

RSMC NADI – TROPICAL CYCLONE CENTRE

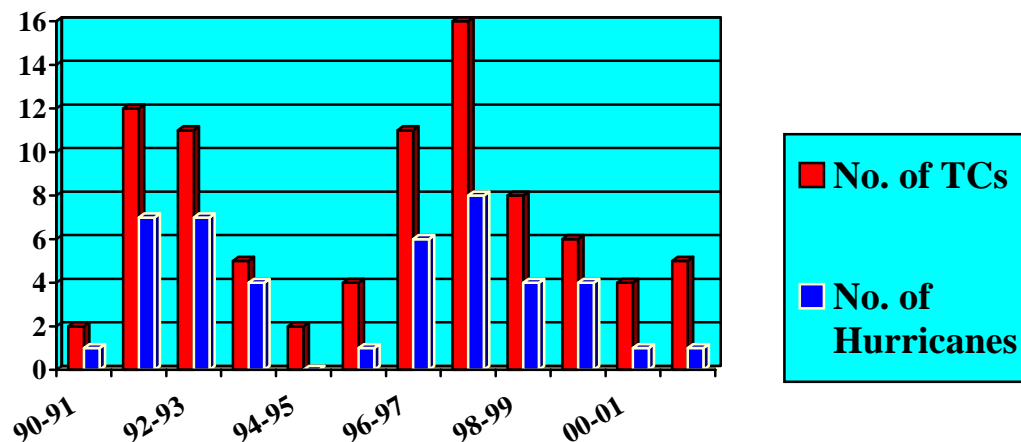
TROPICAL CYCLONE SUMMARY 2001-2002 Season

Introduction

A summary is presented of tropical cyclone activity during the 2001/2002 Tropical Cyclone Season for the Regional Specialised Meteorological Centre Nadi - Tropical Cyclone Centre (RSMC Nadi-TCC) Area of Responsibility (AOR) covering from Equator to 25°South Latitude and 60°East to 120°West Longitude.

Tropical Cyclone activity in the 2001/2002 Tropical Cyclone Season, in the RSMC Nadi area of responsibility (AOR) was below average for the third consecutive Season. A total of only five tropical cyclones occurred in the region (refer **Figure 1**), of which only one attained hurricane intensity.

Figure 1 Tropical Cyclone Activity in RSMC Nadi AOR since 1990/91 TC Season.

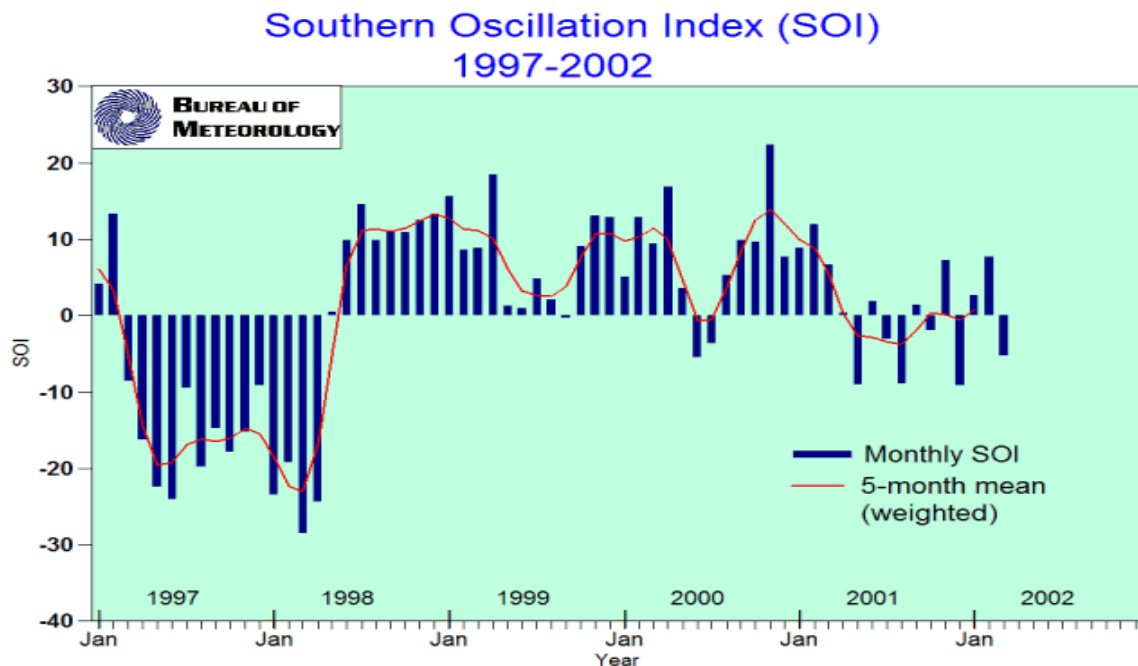


Climatic Indices

ENSO hovered about neutral during the 2001/2002 Tropical Cyclone Season (refer **Figure 2**) though for the first time since April 1998 the SOI values favoured a slightly negative trend. Till January 2002, SST maintained a general pattern of cool anomalies in the eastern equatorial Pacific, while the west displayed a mixture with some significant but brief warming. From February onwards, sub-surface warming had gradually pulsated over much of the eastern equatorial Pacific, even to the coasts of South America.

The Julian-Madden Oscillation (MJO) periodicity was erratic, and for a greater part of the 2001/2002 TC Season, activity was generally suppressed. However, when pulses did migrate into the region, bursts of activity were closely correlated to tropical cyclone developments. By late February, westerly wind anomalies were developing over the low latitude area of Western Pacific, though westerly anomalies persisted right across the Pacific at 200 hPa. This was a major contributing factor to the early as well as rapid decay of systems south of the 20° South Latitude, especially in the Coral Sea area.

Figure 2 Southern Oscillation Index values vs 5-Month Running Means for the period 1997 to 2002.



Special Features

The introduction of the new tropical cyclone naming policy in the 8th RAV/TCC meeting in 2000 contributed to the increase in this Season's final tally.

Whether by coincidence or otherwise, both the first tropical cyclones in 2000/2001 and 2001/2002 Seasons developed from similar atmospheric circumstance and location, near the Southern Cooks. *TCs Oma* and *Trina* were both hybrids, developing off a tropical upper tropospheric trough (tutt), rather than a spin-up, in a high-vorticity strip of the monsoon trough.

Apart from *Waka*, all tropical cyclones in 2001/2002 Season were quite short-lived, with *Vicky* lasting a mere 18 hours. *Trina* and *Vicky* were small cyclones.

Altogether, RSMC Nadi monitored and assigned numbers (01F, 02F....etc) to sixteen systems during the Season. Out of the sixteen, only five managed to attain tropical cyclone status, with *Waka*, having severe impact on life and property in Tonga.

Table 1 Tropical Cyclones in the RSMC Nadi area of responsibility, for the 2001-2002 Season. All dates and times are in UTC¹. (* - named by TCWC Brisbane).

Name	Low first identified			Initial tropical cyclone phase			
	Date	Lat.	Long.	Date	Time	Lat.	Long.
Trina	18 Nov	21.5°S	160.0°W	30 Nov	0600	21.9°S	159.4°W
Vicky	23 Dec	13.7°S	157.1°W	24 Dec	0600	12.6°S	157.5°W
Waka	27 Dec	12.5°S	177.5°W	29 Dec	0600	11.3°S	174.5°W
Claudia*	10 Feb	19.5°S	155.7°E	11 Feb	0600	20.5°S	156.5°E
Des*	03 Mar	14.6°S	154.2°E	05 Mar	0600	19.3°S	159.4°E

Name	Maximum Intensity (knots)					End of Tropical Cyclone Phase			
	Date	Time	Lat.	Long.	Int.	Date	Time	Lat.	Long.
Trina	01 Dec	1200	21.1°S	158.6°W	35	02 Dec	0000	21.5°S	158.5°W
Vicky	24 Dec	1200	12.8°S	157.6°W	35	24 Dec	1800	13.6°S	157.3°W
Waka	31 Dec	1200	18.7°S	174.0°W	95	02 Jan	0600	30.5°S	167.5°W
Claudia*	12 Feb	0600	24.0°S	167.9°E	60	13 Feb	1800	27.0°S	171.0°E
Des*	05 Mar	1800	19.7°S	161.3°E	50	07 Mar	0000	23.7°S	166.5°E

Verification Statistics

Position forecast verification statistics for each cyclone (**Table 2**) were derived by comparing the initial and forecast positions (given in warnings issued by RSMC Nadi-TCC) with post analysis 'best track' positions. It must be noted here that the Australian Tropical Cyclone Workstation (ATCW) verification programme used by RSMC Nadi-TCC is sensitive to temporal amount of data. Consequently, *Vicky* could not be verified beyond the 12-hour forecast positions while *Claudia* could not be verified at all as it lasted mere 6 hours in RSMC Nadi AOR). On the other hand *Des* could only be verified for the 0- and 12-hour forecast times.

Overall, initial position errors for individual tropical cyclones were similar to previous Seasons. However, the aggregate showed improvement, against the past Seasons.

At 12 hours, errors for individual cyclones showed notable improvements from past Seasons, as forecasts displayed skill over persistence. On the aggregate, though, the forecast errors were slightly larger than in the past Seasons.

Again, at 24-hours, the aggregate reveals that forecasts showed skill over persistence which was very similar to last Season. Looking back at the previous six seasons, position forecast errors have maintained a gradual decreasing trend (refer **Figure 3**) thus showing improvement in tropical cyclone location.

¹ UTC - Universal Co-ordinated Time (same as Greenwich Mean Time)

Figure 3 RSMC Nadi Forecast Errors since TC Season 1994/95.

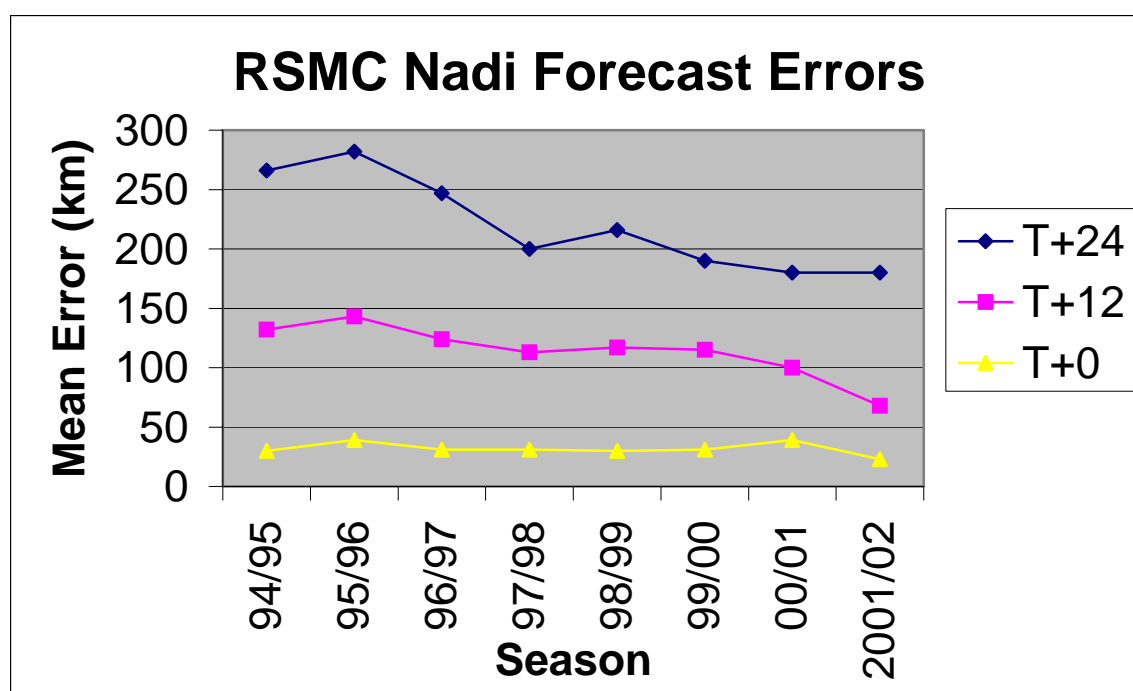


Table 2 Position forecast verification statistics for official warnings issued by RSMC Nadi. Forecast positions are verified against the official best track. Persistence errors (in brackets) are included for comparison. *Vicky* could not be verified beyond 12 hours, while *Claudia* not at all, due to insufficient data.

Lead-time	0 hours		12 hours		24 hours	
	Mean error (km)	Number	Mean error (km)	Number	Mean error (km)	Number
Trina	29	12	52(102)	7	99(82)	5
Vicky	38	7	-	-	-	-
Waka	13	15	73(105)	11	238(414)	7
Claudia*	-	-	-	-	-	-
Des*	20	7	85(106)	3	-	-
Aggregate	23	44	161(108)	23	180(276)	12

In **Table 3**, the radius of the circles (centred on the centroid of the errors) containing 50% of the operational initial positions, is smaller than 0.5 degree of latitude (55.5 km) for all cases. Therefore the location of systems could be summed up as falling within the category of "Position Good" most of the time.

The forecast error centroids and size of the radius of the 50% circle (centred on the centroid of the errors) indicate bias and consistency of bias in the forecast positions. For instance, *Des* consistently ran east of the expected track, so the centroids are biased to the west. *Waka's* large westerly bias, at 24 hours, was due to the difficulty in forecasting its turn towards the southeast when it was steadily moving southwest. This also applies to the prediction of *Des* at 12-hours, which was mainly attributed to the difficulty in forecasting the southerly turn when it was tracking southeast.

Table 3 Centroid of errors for initial (0-hour lead time), 12-hour and 24-hour forecast positions given in warnings issued by RSMC Nadi with the radius of the circle enclosing 50% of the positions. All distances are in kilometres. *Vicky* could not be verified beyond 12 hours, while *Claudia* not at all, due to insufficient data.

Lead-time	0 hours		12 hours		24 hours	
Name	Centroid E-wd, N- wd	Radius of 50% circle	Centroid E-wd, N- wd	Radius of 50% circle	Centroid E-wd, N- wd	Radius of 50% circle
Trina	9, -6	33	5,-36	42	-7,-91	69
Vick	11, -11	33	-	-	-	-
Waka	8, -1	11	-31, 44	53	-112, 113	127
Claudia	-	-	-	-	-	-
Des	-12, 5	22	-68, 20	45	-	-
Aggregate	4, -3	26	-109, -12	220	-81, 40	136

Figure 4 Tracks of Trina, Vicky, Waka, Claudia and Des.

Tropical Cyclones in the RSMC Nadi Area of Responsibility (AOR), 2001/2002 Season.

In the discussion that follows, distances are in nautical miles and wind speeds are 10-minute averages.

Trina (01F) : 30 November - 02 December 2001

Trina was the first tropical cyclone for the 2001/2 TC Season in RSMC Nadi-TCC AOR. It was first identified as a sheared hybrid, developing off an upper cut-off low, which eventually spun its way to the surface to the west of Rarotonga between November 28th and 29th. 01F was then slow-moving and located over marginally warm SSTs of around 27C and under strong wind shear. By 30/0000 UTC it had drifted closer to Rarotonga with deep convection still displaced between 30nm² to 120nm southeast of the exposed Low Level Circulation Centre (LLCC). However, around 30/0230 UTC deep convection and overall organization increased significantly with tops steadily cooling. With an intense surface anticyclone to the south significantly enhancing the gradient in the southwest quadrant, thus resulting in the development gale force winds, TD 01F was named as Tropical Cyclone *Trina* at 30/0600 UTC while lying close to Rarotonga.

Till 01/0600 UTC, the exposed LLCC gradually drifted into a weak steering regime under the upper trough axis, and subsequently partially under the deep convection. However, the prevailing wind shear prevented any opportunities for any further intensification. Consequently, Trina managed to attain only gale intensity and last for 3 days.

Southern Cooks islands of Rarotonga and Mangaia were put under *Tropical Cyclone Alert* in the first Special Weather Bulletin (SWB) issued at November 30/0809 UTC. Twelve hours later, Rarotonga was placed under *Gale Warning* while Mangaia was still under *Alert*. At December 01/0200 UTC, Mangaia was also placed under *Gale Warning* as the cyclone drifted closer to the island. Six hours later the Gale Warning was cancelled for Rarotonga but retained for Mangaia. The final SWB for Mangaia was issued around 03/0335 UTC after Trina had been downgraded to a Tropical Depression.

Preliminary assessment of damage indicated that Mangaia sustained inland and coastal flooding/erosion with 80% of root crops in one area totally destroyed and about 20% of livestock lost. On Rarotonga, minimal damage was incurred to the southeast side of the island from wind and storm surge. The mango crop was also destroyed. A lady was very fortunate to survive from a falling coconut tree as it snapped and landed on her vehicle while she was driving along the main road.

Vicky (04F) : 24 - 25 December 2001

Tropical Cyclone Vicky was a short-lived system, lasting a mere 18 hours at tropical cyclone status. It was relatively small and sheared for most of its life.

04F was first identified around December 22nd while located between the Northern and Southern Cooks as a slow-moving eddy along the active South Pacific Convergence Zone (SPCZ). The disturbance was subjected to strong southerly shear since inception, which removed any deep convection to the north, but at the same time enhancing the prevailing

² nm = nautical miles = 1.15 statutory mile

unstable monsoon flow in the northeast quadrant. By 22/1800 UTC, persistent strong convection and slight deepening induced 10-minute average winds of at least 30 knots (evident through Quikscat) generally to the north of the system, with formation of a good circulation. The system was then upgraded to a Tropical Depression. RSMC Nadi-TCC consequently issued its first international marine warning on 04F as it remained slow-moving about 500nm north-northeast of Rarotonga or 500nm northwest of Tahiti. Subsequent warnings mentioned winds increasing to gale force within the northeast quadrant of the circulation slightly off the LLCC. By 24/0000 UTC, convection was gradually increasing and cloud tops cooling about the LLCC, indicating good potential for the system to becoming a tropical cyclone within 24 hours. This prompted RSMC Nadi-TCC to issue the first Tropical Disturbance Advisory on the system. With SSTs around 28C, decreasing vertical shear (CIMSS) and deep convection erupting over the LLCC (SSM/I) and along the feeder band to the north, TD 04F was named Tropical Cyclone *Vicky* at 24/0600 UTC as it attained average winds of 35 knots close to the centre.

Soon after naming, a marked increase in vertical wind shear and decrease in low-level relative vorticity occurred, thus stifling any further development of the tropical cyclone. By 25/0000 UTC, it was downgraded to a tropical depression while located about 360nm north-northeast of Rarotonga or 450nm west-northwest of Tahiti and drifting southwards about 05 knots. Further warnings were issued on TD 04F (as former TC *Vicky*) till 26/0600 UTC for gales within an area in the northeast quadrant, but away from the centre.

No damage was incurred by TC *Vicky* as it spent most of its life in open seas, away from inhabited islands.

Waka (03F) : 29 December 2001 - 02 January 2002

Waka was the third tropical cyclone of the 2001/2002 South Pacific Tropical Cyclone Season. The cyclone formed to the northeast of Wallis and initially followed a southwest track, passing close to Wallis, before recurving southeastwards and tracking over Niuafu'ou and Vavau of the Kingdom of Tonga. Waka was a relatively intense and well-behaved tropical cyclone with a peak intensity of about 95kt (10-minute average) winds.

A Tropical Depression (TD 03F) was first identified, embedded in an active monsoon trough just south of Solomon Islands, or about 300 miles northeast of Espiritu Santo in Vanuatu, around December 18/2100 UTC. It initially moved southeast towards Fiji before turning northeast on the 23rd to eventually lie slow moving about 100nm to the northeast of Wallis on the 28th. From 20/1200 UTC till 22/0600 RSMC Nadi-TCC issued international marine warnings for development of gales in an area slightly away from the centre of 03F. This was resumed at 26/2136 UTC when it was evident overall development was steadily occurring. The first Tropical Disturbance Advisory on this system was issued around 27/0230 UTC, indicating that it had moderate to high potential for attaining TC status within the next 24 to 48 hours. SST was 30C. Shear was steadily decreasing. Low-level relative vorticity was also persistent. Effectively, 03F's environment favourably supported further development, which was very likely to be rapid. By 29/0600 UTC 03F had formed into a tropical cyclone and was consequently named "Waka", while located about 140nm to the northeast of Wallis.

Waka intensified rapidly as it started moving southwest, reaching storm intensity around 29/1800 UTC. By this time, a mid-level ridge to the southeast of the cyclone had established and was intensifying. As anticipated, the steering field also turned northerly thus nudging Waka southwards, resulting in the cyclone centre passing very close to Wallis as it accelerated slightly. At 30/1200 UTC, Waka reached hurricane intensity,

while located about 80nm north-northwest of Niuafu'ou. Turning further towards the south-southeast, the cyclone passed over Niuafu'ou around 30/2100 UTC. Waka steadily intensified as it finally assumed a southeast track, accelerating further under strengthening steering which was enhanced by an approaching upper trough from the west. The cyclone passed over Vavau around 31/1200 UTC and maintained a steady southeast track, passing about 200nm to the southwest of Niue by 31/1800 UTC, when it also attained peak intensity with maximum average winds of 95 knots. Primary responsibility for warnings on Waka was handed over to TCWC Wellington after January 01/0900 UTC as the cyclone continued to accelerate southeast into the Centre's area of responsibility.

A total of forty-six Special Weather Bulletins were issued for Waka, of which nineteen were for Wallis and Futuna, twenty-one for Tonga and six for Niue.

Wallis was put on *Tropical Cyclone Alert* in their first Special Weather Bulletin issued around 28/0300 UTC when it was anticipated that TD 03F would gradually move towards the Island and possibly develop into a tropical cyclone in the next 24 to 48 hours. By 29/0800 UTC, the *Alert* was replaced with a *Tropical Cyclone Warning*, with damaging gale force winds expected over Wallis. Six hours later, at 1400 UTC, the warning was further upgrade to *Storm Warning* for Wallis and *Gales Warning* for Futuna. Similar warnings were subsequently issued until at 30/2000 UTC when downgrading of the warnings commenced as it became evident that Waka would move away. The final Special Weather Bulletin was issued around 31/0200 UTC when the cyclone moved clear from the French territory.

Niuafu'ou and Niuatoputapu (Niuas) in Northern Tonga were put on *Tropical Cyclone Alert* in the first Special Weather Bulletin for Tonga issued around 29/0200 UTC. It was anticipated then, that gales would affect these islands within the next 24 to 48 hours. The rest of Tonga was subsequently put on strong wind warning. The *Alert* was replaced with a *Tropical Cyclone Warning* for the Niuas around 29/2100, with damaging gale force winds predicted to affect the islands within the next 12 -18 hours. Meanwhile the rest of Tonga was put on a *Tropical Cyclone Alert*. By 30/0200 UTC, Niuafu'ou was on placed on *Storm Warning* while a *Gale Warning* was retained for Niuatoputapu. A **Flash** bulletin containing *Hurricane Warning* was issued for Niuafu'ou at 30/1000 UTC as Waka intensified and headed straight for the island. Consequently, at 30/1430 UTC the warning for Niuatoputapu was upgraded to *Storm Warning*. At the same time the whole of Central Tonga was placed on a *Gale Warning* but, as Waka further intensified and headed towards them, this was upgraded to *Storm Warning* by 30/2040 UTC, and *Hurricane Warning* three hours later. Tongatapu was also put on *Gale Warning* by this time. The final Special Weather Bulletin for Tonga was issued around 31/2330 UTC as the cyclone raced away to the southeast of the Kingdom.

Niue was put on a *Tropical Cyclone Alert* in the first Special Weather Bulletin issued for the island around 30/2200 UTC. 12 hours later, around 31/1000 UTC, this was upgraded to a *Tropical Cyclone Warning* with winds expected to increase to damaging gale force within the next 6 to 12 hours. Subsequent *Gale Warnings* were issued for Niue three hourly until January 01/0200 UTC when the warning was cancelled as the cyclone moved away from the island.

In addition to the Special Weather Bulletins mentioned above, seven *Special Advisories* were issued for Samoa commencing from December 29/0852 UTC and issued at six hourly intervals. These contained information on the latest and forecast positions, intensity and movement trends, with special mention of weather and sea effects.

Thirty-two *International Marine Warnings* were issued on Waka by RSMC Nadi-TCC. These warnings comprised of nineteen gale warnings (including those when still a tropical depression to the northwest of Fiji), two storm warnings and eleven hurricane warnings.

Twenty-two *Tropical Disturbance Advisories* were also issued at six hourly intervals on Waka to meteorological centres in the region and beyond. 6 hours. They included information about the latest and forecast positions, intensity and movement trends of the cyclone.

Twelve SIGMETs (Aviation Warning) and six CREX Bulletins, specifically for the Global Numerical Prediction Centres, were also issued on Tropical Cyclone Waka by the warning centre at Nadi.

Damage was minimal over Wallis and Futuna Group, according to preliminary reports received from Wallis. One house was destroyed in Wallis but about 50% of their banana plantation was destroyed. In Tonga, Newspaper reports claim that damage was severe in Vavau. Communications was severed for several hours. An estimated 60 to 70% of buildings were severely damaged. Damage to crops was also severe. Trees were uprooted. About 10 cruising yachts and launches sank in the main harbour in Vavau. Tourism industry suffered severely. Villages along the western coast of Niue experienced sea spray to 100 metres inland. Niue Meteorological Service has confirmed that the highest surge was 8 metres. Felled and uprooted coconut and other trees blocked roads. A fallen tree snapped power lines to the Telecoms transmitting station, Airport area and part of Alofi South, leaving these areas without power for approximately 6 hours.

Tracking and forecasting of Tropical Cyclone Waka's intensity and movement was relatively easy since the cyclone had typical characteristics, was generally behaved, and followed a relatively steady path. Once leaving Wallis, Waka formed an eye which it maintained throughout its life span in RSMC Nadi-TCC area, though the eye became ragged and increasingly cloud-filled as the system reached the border with TCWC Wellington. RSMC Nadi-TCC warnings were generally well received and appreciated by all.

Claudia (08F) : 12 - 13 February 2002

Tropical Cyclone Claudia developed in the Coral Sea west of 160 East Longitude and was therefore named by TCWC Brisbane. The tropical cyclone attained maximum intensity of hurricane force winds while still in Brisbane AOR.

RSMC Nadi-TCC briefly took over primary responsibility for warnings from 12/0600 UTC when Claudia was located about 360nm southwest of Noumea, New Caledonia. The cyclone was accelerating southeast around 15 to 20 knots under a strong northwesterly steering at the time. Six hours later, it crossed the Nadi-Wellington border (25 South Latitude). Primary responsibility for warnings was handed subsequently over to TCWC Wellington. The system became extra-tropical 30 hours later.

Des (12F) : 5 - 6 March 2002

Tropical Cyclone Des was named by TCWC Brisbane while embedded along an active monsoonal trough some 30nm west of the Brisbane-Nadi border (160 degree East

longitude) at 05/0900 UTC. At the time, it was moving east-southeast at about 08 knots with a maximum winds of 40 knots close to the centre.

RSMC Nadi took over the primary responsibility for warnings from 05/1200 UTC, when Des was located about 200nm west-northwest of the northern tip of New Caledonia. Maximum winds were 45 knots at the time and the system was still moving east-southeast at 08 knots. By 05/1800 UTC, Des reached storm intensity after shear significantly decreased over the system, which subsequently resulted in convective development. By 06/0000 UTC, as steering gradually changed, Des began to turn southeast. With good outflow established and decreasing wind shear, the cyclone was basically in a favourable region for further intensification. However, Des was at the same time advancing closer to the rugged terrain of New Caledonia. Through the evening of the 6th, the cyclone began to gradually lose organisation from friction induced by the imposing landmass. As the system moved away from New Caledonia, it started to accelerate and undergo weakening under the strengthening west to northwesterly shear.

At 06/1800 UTC, the LLCC was exposed at least about 100nm to the west of the deep convection associated with Des. Maximum intensity was 40 knots and the cyclone had accelerated to 15 knots. At 07/0000 UTC, Des was located about 100nm south of Noumea with marginal gale intensity. By 07/0600 UTC, it was downgraded to a *Tropical Depression* with gales remaining in an area away from its centre which was devoid of any deep convection.

New Caledonia was spared from the destructive storm force winds because Des made an early southeast turn, with its centre maintaining a good 90 to 100nm distance from the southern coastline as it kept a steady southeast track. No reports of damage had been received from New Caledonia. On the east coast of Australia swells 5-6 metres (peak heights) reached the Southern Queensland and Northern New South Wales coasts, generated by an extended fetch between Des and the large surface high to the south. Though harmful otherwise, the heavy swells brought perfect conditions for an international surfing contest held there at the time. The conditions still proved dangerous for the general public and lifesavers had to make many rescues and closed a large number of beaches.



References:

1. **Australian Bureau of Meteorology web site**, <http://www.bom.gov.au/>, for Monthly SOI values and 5-month running mean, from 1997 to 2002.