual (mm)	188.5	434.5	444.4	240.3	143.7	140.9	238.3	155.4	173.7	248.3	155.3	449.2	3012.5
	%	51	164	119	66	53	86	176	98	98	113	63	162	100
Nausori Airport	Actual (mm)	347.7	588.1	402.6	232.4	132.2	229.5	284.5	149.3	140.8	290.4	113.6	312.9	3224.0
	%	95	220	105	64	53	152	244	102	85	149	46	117	111
Matuku Lau	Actual (mm)	83.4	445.8	440.2	104.3	48.5	114	182.0	85.4	61.6	149.4	167.7	305.1	2187.4
	%	29	193	145	45	26	90	160	66	45	105	115	166	99
Lakeba	Actual (mm)	123.0	340.8	503.0	109.4	52.5	78.8	188.4	148.2	111.3	145.6	100.9	358.2	2260.1
	%	51	151	172	53	39	98	234	145	110	118	71	200	118

APPENDIX

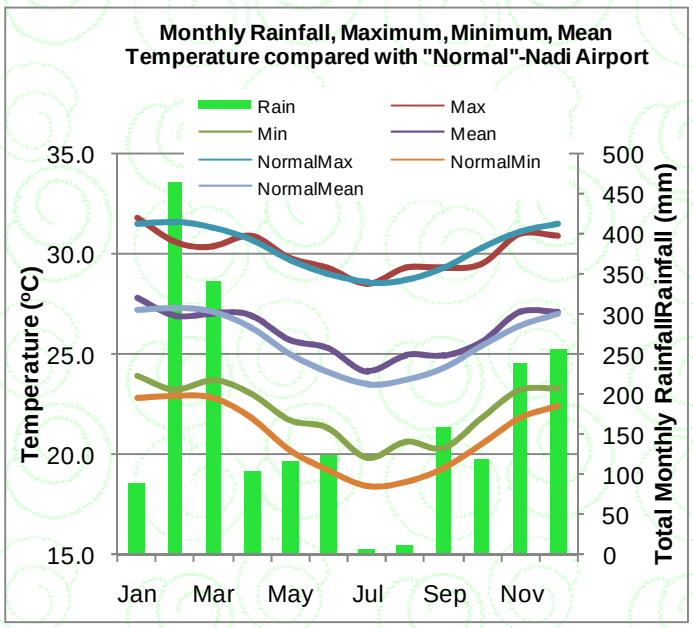
APPENDIX 1A : LAUCALA BAY, SUVA



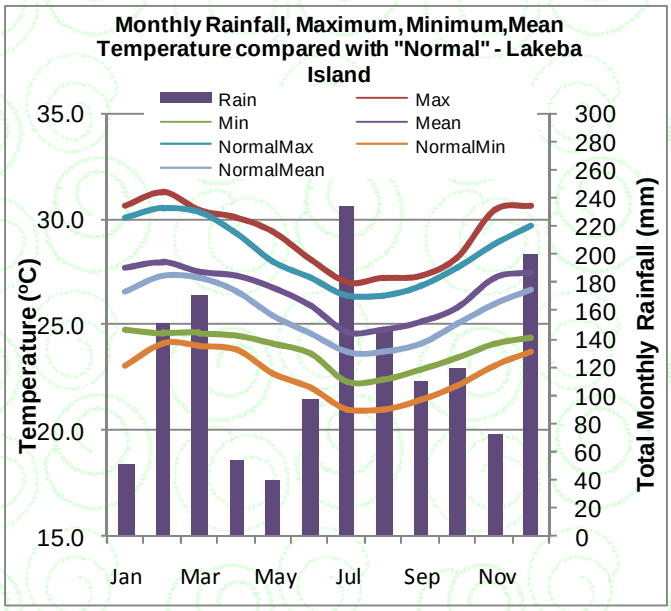
APPENDIX 1B : LABASA AIRFIELD



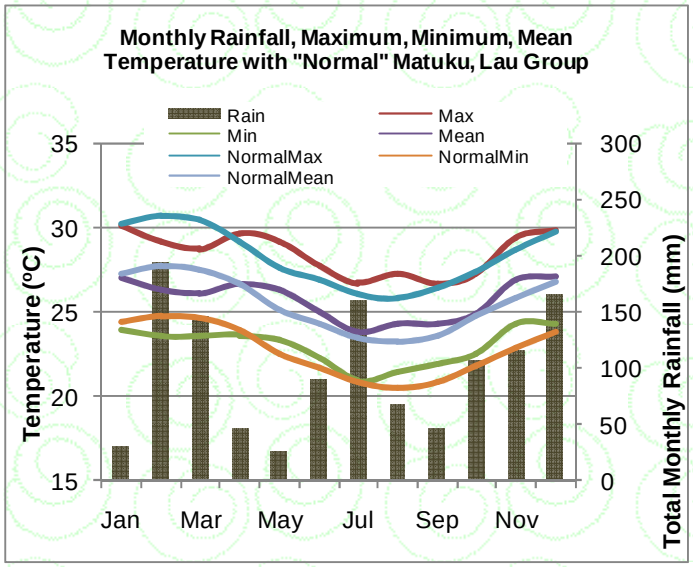
APPENDIX 1C : NADI AIRPORT



APPENDIX 1D : LAKEBA, LAU GROUP



APPENDIX 1E : MATUKU, LAU GROUP



APPENDIX 1F : ROTUMA