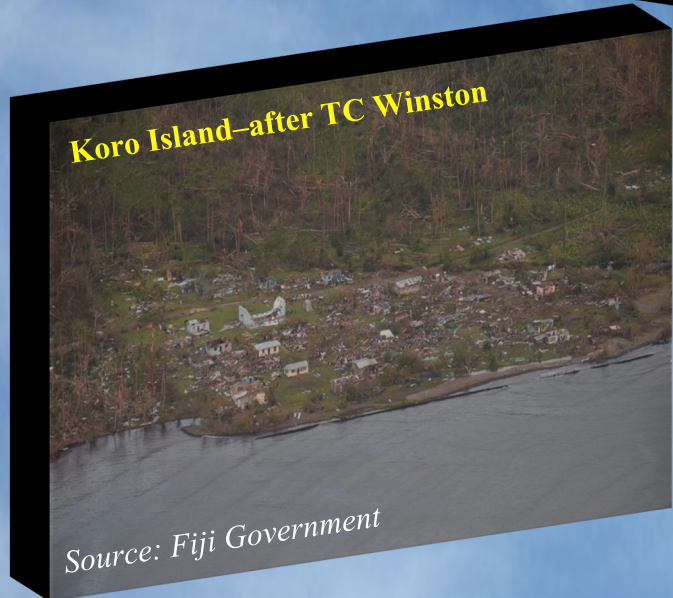
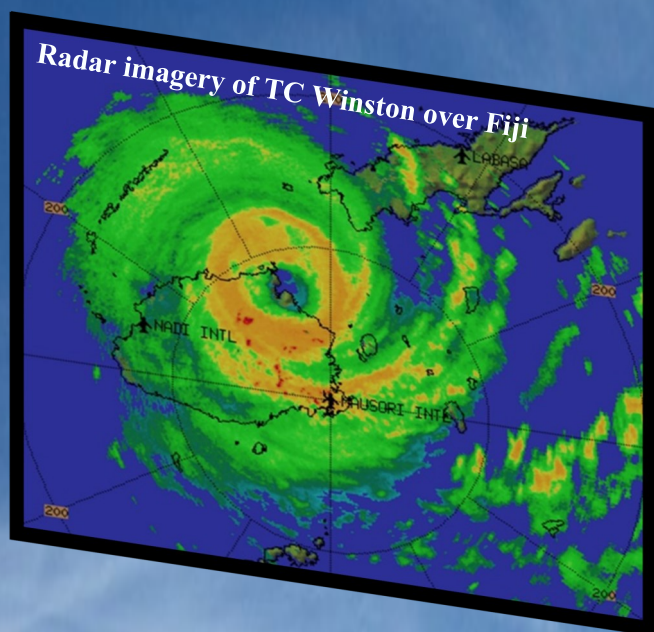


Fiji Annual Climate Summary 2016



Fiji Meteorological Service
Private Mail Bag NAP0351
Nadi Airport

www.met.gov.fj

Facebook Acc: Fiji Meteorological Service

Issued
September 20, 2017

HIGHLIGHTS OF 2016

In this issue

Highlights	2
Year in Review	3-4
ENSO	4
Rainfall	5
Mean Temperature	6
Maximum Temperature	6
Minimum Temperature	7
Sunshine	7
Wind Summary	8
Sea Level	8
New Records	9
Seasonal Forecast Verification	9-10
Tropical Cyclones	11-12
Tables	12-14

- The year began with one of the strongest El Niño's on record, which gradually dissipated and ENSO-neutral conditions returned by May 2016. While generally ENSO-neutral conditions persisted through the rest of the year, certain indicators of the ocean and atmosphere fluctuated in the range of a weak La Niña during the 2nd half of 2016.
- The year was marked by a number of very significant hydro-meteorological disasters, which included tropical cyclone (TC) Winston, the strongest ever TC to affect Fiji and also one of the strongest to occur in the Southern Hemisphere.
- TC Winston broke all previous national records of maximum sustained winds and gusts at a land based station in Fiji, with sustained winds of up to 125 knots and gusts of up to 165 knots recorded at Vanuabalavu on 20th February 2016.
- There were 44 fatalities during Winston, with the estimate of the disaster effects amounting to F\$1.99 billion (US\$0.9 billion) (Post Disaster Needs Assessment Report).
- During April 2016, two significant tropical depressions affected the country, TD14F and TD17F, resulting in major flooding in the Western and Northern Divisions, respectively.
- The year concluded with yet another disaster, with a tropical depression, TD04F, resulting in an overwhelming amount of rainfall over parts of the country during December 2016. Rakiraki town was severely flooded, with Rewa River also breaking its bank. Furthermore, a number of landslides were reported in various parts of the country as a result of prolonged heavy rainfall during the passage of TD04F.
- The national average rainfall during 2016 was 2380mm, which was 56mm above the long term average of 2324mm. This ranks 2016 as the 37th wettest year in 60 years of record.
- It was notably dry from May to July with some parts of the country facing dry spell and water shortages.
- The national average mean air temperature during the year was 26.0°C, which was 6th warmest year since 1959.
- The national average maximum air temperature during 2016 was 30.0°C, which ranked 3rd warmest year since 1959.
- The national average minimum air temperature during the year was 22.1°C, which ranked as 41st coolest year in 58 years of record.
- The sea surface temperatures were near normal in the Fiji region through most of the year.
- A total of 65 new climate extremes (17 rainfall, 45 temperature, 1 sunshine and 2 national wind records) were established during 2016. Majority of the temperature records were new high.
- The total bright sunshine hours were near normal at Nadi Airport, Laucala Bay and Koronivia during the year.
- Negative sea level anomalies persisted in the Fiji region throughout 2016.

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 as its "climatic normal".

YEAR IN REVIEW

January began with the presence of the tropical cyclone (TC) Ula. It passed through the southern Lau Group on the 3rd, with Ono-i-lau recording sustained winds of 51 knots and gusts of up to 74 knots. Other than the rainfall brought by TC Ula, it was significantly dry month, with more than half of the stations receiving less than 50% of the *normal* rainfall. Very hot conditions were experienced at a number of places with the maximum temperatures in the Yasawa and Mamanuca Groups quite noticeable. A new daily high maximum temperature for January was established at Yasawa-i-rara with 37.8°C on the 28th, while Viwa recorded a new daily high maximum temperature of 36.6°C on the 29th. Rotuma was also significantly dry, with only 22% of the *normal* rainfall received during the month.

TC Winston dominated **February**, which was the strongest ever TC to be recorded in Fiji's history and also one of the strongest to occur in the Southern Hemisphere. It entered Fiji Waters as a Category 5 cyclone on the morning of 20th, devastating the northern Lau and Lomaiviti Groups, before making a landfall on Viti Levu near Rakiraki in the afternoon. It exited the land near Ba after causing destruction to the Tailevu to Lautoka corridor. During the passage of Winston, Vanuabalavu recorded sustained winds of up to 125 knots and gusts of up to 165 knots. Tropical cyclone Winston also resulted in some substantial rainfall over the country. Nadarivatu recorded 479mm of rainfall over a 48-hour period between 20th and 21st, followed by Monasavu with 435mm on the same two days. There were 44 fatalities during Winston, with the estimate of the disaster effects amounting to F\$1.99 billion (US\$0.9 billion) (Post Disaster Needs Assessment Report). A number of high air temperature records were also established during the month. Rotuma's weather was largely influenced by the South Pacific Convergence Zone (SPCZ).

East to southeast winds dominated the weather during the 1st half of **March**, resulting in brief showers especially over the eastern half of the larger islands. An active trough of low pressure moved over the group on the 20th and heavy rain warning was issued. The trough cleared the country on the 22nd. During this rainfall episode, Nadi Airport recorded 148mm of rainfall on the 21st. Other than the rainfall produced by this trough of low pressure, it was considerably dry month with more than half of the stations registering less than 50% of the *normal* rainfall. Rotuma's weather was largely influenced by the SPCZ, producing some rain on most of the days.

April began with a tropical depression, TD14F, which resulted in torrential rainfall over parts of the country. Nadarivatu, Rarawai Mill and Nadi Airport recorded 535mm, 457mm and 443mm of rainfall over a 72-hour period between 3rd and 5th, respectively. Consequently, severe flooding was reported in some major towns of the western Viti Levu, which included Nadi, Ba, Tavua and Rakiraki. Tropical cyclone Zena also passed through the Fiji Waters during the 1st week, however, it did not have any significant direct effect on the land areas. Later during the middle of the month, another tropical depression, TD17F, resulted in significant rainfall over the Northern Division. Matei Airfield, Udu Point, and Savusavu Airfield recorded 415mm, 282mm and 165mm of rainfall between 15th and 16th, respectively. Severe floodings were reported in parts of the Vanua Levu. As a result of these two depressions, more than twice the *normal* rainfall was observed at over half of the monitoring stations during the month, with Nadi Airport and Ono-i-lau registering more than 3 times the *normal* rainfall. Rotuma's weather was largely influenced by an active SPCZ, producing rain on most of the days.

Following wetter than *normal* April, **May** was significantly dry with 17

out of the 26 monitoring stations recording less than half the *normal* rainfall. The dryness was particularly notable in the Northern Division with new low rainfall records for May established at Labasa Airport (0mm), Udu Point (17mm) and Matei Airfield (16mm). An intense high pressure system to the far south of Fiji resulted in heavy southerly swells during the 2nd last week on the month. As a result, there were reports of coastal flooding and inundation, in particular over Kadavu and parts of Coral Coast.

Apart from transient troughs of low pressure during the 1st half of the month, semi-permanent high pressure systems and broad southeast Trade winds dominated the weather during **June**. The most significant rainfall producing system affected the country between 9th and 10th, with Nadarivatu registering 121mm of rainfall on the 9th. Cool southerly winds coupled with cloudless nights resulted in very cool nights on occasions, especially between 12th to 14th and then later on the 29th. Nacocolevu recorded night-time temperatures as low as 12.5°C on the 29th, followed by Monasavu with 13.0°C on the 13th. The SPCZ and the southeast Trade winds resulted in showers over Rotuma on most of the days.

The trend of dry conditions continued during **July** with majority of the stations receiving *below average* to *well below average* rainfall. Fourteen out of the 26 stations recorded less than half of the *normal* rainfall. The dryness was particularly notable over the Western Division and northern parts of Vanua Levu with extended periods of without any rainfall. Cool southerly winds coupled with cloudless nights caused night-time temperatures to drop over most parts of the country between 18th and 20th. Nadarivatu recorded 10.1°C on the 18th, followed by Keiyasi with 11.1°C on the 20th. A frontal system brought some relieving rainfall over the Western Division and northern parts of Vanua Levu towards the end of the month. Similar to other parts of the country, Rotuma also experienced significantly dry conditions during the month with only 30% of the *normal* rainfall received.

It was considerably wetter than usual **August** with welcoming rainfall received over many parts of the country that were experiencing very dry conditions from May 2016. Majority (18 out of the 26) of the stations received twice the *normal* rainfall, 5 recorded more than thrice and 4 stations recorded more than four times the *normal*. There were two major rainfall episodes during the month. A slow moving trough of low pressure resulted in rainfall throughout the country between 6th and 9th. Doboilevu recorded a total of 278mm in these 4 days, which was pretty unusual for this time of the year. Another slow moving trough of low pressure resulted in widespread rainfall from 16th to the 19th. During this rainfall event, Monasavu recorded a total of 107mm. Rotuma recorded wet conditions from the 10th to the 21st as a result of a slow moving trough of low pressure, with 126mm of rainfall received on the 17th.

The SPCZ in **September** was weaker than *normal* and displaced to the north of its climatological position. Consequently, suppressed rainfall was received across the country with 24 out of the 25 stations recording less than half the *normal* rainfall. Notably, a new low rainfall record (0mm) for September was established at Nacocolevu and Levuka since the observations began in 1926 and 1984, respectively. Cool southerly wind flow together with the minimal cloud cover resulted in significantly cold nights on occasions with Monasavu recording an overnight minimum of 13.0°C on the 22nd. SPCZ and a trough of low pressure brought significant rainfall at Rotuma during the month resulting in *above average* rainfall.

October was generally wetter than *normal* with majority of the sites experiencing *above average* to *well above average* rainfall. There were two episodes of notable rainfall across the country. A low pressure embedded along the trough coupled with active rain bands lead to heavy rain and strong winds over Fiji from 9th to 11th. Many stations recorded significant rainfall during this period with Ono-i-lau registering the highest 24-hour rainfall of 121mm on the 10th. Towards end of the month between 30th and 31st, another major rainfall episode was experienced across the country when many stations recorded more than 50mm of rainfall over a 24-hour period. Rotuma experienced *above average* rainfall during the month due to active SPCZ.

Drier than *normal* conditions returned during **November** following a wet October with almost half of the stations (12 out of the 25) receiving less than 50% of the *normal* rainfall. Exceptionally hot and humid conditions were recorded on certain occasions, with maximum temperatures reaching above 33°C at some of the stations, especially during the second half of the month. Levuka recorded daily maximum temper-

ature as high as 37.1°C on the 26th, followed by Yaqara with 36.2°C on the 24th. Rotuma's weather was influenced by SPCZ and moist easterly wind flow.

Tropical depression, TD04F, was the most significant weather feature during **December**. The trough of low pressure and active rain bands associated with TD04F, enhanced by moist easterly wind flow, caused an overwhelming amount of rainfall in parts of the country from the 12th to the 20th. Rakiraki town was severely flooded during this period, with Rewa River also breaking its bank. A number of landslides were reported resulting from prolonged heavy rainfall in various parts of the country. As a result of TD04F, record high total monthly rainfall for December was established at Koronivia, Nausori Airport, Laucala Bay, Navua and Viwa. Furthermore, a new daily high rainfall for December was set at Matei Airfield and Nabouwalu on the 17th. Active SPCZ together with the southeast wind and TD04F resulted in rain at Rotuma on most of the days.

LARGE SCALE DRIVERS OF CLIMATE

The year began with one of the three strongest El Niño's on record. The other two are the 1997-98 and 1982-83 events. However, the ENSO conditions gradually weakened and reached neutral levels in May 2016.

Situation changed during the 2nd half of the year with the oceanic conditions in the equatorial Pacific Ocean transitioning towards a weak La Niña like state. However, the overlying atmosphere did not reinforce the oceanic changes and as such, a fully developed La Niña event did not eventuate and neutral conditions persisted until the end of the year.

The 2015-16 El Niño event continued to have an impact on Fiji until July 2016 with *below average* to *well below average* rainfall received at majority of the places during this period. The exceptions to this were February and April, when tropical cyclone Winston and tropical depressions, TD14F and TD17F, resulted in substantial rainfall across the country.

Globally, the strong El Niño conditions at the beginning of the year together with the anthropogenic influence on the climate system contributed to yet another record breaking global average temperature, following the record of 2015.

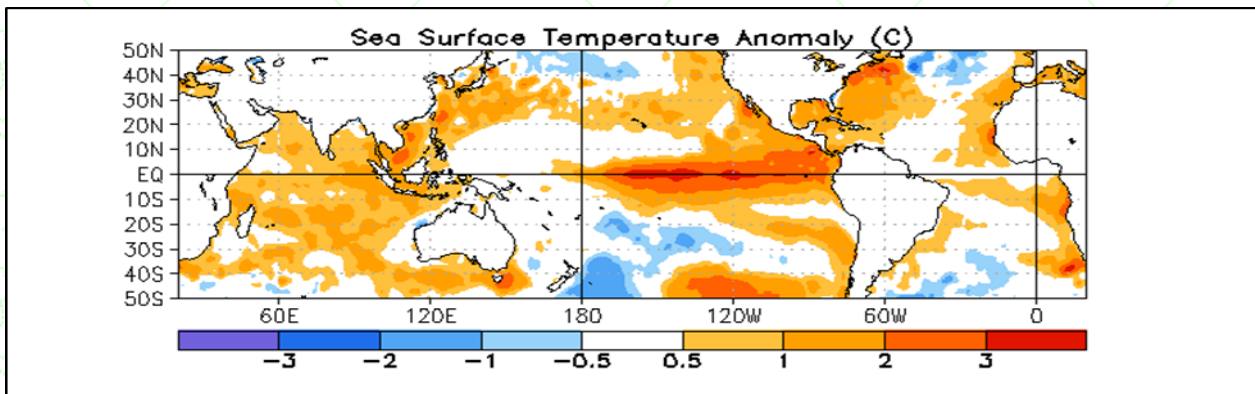


Figure 1: Sea surface temperature anomalies during January 2016. Strong El Niño conditions were present at the beginning of the year with SSTs more than 2°C warmer than normal in the central and eastern equatorial Pacific. Source: NOAA-USA.

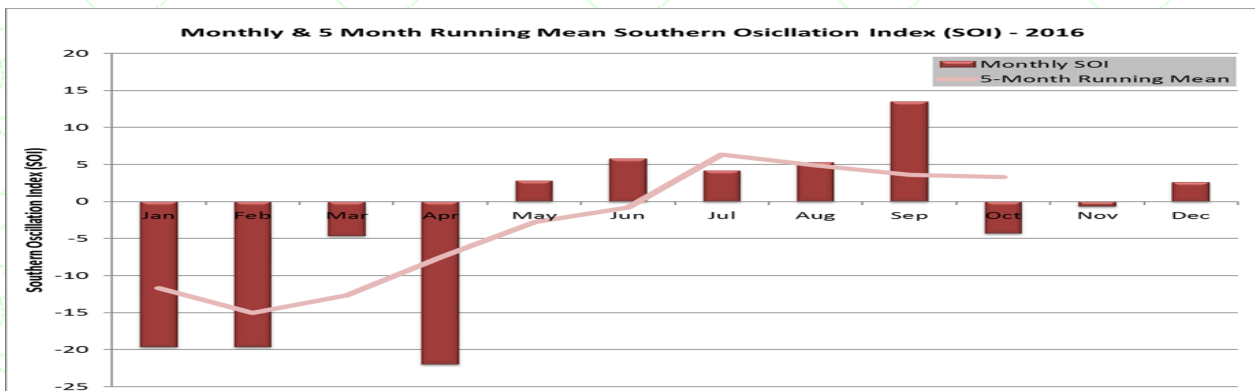


Figure 2: Southern Oscillation Index is one of the indicators of the persistence of El Niño or La Niña conditions, with sustained negative values of the SOI below -7 typically indicating El Niño and above +7 signifying La Niña. Sustained negative values of SOI persisted at the beginning of the year, with generally neutral values during the second half of 2016. Data Source: Bureau of Meteorology and Graphic by FMS.

RAINFALL DURING 2016

Rainfall during the year was *near normal* over most parts of the country. Out of the 21 rainfall monitoring sites, 18 received *average* rainfall and 3 *above average* (Figure 2a). However, rainfall varied through the year with very wet conditions experienced in some of the months, while it was significantly drier than *normal* in other months. It was notably dry from May to July with the Western & Northern Division facing water issues. On the other hand, Tropical cyclone Winston in February, TD14F and TD17F in April, and TD04F in December brought some very heavy rainfall events over the country, resulting in severe flooding.

The national average rainfall during 2016 was 2380mm, which was 56mm above the long term average of 2324mm. This ranks 2016 as the 37th wettest year in 60 years of record (Figure 2b).

The wettest location during the year was Monasavu with 6003mm of rainfall, followed by Nadarivatu with 5104mm, Tokotoko with 3358mm and Nausori Airport with 3177mm. On the other hand, the driest was Yaqara with 1481mm of rainfall, followed by Momi with 1495mm, Lakeba with 1598mm and Matuku with 1786mm.

A number of very significant rainfall producing systems affected the country through the year. During the passage of tropical cyclone Winston, Nadarivatu registered 358mm of rainfall over a 24-hour period on the February 20th, followed by Monasavu with 308mm on the same day. Then during the 1st week of April, a tropical depression, TD14F, resulted in torrential rainfall over the country when Nadarivatu and Vatukoula recorded 296mm and 247mm of rainfall, respectively, on the 3rd. Later during the same month, TD17F resulted in some significant rainfall over the country with Matei Airfield recording highest 1 day rainfall of rainfall of 357mm on the February 16th. As we approached the end of the year, yet another tropical depression, TD04F, produced very heavy rainfall over parts of the country. Over the 24-hour period, Monasavu recorded 287mm of rainfall on the December 17th, followed by Waimanu with 283mm on the December 15th.

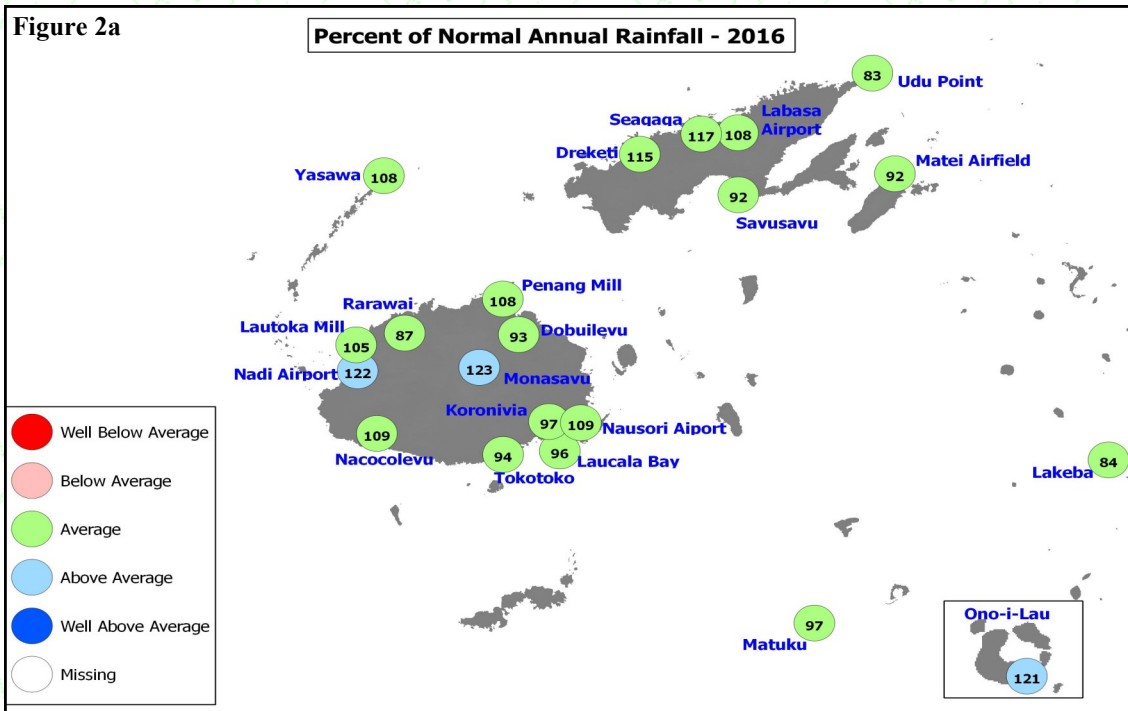


Figure 2(a): Percent of normal annual rainfall during 2016. Most of the stations registered normal rainfall.

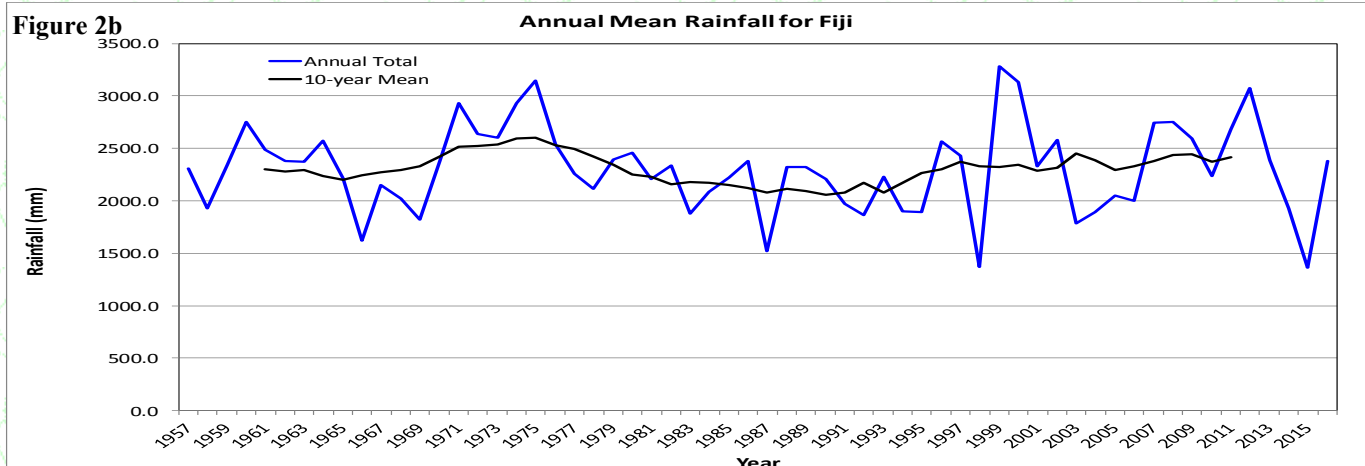


Figure 2(b): Time series of annual and 10 year mean rainfall for Fiji.

MEAN AIR TEMPERATURE

The national average mean annual air temperature during 2016 was 26.0°C, which was 0.5°C warmer than the *normal*. This ranked the year 6th warmest since 1959. The year 2007 still ranks as the warmest on record, followed by 2010. Nationally, positive mean air temperature departures from the *normal* were recorded throughout the year, with the most significant anomaly of +1.3°C recorded in February, followed by +0.8 in January, March and October.

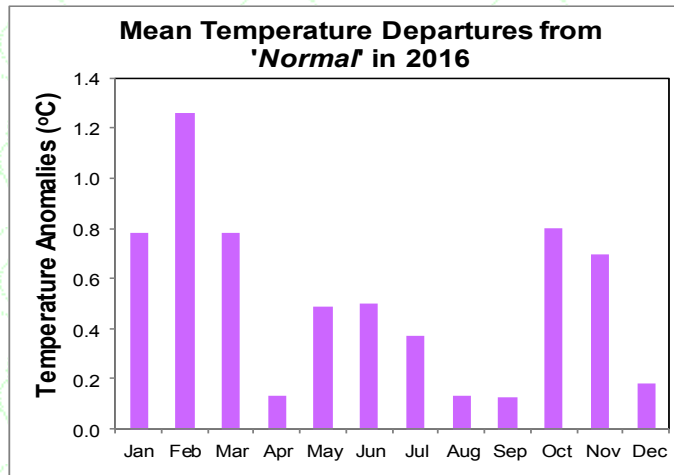


Figure 3: National average mean monthly air temperature departures from the normal during 2016.

The mean annual air temperature at **Nadi Airport (Western Division)** was 26.1°C, which was 0.6°C warmer than the *normal*. On the monthly timescale, *normal to above normal* anomalies were recorded at the station, with the highest positive departure recorded in Febru-

MAXIMUM AIR TEMPERATURE

The national annual average daytime (maximum) air temperature during the year was 30.0°C, which was 0.6°C above *normal*. This ranks 2016 maximum air temperature as 3rd warmest year since 1959. The year 1998 still ranks warmest on record, followed by 2007. Nationally, *above normal* mean monthly temperatures were recorded during most of the months, with the most significant anomaly of +1.3°C recorded in February, followed by +1.0°C in June, +0.9°C in May and November, and +0.8°C in January and July (Figure 4).

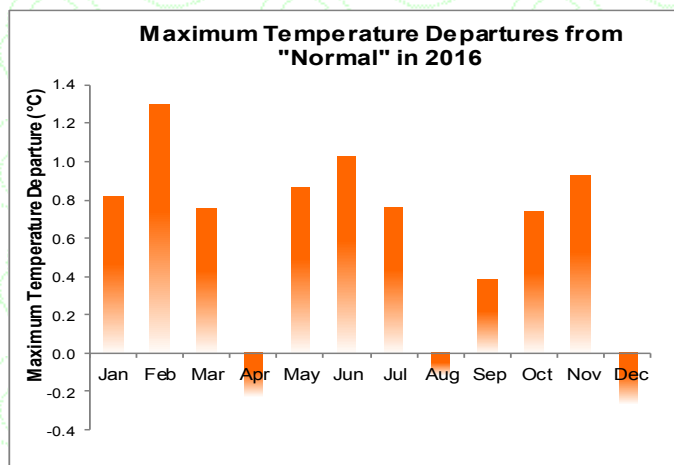


Figure 4: National average mean monthly maximum air temperature departures from the normal during 2016.

ary (+1.6°C). The rest of the months recorded anomalies between +0.9°C and +0.1°C.

At **Laucala Bay (Suva) (Central Division)**, the mean annual air temperature was 26.5°C, which was 0.8°C warmer than the *normal*. The mean monthly air temperatures were *normal to above normal* during the year, with significant positive anomaly of +1.6°C recorded in February, followed by +1.3°C in November, +1.1°C in January and +1.0°C in both March and May.

The annual mean air temperature at **Labasa Airport (Northern Division)** was 25.7°C, which was 0.1°C warmer than the *normal*. Generally, *normal* anomalies ($\pm 0.5^\circ\text{C}$) from the mean monthly air temperatures were registered during most of the months. However, the most significant positive anomaly of +0.7°C was recorded in October, while December registered the most significant negative anomaly of -0.7°C.

At **Matuku (Lau Group) (Eastern Division)**, the annual mean air temperature was 25.5°C, which was 0.1°C warmer than the *normal*. The station recorded *normal* ($\pm 0.5^\circ\text{C}$) temperatures during 8 of the 12 calendar months, while *above normal* temperatures were recorded during June (+0.7°C), January (+0.6°C) and November (+0.5°C) and *below normal* recorded during April (-0.7°C) and September (-0.6°C).

There were 15 new daily high maximum temperature records established during the year, while 1 new low daily maximum temperature record was set. Additionally, 14 new high mean monthly temperature records were observed during 2016. February alone had five new high daily and seven new high mean monthly maximum temperature records (Table 2).

At **Nadi Airport (Western Division)**, the annual average daytime temperature was 30.4°C, which was 0.3°C warmer than the *normal*. The monthly temperatures ranged from 27.7°C to 32.8°C. Significant positive anomaly of +1.2°C was recorded in February, followed by +0.6°C in April and June, and +0.5°C in March. On the other hand, notable negative anomaly of -1.0°C was recorded in August, while *normal* ($\pm 0.5^\circ\text{C}$) anomalies were recorded during the rest of the months (Table 3).

The annual average daytime temperature at **Laucala Bay (Suva) (Central Division)** was 29.3°C, which was 0.3°C warmer than the *normal*. The monthly temperatures ranged from 26.1°C to 32.7°C. *Above normal* mean maximum temperatures were recorded during January, February, June, October and November, with the greatest anomaly of +1.5°C registered in February. The greatest negative departure from *normal* was recorded in April and August with both deviating by -0.6°C, while the rest of the months had anomalies within $\pm 0.5^\circ\text{C}$ (Table 3).

The annual daytime temperature at **Labasa Airport (Northern Division)** was 31.9°C, which was 1.2°C warmer than the *normal*. The mean monthly temperatures ranged from 30.6°C to 33.0°C, with the highest of 33.0°C recorded in February. Generally *above normal* mean monthly maximum temperatures were recorded during the year. Notable significant positive departures from *normal* were recorded in July (+2.3°C), followed by June (+2.2°C), May (+1.7°C), February (+1.4°C), March (+1.3°C), October (+1.3°C), August (+1.2°C) and September (+1.1°C). December was the lone month to record a negative anomaly (Table 3).

At **Matuku (Lau Group) (Eastern Division)**, the annual average daytime temperature was 28.8°C, which was 0.5°C warmer than the *normal*. The mean monthly temperatures ranged from 25.7°C to 31.6°C. Temperatures were *above normal* during most of the months, with notable significant positive departures from the *normal* recorded in June (+1.7°C), May (+1.6°C), January (+1.4°C) and November (+1.0°C). There was no notable negative mean monthly maximum temperature departure from the *normal* (Table 3).

MINIMUM AIR TEMPERATURE

The national average annual night-time (minimum) air temperature was 22.1°C, which was 0.5°C warmer than the *normal*. This ranks 2016 as 41st coolest year in 58 years of record. The year 1978 still ranks coolest on record, followed by 1965. Nationally, *normal* to *above normal* mean monthly minimum temperature departures from the *normal* were recorded throughout the year, with the most significant anomaly of +1.2°C registered in February, followed by +0.9°C in October and +0.8°C in January and March (Figure 5).

try. February alone registered 2 daily high minimum temperature and 7 new high mean monthly minimum temperature records (Table 2).

At **Nadi Airport (Western Division)**, the annual average night-time temperature was 21.9°C, which was 1.0°C *above normal*. Significant positive mean monthly minimum temperature anomalies from the *normal* was recorded in February with +1.9°C, followed by August with +1.3°C, April, October and December with all +1.2°C, and January and March with both +1.1°C (Table 4).

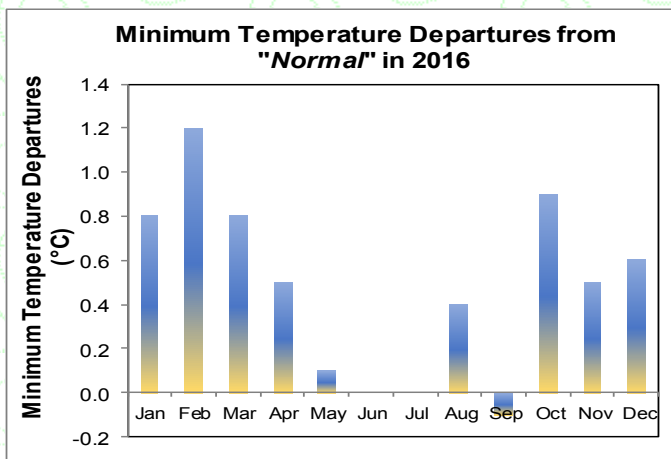


Figure 5: National average mean monthly minimum temperature departures from the *normal* during 2016.

The annual average night-time temperature at **Laucala Bay (Suva) (Central Division)** was 23.7°C, which was 1.2°C warmer than the *normal*. A number of months recorded significant positive mean monthly minimum temperature departures from the *normal*, with the highest of +1.7°C registered in February and May, +1.6°C in March, +1.5°C in April, +1.4°C in January and November, +1.3°C in October and +1.2°C in December (Table 4).

Labasa Airport's (Northern Division) annual average night-time temperature was 19.5°C, which was 1.0°C *below normal*. Significant negative mean monthly minimum temperature anomalies from the *normal* were recorded in June (-2.1°C), July (-1.9°C), September (-1.8°C), August (-1.4°C), and May and November (-1.2°C) (Table 4).

There were 6 new daily high minimum temperature records registered during the year, with 1 daily low record. Furthermore, 10 new high mean monthly temperature records were established across the coun-

The annual average night-time temperature at **Matuku (Lau Group) (Eastern Division)** was 22.3°C, which was 0.4°C *below normal*. Significant negative mean monthly minimum temperature anomalies were recorded in September (-1.5°C), followed by May (-1.2°C) and July (-1.0°C) (Table 4).

BRIGHT SUNSHINE HOURS

The annual total bright sunshine was *near normal* (within 10% of annual *normal*) at Nadi Airport, Laucala Bay and Koronivia. Of the three stations, Nadi Airport was the sunniest in 2016, recording 2661 hours of sunshine, followed by Laucala Bay with 1959 hours and Koronivia with 1685 hours (Table 1).

below *normal* sunshine hours. The sunniest month was November (261 hours), while August recorded the least hours of sunshine (156 hours).

Nadi Airport registered 104% of the *normal* bright sunshine hours during the year. A total of 6 out of the 12 months recorded *above normal* sunshine hours, with the greatest deviation from *normal* observed in February (120%). In contrast, August and December experienced

The annual total bright sunshine at Laucala Bay was 102% of the *normal*. The station recorded *above normal* bright sunshine hours in January, May to July period and November. On the other hand, *below normal* sunshine hours were registered in April, August, October and December. The highest total bright sunshine hours was recorded in January (237 hours), while the lowest was in April (89 hours).

Table 1: Total bright sunshine hours during 2016

Location	Sunshine (hours)	% of Normal	Comments
Nadi Airport	2661	104	Near normal
Laucala Bay	1959	102	Near normal
Koronivia	1685	96	Near normal

WIND ROSE AT SELECTED AUTOMATIC WEATHER STATIONS

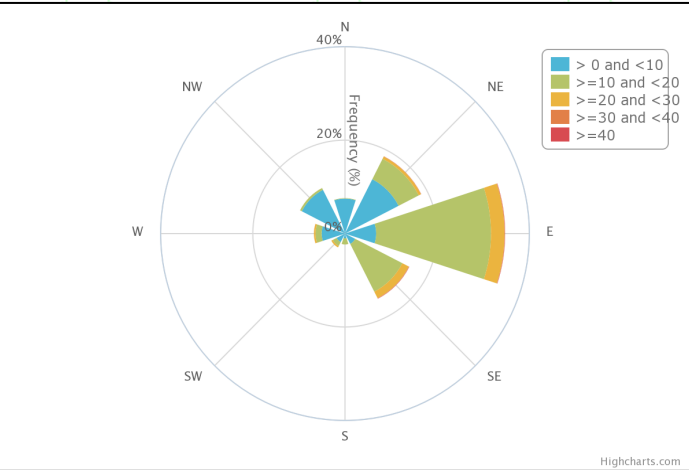
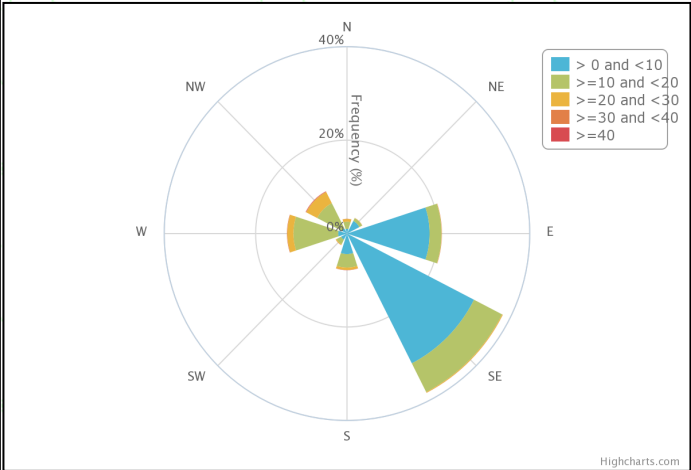


Figure 6(a): Wind rose for Nadi Airport based on 10 minutes interval data. Wind speed: km/hr.

Figure 6(b): Wind rose for Tokotoko, Navua based on 10 minutes interval data. Wind speed: km/hr.

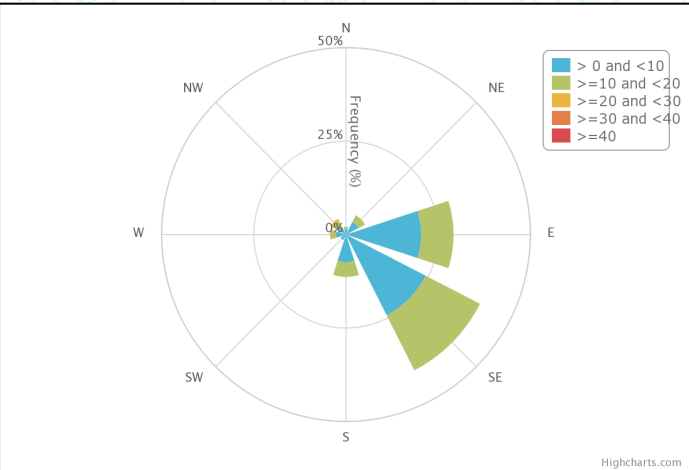
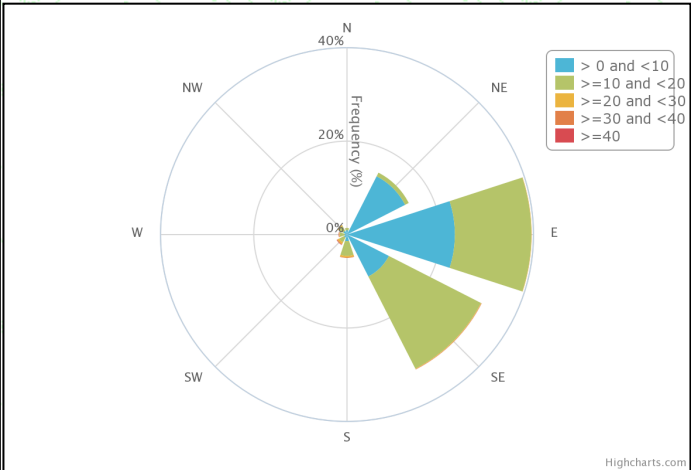


Figure 6(c): Wind rose for Lakeba based on 10 minutes interval data. Wind speed: km/hr.

Figure 6(d): Wind rose for Rotuma based on 10 minutes interval data. Wind speed: km/hr.

SEA LEVEL IN 2016

The sea level trend at the Lautoka SEAFRAME station for the period 1993 to 2016 show an increasing trend of +4.1mm/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, sea level rise are being observed across the region (Figure 7).

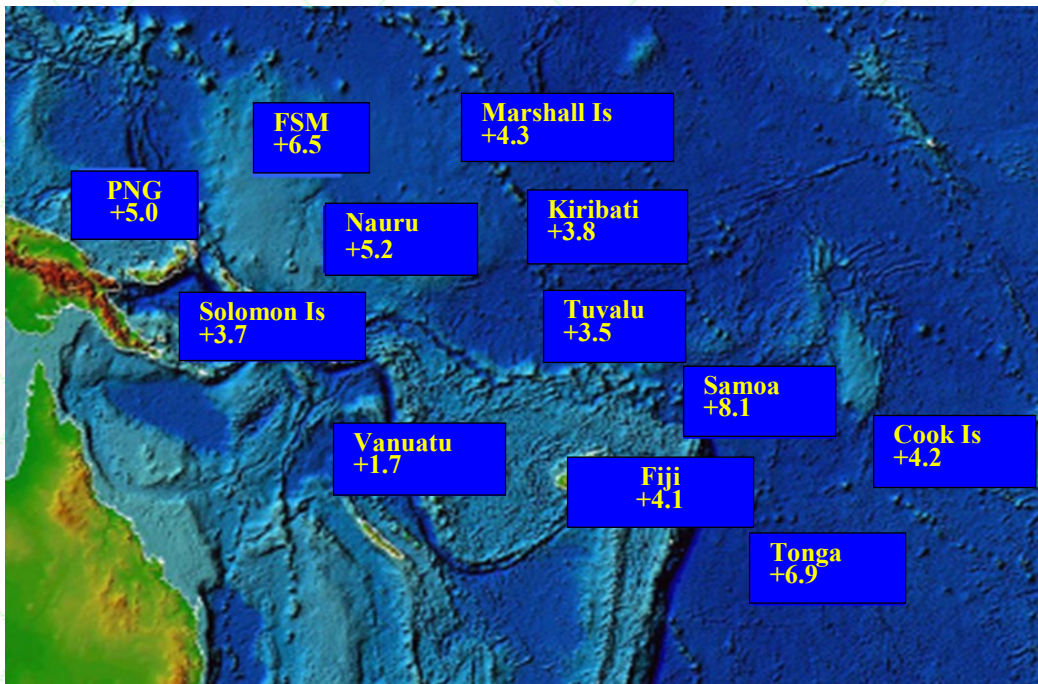


Figure 7: Sea level trends (mm/yr) in the Pacific Island region.

NEW RECORDS

A total of 65 new climate extremes were established during 2016. In contrast, there were 46 and 56 new records established during 2015 and 2014, respectively. Out of these 65 new records, 45 were for temperature, 17 for rainfall, 1 for sunshine and 2 national wind records. The highest number of records were established during February, with 23 records.

There were 24 new daily records set during 2016, of which 21 were for temperature and 3 rainfall. A total of 16 extreme daily maximum temperature records were established, with 14 records being new high and 1 new low. For the extreme daily minimum temperature, there were 5 new records, with 4 being new high and 1 new low. Three new high daily maximum rainfall records were established.

Thirty-nine new monthly records were established during 2016, of which 14 were for mean maximum temperature, 10 for mean minimum temperature, 14 for total monthly rainfall and 1 for total monthly sunshine hours. It is noted that all monthly mean temperature records were for new high (Table 1).

In addition to the above, national maximum sustained wind and gust records were established at Vanuabalavu during the passage of TC Winston, with 10-minute average wind of 125 knots and gust of 165 knots recorded on 20th February 2016.

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Daily Rainfall	-	-	-	1	-	-	-	-	-	-	-	2	3
Daily Maximum Temperature	2	5	2	-	1	-	-	-	3	-	2	1	16
Daily Minimum Temperature	1	2	-	-	1	-	-	1	-	-	-	-	5
Monthly Total Rainfall	2	-	-	-	3	-	-	-	2	-	-	7	14
Mean Monthly Max Temperature	1	7	1	-	-	1	2	-	-	-	2	-	14
Mean Monthly Min Temperature	-	7	1	-	-	-	1	-	-	-	1	-	10
Total Monthly Sunshine	-	-	-	-	1	-	-	-	-	-	-	-	1
National maximum 10 minutes average wind	-	1	-	-	-	-	-	-	-	-	-	-	1
National maximum wind gust	-	1	-	-	-	-	-	-	-	-	-	-	1
Total	6	23	4	1	6	1	3	1	5	-	5	10	65

Table 2: Summary of new climate records established during 2016.

TOPICAL CYCLONE SEASONAL OUTLOOK 2015-16 VERIFICATION

Fiji Meteorological Service in its 2015/16 Seasonal Tropical Cyclone Outlook predicted for an **above average** number of tropical cyclones for the 2015–16 season, with ten to fourteen (10-14) named tropical cyclones to occur within the Regional Specialised Meteorological Centre Nadi - Topical Cyclone Centre (RSMC Nadi-TCC) Area of Responsibility (AoR) (Equator to 25°S, between 160°E and 120°W) compared to an average of 6-8. Four to eight (4-8) of these tropical cyclones were expected to intensify into category 3 severe tropical cyclones, while 3-7 were predicted to intensify into Category 4 or 5 severe tropical cyclones. The tropical cyclone genesis trough was expected to be displaced far eastwards of its long term average position. This was based on the expected and predicted ENSO conditions, and the existence of the Pacific warm pool of sub-surface temperature anomalies in this region.

During 2015/16 tropical cyclone season, 18 systems developed but only 8 managed to advance to a tropical cyclone stage, while rest of the systems remained in either tropical disturbance or tropical depression stage. The 8 named tropical cyclones that traversed RSMC Nadi's AoR were namely; Tuni, Ula, Victor, Winston, Tatiana, Yalo, Zena and Amos (Figure 9).

Over all, TC Tuni and Yalo managed to reach maximum intensity of Category 1 cyclone, TC Tatiana reached maximum intensity of Category 2, TC Victor, Zena and Amos reached Category 3, TC Ula attained maximum intensity of Category 4 while TC Winston attained maximum intensity of Category 5.

SEASONAL CLIMATE FORECAST VERIFICATION

Fiji Meteorological Service used data from twenty-six (26) sites around the country to monitor the climate of Fiji in 2016. The national, divisional and locality forecasts were issued seasonally (3-month periods) and verified for individual location. Overall, 33% of the forecasts were consistent or had the total observed rainfall in the predicted category, 29% near-consistent forecasts, 26% inconsistent forecasts and 12% of the forecasts could not be verified (due to missing observations).

The results for consistent, near-consistent and inconsistent forecasts for each station are presented in Figure 8. There were high success rates in the seasonal predictions for the Central Division (50%), followed by the Eastern Division (37%), Western (32%), and Northern Division (24%).

The overall assessment of the model performance in 2016 is rated as average compared to the total variance explained by the predictor (SSTs) 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 of climatologists.

In total, three hundred and twelve (312) individual seasonal climate predictions were issued. Of these, one hundred and two (102) forecasts were consistent, ninety-one (91) near-consistent and eighty-two (82) inconsistent, while thirty-seven (37) forecasts could not be verified due to unavailability of the data or missing records.

During the wet season, there were 40% consistent forecasts, 22%

near-consistent, 23% inconsistent and 15% unverified forecasts. Similarly, during the dry season, 26% of the forecasts were consistent, 37% near-consistent, 29% inconsistent and 8% unverified forecasts.

In the **Western Division**, 32% of the forecasts were consistent, 26% near-consistent, 31% inconsistent and 11% unverified forecasts. The wet season had a higher consistency rate (39%) compared to the dry season (26%).

In the **Central Division**, there were 50% consistent forecasts, 33% near-consistent and 17% inconsistent. For Central Division, there was high consistency in the wet season prediction (67%) compared to the dry season prediction (33%).

For the **Eastern Division**, 37% of forecasts were consistent, 33% near-consistent, 20% inconsistent and 10% unverified forecasts. The Eastern Division had higher consistency rate during wet season (47%) compared to dry season (27%).

In the **Northern Division**, 24% of forecasts were consistent, 27% near-consistent, 30% inconsistent and 19% unverified forecasts. The Northern Division has higher consistency rate in the wet season (26%) compared to dry season (21%).

For **Rotuma**, only 8% of the forecasts were consistent, 34% near-consistent, 33% inconsistent and 25% of the forecasts could not be verified.

Percent of Consistent/Near-Consistent/Inconsistent Forecasts in 2016

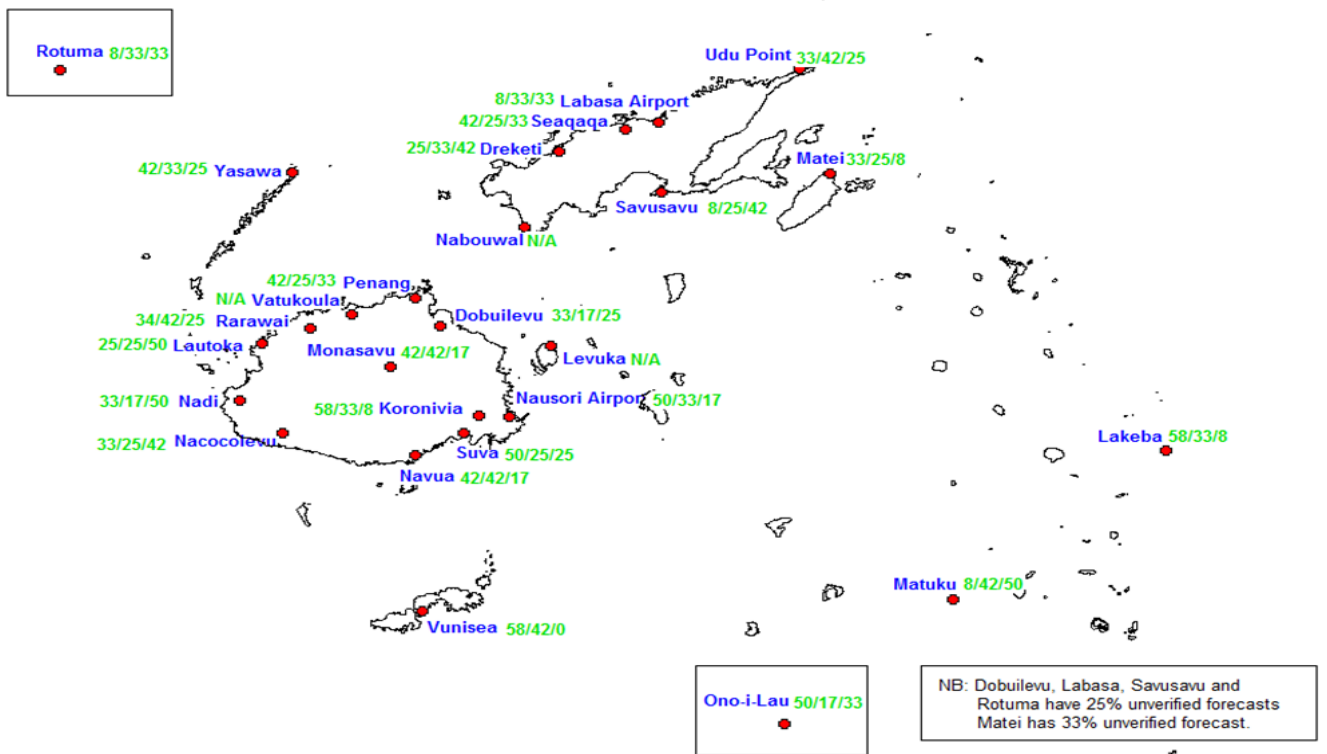


Figure 8: Percentage of consistent /near-consistent and inconsistent forecasts at individual locations in 2016.

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 CYCLONE ACTIVITY IN THE SOUTHWEST PACIFIC REGION DURING 2016

Severe Tropical Cyclone (TC) **Ula** was the first cyclone that formed in 2016 and the second cyclone to be named by Regional Specialised Meteorological Centre Nadi (RSMC-Nadi) for the 2015-16 season. It attained TC status at 0700UTC on 30/12/15 and was subsequently named "Ula" when it was approximately 530km east-northeast of Apia. At midday on 31/12/2015, Ula intensified further into Storm force intensity and at 1500UTC on 31/12/2015, Ula attained Hurricane force intensity. The system passed just 40km north of Vava'u at around 1600UTC on 01/01/16. Vava'u reported sustained winds of 52 knots and gusts of 82 knots from 1800UTC to 1900UTC on 01/01/16.

At 1800UTC on 02/01/16, Ula was analysed approximately 200km north-northeast of Ono-i-Lau as a Category 3 TC. It eventually passed over Ogea and Vatoa Island in the Lau Group. At 0000UTC, it rapidly weakened into a Category 2 system and 12 hours later it was degraded into a Category 1 system. Overnight of 07/01/16, Ula was showing signs of re-intensification and by 1800UTC on 07/01/16 it had attained Category 2 status once again. At 1800UTC on 18/01/16, it had re-attained Hurricane force intensity with 70 knots winds close to its centre. By 1500UTC on 09/01/16, it intensified further into a Category 4 system. And attained maximum winds of 100 knots for a 21-hour period from 2100UTC on 09/01/16 to 1800UTC on 10/01/16. Thereafter, Ula moved south-southwest and moved out of RSMC-Nadi Area of Responsibility (AoR) by 1200UTC on 11/01/16.

Severe TC **Victor** was first analysed as a low pressure system on 11/01/16. It continued to strengthen and was named as TC "Victor" at 0600UTC on 15/01/16. At this stage, it was 500km to the east of Pagopago. At 1800UTC on 15/01/16, it had intensified into Category 3 system with maximum winds of 65 knots close to the centre. As it moved south over open waters, it continued to intensify and reached maximum winds of 80 knots winds at 1800UTC on 18/01/16. It started to weaken, and by 1200UTC on 21/01/16, it had lost its TC characteristics and was eventually declassified.

TC **Tatiana** was named on the afternoon of 11/02/16. It strengthened further into a Category 2 cyclone and turned southeast. It eventually moved into RSMC-Nadi AoR at around 1100UTC. Tatiana turned south in the early hours of 13/02/16 and maintained its strength as a Category 2 TC. It weakened rapidly overnight on 13/02/16 and was downgraded to a Category 1 TC, and finally declassified into an ex-TC at around 1700UTC on 14/02/16.

TC **Winston** started as a tropical disturbance, TD09F, to the far northwest of Fiji. It continued to intensify and later on 11/02/16, it was upgraded to a TC. On the morning of 15/02/16, when located to the far south of Fiji, TC Winston took a northeast turn and started moving towards the Southern Lau Group. Winston entered Southern Lau Waters as a Category 2 TC on the evening of 15/02/16 and exited around midday on the 16/02/16 towards Tonga. Gale to Storm force winds affected southern Lau Group during this period. On the morning of 18/02/16, Winston, a Category 4 system by then, located to the northwest of Niue, took a westerly turn and started moving towards the Fiji Group. Winston further intensified into a Category 5 system on the evening of the 19/02/16.

It entered the Northern Lau Waters with very destructive hurricane force winds and heavy rain in the early hours of 20/02/16. The centre passed very close to Vanuabalavu at about 6am, with maximum

sustained winds of 125 knots and momentary gusts to 165 knots. Winston continued to move in a westerly direction at about 15 knots and the centre passed over the southern part of Taveuni at around midday. Winston slightly changed its direction to west-southwest after passing Taveuni, transiting very close to Koro Island at around 2pm.

It continued to move in the west-southwest direction and maintained the speed of about 15 knots, made landfall on the northeast coast of Viti Levu at about 7pm. TC Winston exited Viti Levu between Ba and Lautoka at around 9.30pm and took a westerly direction and passed very close to Viwa island at around 11pm and was out of Fiji Waters by 3am on 21/02/16.

Yalo was a short lived system as it maintained TC status for only 30 hours. It started-off as a low pressure system on 23/03/16 and advanced into tropical depression at 1200UTC on 24/02/16 and eventually reached TC intensity at 0600UTC on 25/02/16. At this stage, it was 460km east of Aitutaki. It moved close to the Austral Islands of French Polynesia on 26/02/16 but at this stage it was weakening as it was moving into an area of cooler sea surface temperatures. It was eventually declassified at 1200UTC on 26/02/16.

Initially, TC **Zena** was analysed as a low pressure on 04/04/16 and overnight on the 05/04/16, it developed into a tropical depression. It was upgraded and named TC Zena at midnight on 05/04/16 when it was approximately 265km north of Port Vila. By 0000UTC on 06/04/16, it had attained Hurricane intensity with maximum sustained winds of 65 knots winds close to the centre. At this stage, it was accelerating south-eastwards at approximately 20 knots. At 1200UTC on 06/04/16, Zena was analysed approximately 95km south of Kadavu with Gale force winds extending no more than 100 nautical miles away from the centre. It moved to the south of Fiji overnight on 06/04/16 with minimal effects. It continued to weaken as it moved eastwards, moving over Tongatapu group at 0000UTC on 07/04/16 before it was downgraded at 1200UTC on 07/04/16. At its peak, Zena attained Category 3 status with estimated sustained winds of 70 knots and momentary gusts of 100 knots close to its centre.

Amos was first analysed as a low pressure system at 0600UTC on 15/04/16 when it was approximately 200km southwest of Rotuma. It became a tropical depression overnight on 15/04/16 and was moving in a general south-eastward direction towards the Fiji Group. It eventually attained TC status at 1200UTC on 20/04/16. It remained slow moving within the same vicinity for almost 18 hours before it started to gradually move eastwards. The system intensified as it moved and by 0300UTC on 22/04/16, it had attained Hurricane intensity with sustained maximum winds of 65 knots when it was approximately 130km northwest of Wallis Island. At 0000UTC on 23/04/16, the system turned and started moving southeast, towards Samoa. Even though at this stage it was still a Category 3 system, it attained maximum sustained winds of 80 knots close to the centre. It passed just north of Samoa overnight on 23/04/16. At this stage, it moved into a zone of high wind shear and gradually weakened. It was eventually downgraded at 2100UTC on 24/04/16.

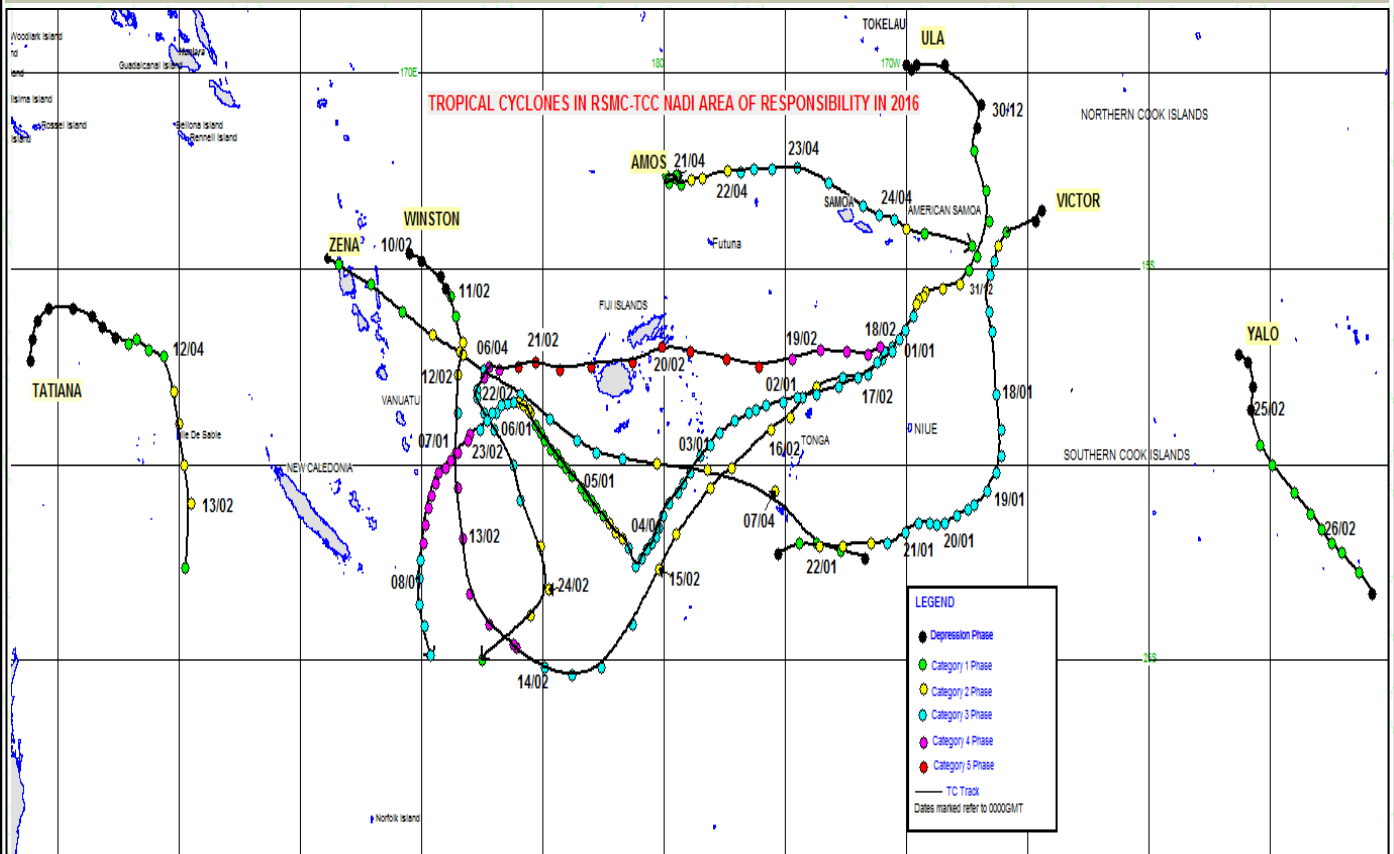


Figure 9: Tracks of TCs within the RSMC Nadi Area of Responsibility in 2016.

TABLE 3: MEAN MONTHLY MAXIMUM AIR TEMPERATURES AND DEPARTURES FROM THE NORMAL (° C)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airport	Max	32.6	33.0	32.8	31.0	31.9	32.0	31.5	30.6	31.2	32.1	32.1	31.4	31.9
	Dep	0.9	1.4	1.3	0.0	1.7	2.2	2.3	1.2	1.1	1.3	0.7	-0.3	1.2
Udu Point	Max	31.8	32.6	31.7	29.2	29.3	29.0	28.2	27.4	27.7	29.6	30.4	30.4	29.8
	Dep	1.3	1.8	1.0	-1.0	0.1	0.3	0.2	-0.7	-0.9	0.3	0.3	-0.1	0.2
Rarawai Mill	Max	32.2	32.9	32.7	31.5	31.7	31.0	30.9	30.3	31.3	32.0	33.0	31.4	31.7
	Dep	0.1	0.9	0.7	0.0	1.1	1.0	1.3	0.5	0.9	0.8	1.1	-0.9	0.6
Nadi Airport	Max	31.2	32.8	31.8	31.3	29.8	29.6	28.7	27.7	29.0	30.3	31.0	31.3	30.4
	Dep	-0.3	1.2	0.5	0.6	0.1	0.6	0.1	-1.0	-0.3	0.0	-0.1	-0.2	0.1
Laucala Bay	Max	31.6	32.7	31.2	29.3	28.8	28.4	27.0	26.1	27.3	28.7	30.4	30.0	29.3
	Dep	0.8	1.5	0.3	-0.6	0.3	0.7	0.2	-0.6	0.1	0.5	1.1	-0.3	0.3
Nausori Airport	Max	31.4	32.2	31.2	28.8	28.5	28.0	26.7	25.7	26.9	28.4	30.1	29.6	29.0
	Dep	1.0	1.4	0.7	-0.5	0.6	0.7	0.4	-0.5	0.3	0.8	1.3	-0.1	0.5
Matuku	Max	31.6	31.2	30.4	28.6	29.2	28.6	26.5	25.7	26.7	28.3	29.7	29.2	28.8
	Dep	1.4	0.5	0.0	-0.6	1.6	1.7	0.5	-0.1	0.3	0.9	1.0	-0.5	0.5
Vunisea	Max	31.2	32.1	31.5	29.2	28.7	27.6	26.8	26.1	27.7	28.4	30.4	29.7	29.1
	Dep	1.3	1.7	1.5	0.3	1.4	1.0	1.1	0.3	1.6	1.3	2.0	0.3	1.1

TABLE 4: MEAN MONTHLY MINIMUM AIR TEMPERATURES AND DEPARTURES FROM THE NORMAL (° C)

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airfield	Min	21.7	22.3	21.8	20.7	18.7	16.8	16.2	17.3	17.5	19.9	20.0	20.6	19.5
	Dep	-0.5	-0.1	-0.5	-0.6	-1.2	-2.1	-1.9	-1.4	-1.8	0.1	-1.2	-1.1	-1.0
Udu Point	Min	25.4	26.0	25.7	24.6	24.3	24.0	23.0	23.0	22.4	24.6	24.7	25.0	24.4
	Dep	1.1	1.5	1.3	0.4	0.8	0.9	0.7	0.8	-0.1	1.7	1	0.9	0.9
Rarawai Mill	Min	23.4	24.0	23.1	21.7	19.1	17.4	16.4	18.7	u/s	20.4	20.7	22.5	20.7
	Dep	1.3	1.7	0.8	0.5	0	-0.6	-0.6	1.3	u/s	0.8	-0.1	0.8	0.7
Nadi Airport	Min	23.9	24.8	23.9	23.0	21.0	19.8	19.1	19.9	19.7	21.7	22.5	23.6	21.9
	Dep	1.1	1.9	1.1	1.2	0.8	0.6	0.7	1.3	0.4	1.2	0.7	1.2	1.0
Laucala Bay, Suva	Min	25.3	25.7	25.5	24.8	23.9	22.3	21.3	21.3	21.9	23.2	24.2	24.7	23.7
	Dep	1.4	1.7	1.6	1.5	1.7	0.9	0.6	0.6	0.9	1.3	1.4	1.2	1.2
Nausori Airport	Min	23.8	24.2	24.0	22.8	20.8	20.2	19.6	19.8	20.2	21.5	22.4	22.8	21.8
	Dep	0.6	0.9	0.8	0.3	-0.4	-0.3	0.0	0.2	0.0	0.6	0.4	0.2	0.3
Matuku, Lau	Min	24.2	25	24.4	23.0	21.3	21.3	19.8	19.9	19.3	21.6	22.9	24.3	22.3
	Dep	-0.2	0.3	-0.2	-0.9	-1.2	-0.4	-1.0	-0.6	-1.5	-0.2	0.0	0.5	-0.4
Vunisea	Min	24.6	25.5	25.1	24.2	21.9	21.3	20.9	20.2	20.8	22.2	23.4	24.2	22.9
	Dep	1.2	1.9	1.6	1.5	0.4	0.8	1.3	0.8	1.0	1.4	1.5	1.3	1.2

TABLE 5: SUNSHINE HOURS AND PERCENTAGE OF NORMAL

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Nadi Airport	Actual	236.1	224.7	198.6	200.0	241.8	222.7	244.3	156.2	246.6	228.4	260.5	201.3	2661.2
	%	112	120	103	101	116	109	112	68	117	97	117	88	104
Laucala Bay, Suva	Actual	236.9	192.0	165.3	89.3	202.3	172.9	161.9	95.7	145.4	145.5	224.1	128.1	1959.4
	%	123	109	98	58	140	123	120	67	107	89	133	66	102
Koronivia	Actual	217.2	142.5	145.9	93.0	152.8	140.8	164.5	82.7	110.6	126.2	212.0	96.8	1685.0
	%	128	88	89	63	112	109	134	60	89	86	144	58	96

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

		Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
Labasa Airport	Actual (mm)	247.4	229.0	241.9	719.3	0.0	32.5	33.9	210.2	7.9	222.2	23.4	462.0	2429.7
	%	64	67	65	304	0	49	63	442	11	180	13	192	108
Savusavu Airfield	Actual (mm)	67.6	204.1	138.6	549.3	30.6	37.2	83.0	301.9	45.6	268.8	73.0	358.4	2158.1
	%	25	84	49	211	16	31	86	260	34	158	39	139	92
Penang Mill	Actual (mm)	84.3	633.9	120.1	552.3	58.0	56.9	13.0	199.0	1.2	72.5	126.0	707.5	2624.7
	%	21	189	28	206	36	57	23	273	1	64	79	268	107
Nadi Airport	Actual (mm)	227.4	427.1	324.0	499.7	21.0	28.1	13.4	197.1	7.3	164.6	123.4	269.9	2303
	%	66	147	95	313	24	44	29	305	10	162	93	151	122
Laucala Bay, Suva	Actual (mm)	167.1	321.3	106.4	343.1	172.6	50.1	78.8	404.8	56.9	310.3	118.0	761.8	2891.2
	%	45	121	28	94	64	31	58	256	32	141	48	275	96
Nausori Airport	Actual (mm)	104.6	521.4	110.9	388.0	190.5	92.7	61.2	387.7	22.0	300.5	73.7	924.2	3177.4
	%	29	195	29	108	77	62	52	264	13	154	30	346	109
Matuku	Actual (mm)	110.0	225.3	196.6	229.6	141.1	140.5	77.4	351.7	4.7	90.9	39.3	179.1	1786.2
	%	40	122	77	133	91	130	94	320	5	79	31	117	97
Lakeba	Actual (mm)	167.1	170.9	50.5	306.4	47.7	92.3	21.0	188.2	3.0	139.5	29.5	453.5	1669.6
	%	69	76	17	149	36	114	26	184	3	113	21	253	87

This Summary is prepared as soon as ENSO, climate and oceanographic data/information is received from recording stations around Fiji and Meteorological Agencies around the region/world. Delays in data collection, availability of appropriate information, communication and processing occasionally arise. While every effort is made to verify observational data and information, the Fiji Meteorological Service does not guarantee the accuracy and reliability of the analyses presented, and accepts no liability for any losses incurred through the use of this Summary and its contents. The contents of the Summary may be freely disseminated provided the source is acknowledged. All requests for data should be addressed to the Director, Fiji Meteorological Service HQ, Namaka, Nadi.

For more information, contact:

Fiji Meteorological Service, Private Mail Bag NAP0351, Nadi Airport, Fiji. Phone : 6724888, Fax : 6724050. Visit website at <http://www.met.gov.fj> for other products and services. Email: climate@met.gov.fj or fms@met.gov.fj. All correspondences must be addressed to the Director of Meteorology.