

RSMC NADI – TROPICAL CYCLONE CENTRE

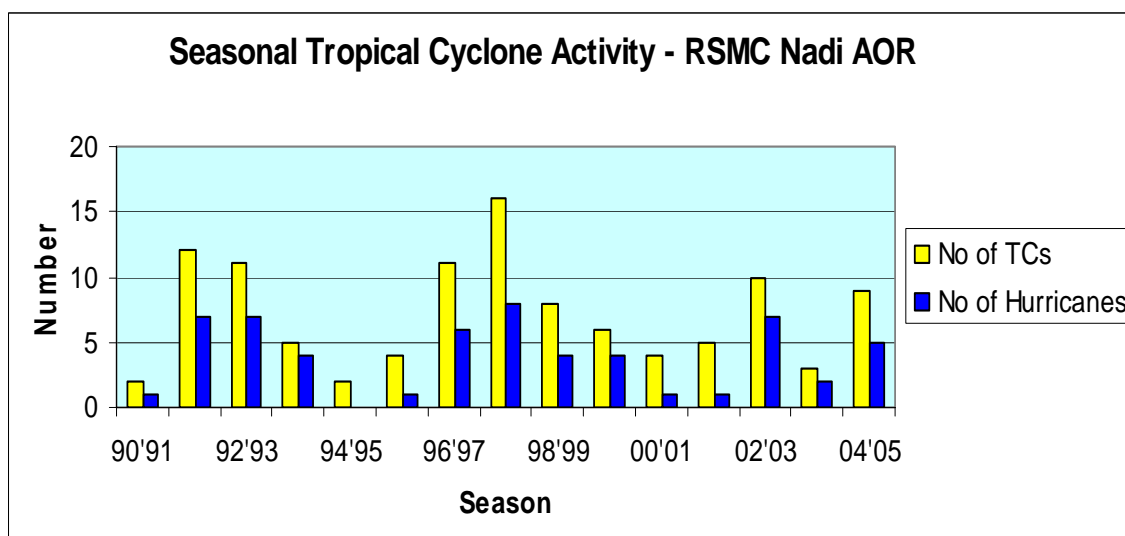
TROPICAL CYCLONE SUMMARY 2004-2005 Season

Introduction

A summary is presented of tropical cyclone activity during the 2004/2005 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 160°East to 120°West Longitude.

Tropical Cyclone activity in the 2004/2005 Tropical Cyclone Season, in the RSMC Nadi AOR was at its climatological average. In total, nine tropical cyclones occurred in the region. Five of these cyclones attained hurricane intensity whilst the remaining four reached gale force.

Figure 1 Tropical Cyclone Activity in RSMC Nadi AOR by Season

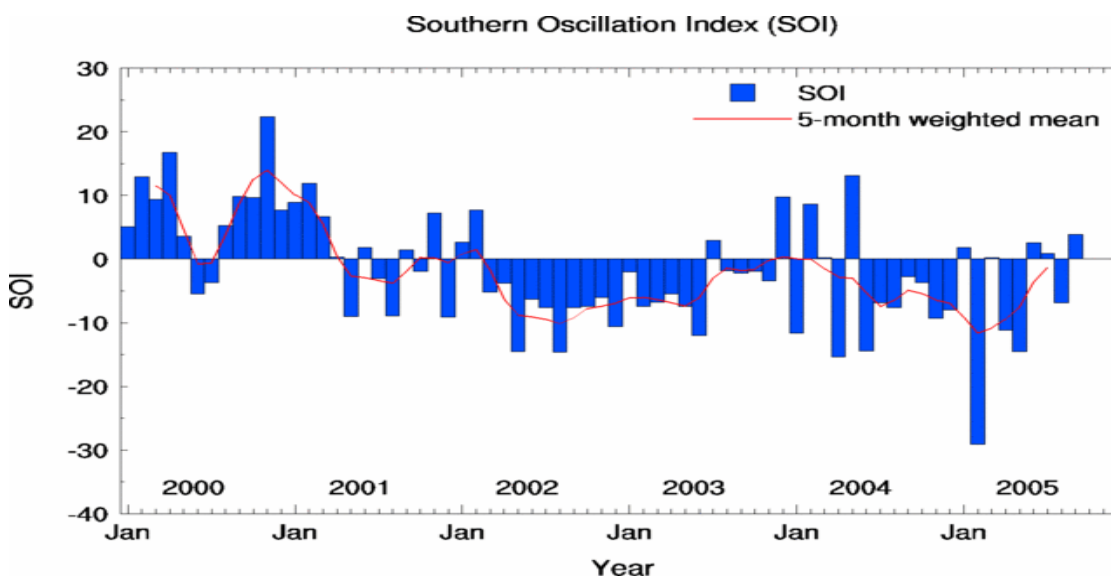


Climatic Indices

The 2004/5 Season was characterised by a rather “warm” neutral ENSO. The monthly SOI values (refer **Figure 2**) remained mostly negative, with a sharp fall to -29 in February 2005. The associated 5-month running mean SOI, centred on December, was -1.0. Sea Surface Temperature (SST) was warmer than average in the region throughout the Season with the warmest anomalies observed about the near-equatorial Dateline. During January and February, though, very active convection persisted through much of the region. In response to this

persistent cloudiness and rainfall, SSTs cooled slightly, but still remained warmer than average. During this period as well, low level westerly wind anomalies were evident west of this convectively active area. However, in the first few months of the Season, near-average trade winds behaviour was observed over much of the tropical Pacific. On most occasions, consistent with the behavior of the active phases of the Madden Julian Oscillation [MJO], the convectively active area progressed eastward across the region, enhancing the formation of tropical cyclones.

Figure 2 Southern Oscillation Index values vs 5-Month Running Means for the period 2000 to late 2005.



Occurrence

A total of nineteen significant tropical disturbances were monitored and assigned numbers of the series (01F, 02F,.....etc) in the 2004/5 Tropical Cyclone Season by RSMC Nadi. Nine of these eventually developed into tropical cyclone, of which were four gales (category 1) and five hurricanes (one category 3, one category 4 and three category 5).

Apart from *Judy*, all the 2004/5 Season cyclones originated about the Dateline between 05°S and 20°S latitudes. This identified the genesis trough as coincidental with the pool of warmest SST anomalies.

It was also observed that about 50% of the cyclones displayed some northward movement, particularly, in their formative stages. The rest generally moved towards the south or southeast, with the exception of *Kerry*, which tracked westwards for most of its life as a cyclone, and to a small degree, *Judy* and *Nancy*, for taking a west of south track for certain periods.

Table 1 Tropical Cyclones in the RSMC Nadi area of responsibility, for the 2004/5 Season. All dates and times are in UTC¹.

Name	Low first identified			Initial tropical cyclone phase			
	Date	Lat.	Long.	Date	Time	Lat.	Long.
Judy	21 Dec	16.0°S	144.4°W	24 Dec	1800	19.5°S	145.3°W
Kerry	03 Jan	09.0°S	176.6°E	05 Jan	1800	13.3°S	171.6°E
Lola	27 Jan	18.0°S	168.4°E	31 Jan	1800	22.6°S	176.2°W
Meena	01 Feb	14.0°S	165.0°W	03 Feb	0600	14.4°S	168.2°W
Nancy	10 Feb	11.7°S	169.6°W	12 Feb	1800	12.8°S	165.8°W
Olaf	10 Feb	13.0°S	179.0°W	13 Feb	0600	09.0°S	177.6°W
Percy	23 Feb	08.5°S	172.8°E	24 Feb	1800	08.2°S	179.3°W
Rae	28 Mar	11.8°S	179.0°E	05 Mar	1800	20.5°S	164.7°W
Sheila	20 Apr	17.0°S	179.5E	22 Apr	0000	17.4°S	170.6°W

Name	Maximum Intensity (knots)						End of Tropical Cyclone Phase			
	Date	Time	Lat.	Long.	Int.	Cat.	Date	Time	Lat.	Long.
Judy	25 Dec	1800	22.5°S	146.7°W	45	1	27 Dec	0000	28.5°S	146.5°W
Kerry	10 Jan	0000	18.1°S	159.1°E	75	3	14 Jan	0000	24.6°S	158.2°E
Lola	01 Feb	0000	23.5°S	175.6°W	40	1	02 Feb	0000	25.1°S	175.5°W
Meena	06 Feb	1200	19.6°S	160.6°W	115	5	08 Feb	0000	28.0°S	150.0°W
Nancy	14 Feb	1200	14.4°S	162.1°W	95	4	17 Feb	0600	25.0°S	164.0°W
Olaf	17 Feb	0000	15.6°S	168.1°W	115	5	20 Feb	0000	32.2°S	161.2°W
Percy	02 Mar	1200	17.6°S	165.1°W	125	5	05 Mar	0000	25.8°S	152.8°W
Rae	06 Mar	0000	21.9°S	163.8°W	40	1	06 Mar	1200	22.9°S	161.3°W
Sheila	22 Apr	1200	19.4°S	166.6°W	40	1	22 Apr	1800	20.9°S	164.8°W

Verification Statistics

Position forecast verification statistics for each cyclone (**Table 2**) was derived by comparing the initial and forecast positions (given in warnings issued by RSMC Nadi-TCC) with post analysis 'best track' positions. It is worth noting that the Australian Tropical Cyclone Workstation (ATCW) verification programme used by RSMC Nadi-TCC is sensitive to the number of forecast positions verified. Subsequently, certain cyclones could not be verified beyond 12-hour and/or 24-hours, with one even at 0-hour.

Overall, initial position errors for individual tropical cyclones were similar to previous Seasons. However, the aggregate for 2004/5 registered the lowest for any of the previous Seasons, even when *Meena*, in its formative stage, ran a gentle clockwise loop, while embedded in an active monsoon trough, before turning and shuttling towards the southeast.

At 12, 24, 36 and 48 hours, errors for all the individual cyclones displayed forecast skills. This was despite *Olaf* executing a tight loop soon after trekking northward and *Nancy*, steadily continuing and eventually running southwest, after an initial southeast and then southward turn.

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

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

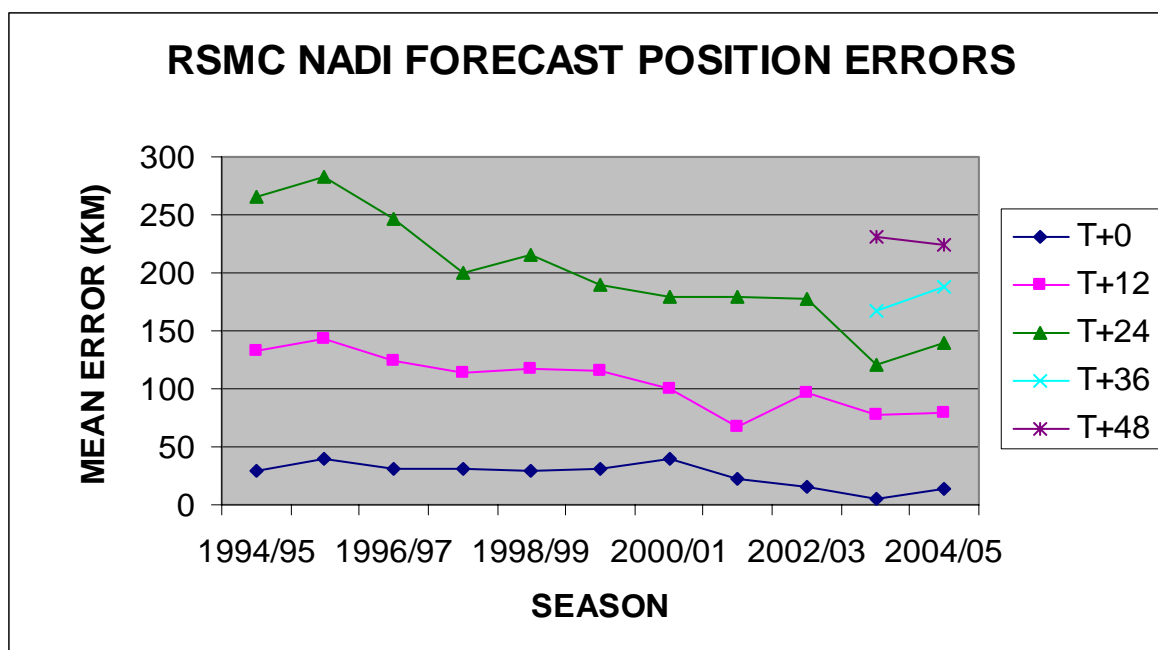


Table 2 Position forecast verification statistics for official warnings issued by RSMC Nadi. Forecast positions are verified against the official best track. Persistence errors (in brackets) are included for comparison.

Lead-time	0 hours		12 hours		24 hours		36 hours		48 hours	
	Mean error (km)	No.	Mean error (km)	No.	Mean error (km)	No.	Mean error (km)	No.	Mean error (km)	No.
Judy	14	12	63(61)	6	119(162)	4	-	-	-	-
Kerry	19	16	79(89)	9	125(221)	7	114(460)	4	-	-
Lola	21	7	-	-	-	-	-	-	-	-
Meena	19	24	74(112)	17	117(322)	15	134(593)	12	152(960)	8
Nancy	15	23	99(130)	16	191(360)	14	309(569)	11	353(853)	7
Olaf	10	24	88(134)	20	173(235)	17	237(346)	12	326(590)	8
Percy	13	31	67(84)	27	102(199)	23	137(402)	19	149(659)	15
Rae	9	7	-	-	-	-	-	-	-	-
Sheila	-	-	-	-	-	-	-	-	-	-
Aggregate	14	147	80(107)	100	139(258)	80	188(466)	58	224(744)	38

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**" for all the cyclones.

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, *Nancy*, consistently ran east of the expected track, forcing a westerly bias of the centroids. The southwest bias with *Meena*, *Olaf* and *Percy* was attributed to difficulty in forecasting the southward turn when the cyclones were heading east or southeast.

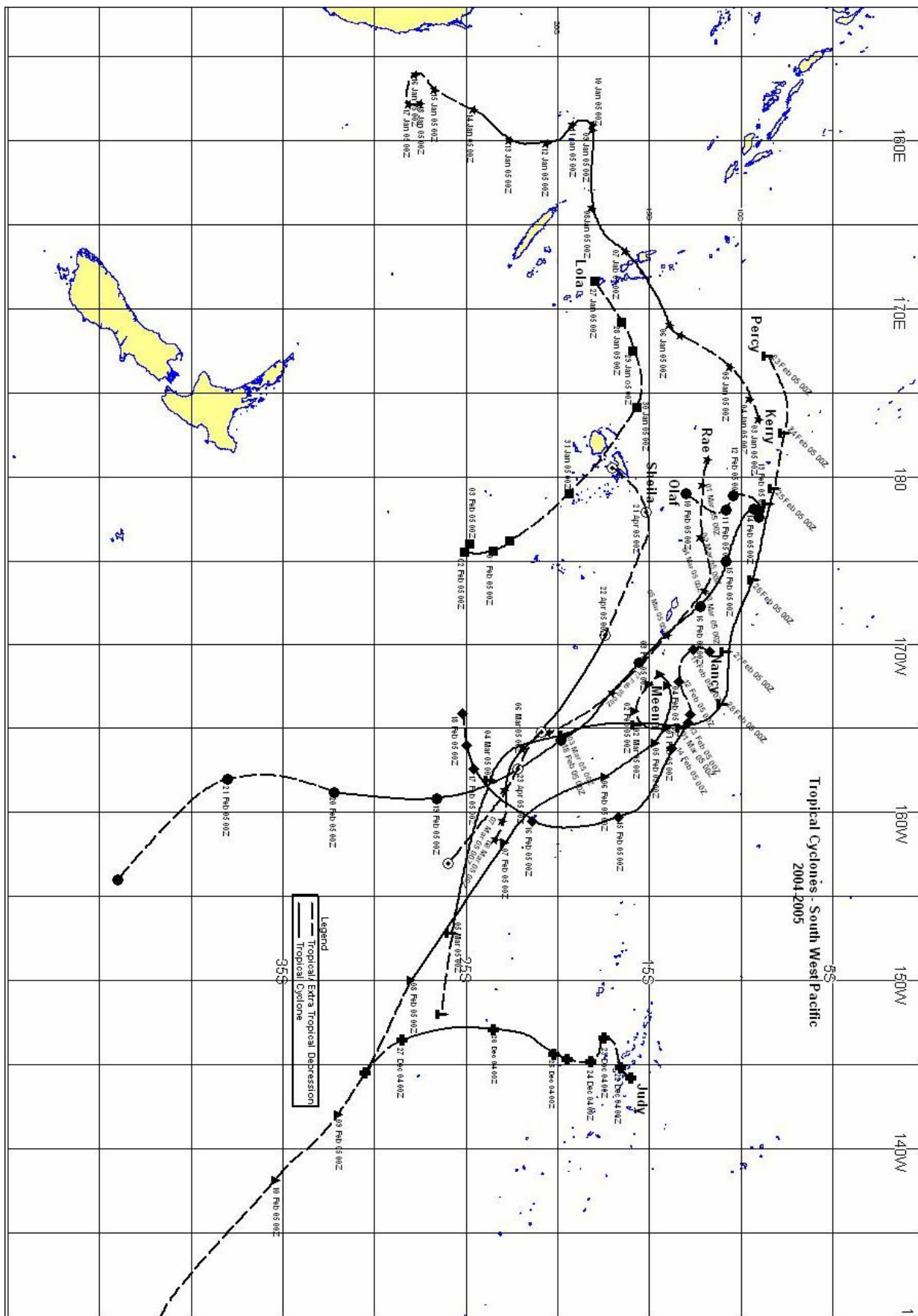
Table 3 Centroid of errors for initial (0-hour lead time), 12-hour and 24-hour forecast positions given in warnings issued by RSMC Nadi with the radius of the circle enclosing 50% of the positions. All distances are in kilometres.

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
Judy	4,4	15	12,39	39	67,92	38
Kerry	8,6	24	10,9	67	-2,36	93
Lola	-10,-5	18	-	-	-	-
Meena	1,-8	21	-18,-36	57	-43,-64	89
Nancy	-1,-1	17	-41,8	79	-101,29	115
Olaf	1,-1	11	-36,-17	79	-70,-31	145
Percy	3,-1	17	-31,-15	56	-74,26	83
Rae	-0,2	8	-	-	-	-
Sheila	-	-	-	-	-	-
Aggregate	2,-1	19	-27,-9	72	-59,-17	124

Table3 Contd.....

Lead-time	36 hours		48 hours	
Name	Centroid E-wd, N-wd	Radius of 50% circle	Centroid E-wd, N-wd	Radius of 50% circle
Judy	-	-	-	-
Kerry	-24,98	87	-	-
Lola	-	-	-	-
Meena	-73,-80	88	-89,102	135
Nancy	-180,70	183	-259,139	224
Olaf	-92,-39	158	-97,-47	216
Percy	-89,-57	101	-91,-100	152
Rae	-	-	-	-
Sheila	-	-	-	-
Aggregate	-91,-19	164	-115,-36	217

Figure 4 Tracks of *Judy, Kerry, Lola, Meena, Nancy Olaf, Percy, Rae and Sheila*.



Tropical Cyclones in the RSMC Nadi Area of Responsibility (AOR), 2004/2005 Season.

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

Judy (04F) : 24 – 27 December 2004

Judy was the first tropical cyclone observed inside the RSMC Nadi AOR in the 2004/5 Season. It was a 'hybrid' system developing along an active and slow-moving monsoon trough over French Polynesia. After re-assessment of data, 04F was first identified as a tropical disturbance on 21st December 2004 by RSMC Nadi. Up till the 23rd, it was encountering strong shear as well as diurnal effects. However, a low-level centre was developing all this while, but at the southern-most end of the trough. On the 24th, the tropical depression was displaying baroclinic characteristics with the surface centre well exposed. Environmental pressure at the surface was quite low and falling still. Strongest winds at the surface were confined away from the centre but under the associated active convection of the trough. Overnight of the 24th, deep convection erupted over the centre whilst getting significantly organized. At 24/1800 UTC, TD04F was named *Judy*, at gale intensity. The cyclone was then located south of Tahiti and moving south-southwest. Under strengthening shear, *Judy* struggled to maintain its structure. As it moved further towards the south, however, it was caught under the strengthening steering field, enhanced by a short-wave trough to the west. This subsequently neutralized the resultant effect of shear over it. Additionally, *Judy* was moving under the equator-ward entrance of the subtropical jet. Consequently, the cyclone intensified further, though only slightly. It reached peak intensity of 45 knots close to the centre, around 25/1800 UTC whilst turning southward and accelerating further into New Zealand's AOR. Wellington TCWC assumed primary responsibility for future warnings on *Judy* from 26/1200 UTC. *Judy* remained as a tropical cyclone inside New Zealand's AOR for another 12 hours before becoming extra-tropical. No reports of damage on this cyclone have been received as yet.

Kerry (05F) : 05 – 14 January 2005

Kerry was first identified and analysed on surface charts as a westward-moving disturbance just west of Tuvalu at 03/0000 UTC January 2005. Environmental shear was weak and SST was around 30°C. At 250-hPa, the subtropical ridge located just north of the disturbance was drifting south maintaining low shear and diffluence over the system. Later on the 3rd, the potential for becoming a cyclone in 24 to 48 hours was raised to moderate to good as banding features became evident. The depression was named *TC Kerry* at 05/1800 UTC as overall organization improved markedly. The cyclone was then located some 315 nm northeast of Port Vila, Vanuatu, and moving southwest at about 11 knots with maximum winds of 40 knots close to the centre.

Kerry maintained gale intensity for the next 48 hours while heading southwest and then west-southwest as middle-level dry air was drawn into the system, suppressing deep convection around the CDO. The cyclone picked up forward speed as it approached Vanuatu, crossing the central parts of the country between 06/1800 UTC and 07/0000 UTC. Interaction with the rugged, volcanic islands further arrested development. During its passage through Vanuatu, the centre crossed over Pentecost, passed to the north of Ambrym and exited via Malekula. Once clear of Vanuatu, at 07/1200 UTC, *Kerry* attained storm intensity whilst continuing west-southwestward at a steady 20-knot speed, driven along the northern side of a deep subtropical

ridge to the southeast. 12 hours later, at 08/0000 UTC, *Kerry* reached hurricane status with winds of 65 knots close to the centre, as it moved west and closer to the upper-level ridge axis. Overall organisation continued to improve with a cloud-filled eye evident at times. At the same time, the cyclone slowed in response to a low-level ridge building to its southwest. Primary responsibility for future warnings on *Kerry* was handed over to Brisbane TCWC after 08/0600 UTC when it exited Nadi AOR. However, the cyclone moved back, albeit marginally, into Nadi AOR between 11/1800 UTC and 13/0000 UTC after doing a southward turn while progressively weakening. Even though this happened, RSMC Nadi and Brisbane agreed that Brisbane TCWC would continue as the primary warning centre, as it was anticipated that the cyclone would eventually move back into Brisbane AOR. Peak intensity was attained at 10/0000 UTC with 75 knots close to the centre whilst moving slowly south-southwest. *Kerry* remained a cyclone till after 14/000000 UTC, when it was downgraded into a tropical depression.

The remaining exposed low level circulation centre (llcc) of former *TC-Kerry* continued southward to approximately 80 miles off the southern Queensland coast and by 20th January, a week after losing tropical cyclone status, it was still evident in high resolution visible satellite imagery.

No reports of damage associated with *Kerry* have been received. However, there were no reported casualties.

Lola (06F) : 31 January – 02 February 2005

Lola was first identified as a tropical disturbance embedded in the South Pacific Convergence Zone (SPCZ) over Vanuatu on 27th January 2005 and drifting east-northeast about 05 knots. For the next 48 hours, the system was subjected to shear and diurnal influence. Throughout this period, 06F was lying under a divergent region, downstream of an approaching upper trough. SST was around 30°C. On the 29th, convection apparently increased, though briefly, about the low level centre but without any definite organization. TD 06F was then upgraded to a tropical depression. Through the 30th, the depression moved southeast across Fiji about 10 to 15 knots, with deep convection still displaced from the llcc. Overnight of the 31st, the llcc that was exposed in the day moved under the deep convection which had also erupted about the depression centre. Shear was still apparent but spiral bands were evidently wrapping with increasing curvature. 06F was then named *TC Lola* at 31/1800 UTC with winds of 35 knots close to the centre while moving southeast. *Lola* was located about 100 miles to the southwest of Nukualofa, Tonga by this time.

Lola continued southeast with slight intensification but dry air intrusion from the southwest quadrant and strong westerly winds aloft hindered any further development. Later on the 1st, the llcc was apparently re-exposed and movement towards the south slowed significantly. By 02/0000 UTC it was downgraded to a depression whilst located about 250 nm south-southwest of Nukualofa. The remnant depression slowed down in response to the ridge of high pressure to the south and persisted as a westward-moving and fully-exposed depression for several days. Apart from some losses to crops, particularly fruits, damage in Tonga was otherwise minimal.

Meena (07F) : 03 – 08 February 2005

Meena was the fourth cyclone of the Season and the first in a wave of intense tropical cyclones that were to develop in a very active convective trough which persisted through much of the central South Pacific, about the Dateline, for the entire month of February and into early March.

A tropical disturbance was first identified west of the Northern Cooks on the 1st of February, moving initially south slowly, as it began a gentle clockwise loop. At this stage, 07F was evidently sheared, being located just south of a 250-hPa ridge axis but in a divergent region. SST was around 30°C. Shear was anticipated to remain minimal. On the 2nd, the overall organization of the depression improved significantly with convection increasing and cooling about the centre. The llcc, however, was visibly exposed and displaced slightly away from the deep convection and outflow enhanced by the cross-equatorial flow. On the 3rd, the llcc gradually slipped underneath the steadily developing CDO. TD07F was then named *TC Meena* at 03/0600 UTC, while moving slowly north-eastwards and located some 100 miles east of Pago Pago, American Samoa.

12 hours later, at 03/1800 UTC, *Meena* was on a slow eastward path with storm force intensity, despite interaction with a short-wave upper trough to the southwest, which apparently retarded intensification. By 04/1200 UTC, organization had improved markedly, further, with a banding eye developing, though only discernible in visible satellite imagery. The cyclone then turned to the southeast at 10 knots and gradually accelerated under a strong northwesterly steering field. *Meena* continued to intensify with convective bands wrapping tightly around the CDO, deep convective tops cooling steadily, and a well-defined eye clearly evident. By 06/1200 UTC, peak intensity of 915 hPa and 10-minute average winds of 115 knots was reached and maintained for the following 12 hours. The very destructive core of the cyclone was then centered about 100 miles to the northwest of Rarotonga.

Thereafter, equator-ward outflow decreased with steady erosion in the deep convection in *Meena's* western semicircle. The rapid weakening was enhanced by increasing vertical wind shear and cooling SSTs. The cyclone moved into Wellington's AOR at 07/1200 UTC and soon afterwards merged with a baroclinic zone and was declared extra-tropical at 08/0000 UTC when located approximately 550 miles south of Tahiti. The remnant Low continued to accelerate to the east-southeast at 30 knots towards higher latitudes and the final reference to the former *Meena* system was at 08/1200 UTC with the centre a little over 850 miles southeast of battered Rarotonga.

The entire group of islands in the Southern Cooks fortunately escaped the destructive core of *Meena* as the cyclone weaved its way southwards without making a direct hit. In Palmerston, though, damage was limited to some coconut trees and small huts being blown down. Similarly, damage on Aitutaki was with felled trees and houses losing roofing and other damage caused by debris.

Meena's memorable fury was unleashed in the form of sea swells impacting on the fringing reef and coastline. Waves reportedly averaging 14 metres in height pounded the northern coast of Rarotonga especially in the commercial district of Avarua, causing severe damage to buildings along the waterfront and widespread rocks strewn some distance inland. Moderate damage was reported to homes and businesses immediately on or near the shore. Large amounts of debris were deposited along the coast and coastal roads. Power and phone services remained functional throughout most of the island with only isolated outages reported. Widespread damage was reported to cooking sheds, trees and gardens, especially in exposed

coastal areas along the eastern coast. However, damage was considerably less inland away from the coast. On Mangaia, the island's airport was strewn with rocks, the harbour reported as being un-operational and in need of urgent repairs, and the water distribution network was severely disrupted. Inland roads were made inaccessible due to fallen trees. It is believed that no critical injuries or fatalities were caused by the cyclone, which was attributed to good preparedness and public awareness initiatives.

Nancy (09F) : 12 – 17 February 2005

TD09F was first identified embedded in a monsoon trough and located to the northeast of Samoa at 10/1800 UTC. The system was located just west of an upper-level outflow in a low shear environment with SSTs around 30°C. Early development was hindered by an approaching trough from the southwest, which briefly increased shear. However, by 12/0600 UTC organisation and outflow had improved with a small CDO developing under the llcc. At 12/1800 UTC the depression was upgraded to cyclone status and named *Nancy* at approximately 300 miles east-northeast of Pago Pago and moving northeast at about 05 knots. *Nancy* was then located in a region of strong diffluence with good outflow to the north and south.

With the CDO increasing, deep convective tops cooling and primary bands wrapping tightly around the llcc, the cyclone attained storm intensity around 13/1200 UTC. 12 hours later, it reached hurricane force, while located about 400 miles east of Pago Pago, and moving southeast at 04 knots, closer towards, but to the south of Suvarrow Atoll. After some rapid intensification, satellite imagery revealed a symmetrical cloud pattern with an irregular but warm eye. Further intensification followed as *Nancy* remained in a region of strong diffluence assisted by twin outflow channels to the north and southeast

Peak intensity of 935 hPa and 10-min average winds of 95 knots was achieved at 14/1200 UTC when located approximately 100 nm south-southeast of Suvarrow Atoll and moving east-southeast at 12 knots. A gradual turn to the south-southeast and south ensued in the following 36 hours as *Nancy* crossed over the uninhabited atoll of Manuae, situated almost midway between Aitutaki and Atiu. Rapid weakening became evident as a result of increasing vertical wind shear associated with a sharpening upper-level trough to the southwest. Hurricane intensity was lost at 16/0600 UTC as the llcc became exposed 30 miles away from deep convection. By this time, *Nancy* had turned to a southwesterly path at 10-12 knots as a result of interaction with strengthening Tropical Cyclone *Olaf* situated to its northwest. Continued interaction with *Olaf* resulted in *Nancy's* deep convection being completely displaced toward the southwest away from the llcc. By 17/0600 UTC, *Nancy* had transformed into an extra-tropical Low on the Fiji/New Zealand border or approximately 300 miles southwest of Rarotonga with convection completely confined to the southern quadrant. The remnant Low moved into Wellington's AOR at this time and was soon afterward absorbed into the outer circulation of intense *Olaf* to the north.

Nancy had weakened considerably before brushing past Rarotonga, on its way towards the southwest. Damage incurred on the islands was severe to crops, trees/foliage, homes, buildings, infrastructure and public utilities. Damaging surge/swells pounded the north and northeastern coastlines of the islands of the Southern Cooks, severely affecting the coastal environment, businesses along the waterfront including hotels, and piling debris on roads as well as inland. As a precaution against surge/swells tourists were moved to evacuation centres and villagers told to move to higher and safer grounds. There were no reports of injury or casualties.

Olaf (08F) : 13 – 20 February 2005

Olaf developed into a tropical cyclone at 13/0600 UTC, only 12 hours after the naming of its 'twin' cyclone, *Nancy*, to its near east. Since 10/0000 UTC, a broad area of low pressure had become established from between Tuvalu across to the north of Samoa. Two disturbances were spawned off this area with the one to the west developing into TD08F roughly 500 miles northeast of Fiji and slow moving. For the following 48 hours, moderate shear and diurnal variations restricted intensification, despite the depression being located south of a 250-hPa outflow centre and under strong divergence. However, by 13/0600 UTC, convection increased in organisation and cooled about the central area with bands spiraling into the lcc. SSM/I data around this time evidently showed a definite banding eye. 08F was then named at 13/0600 UTC, after re-analysis, with winds of 35 knots near the centre. The cyclone was then located about 450 miles to the northwest of Apia, Samoa, and at the commencement of a tight clockwise loop.

At 14/0600 UTC, *Olaf*, underwent some rapid intensification, under decreasing environmental shear and strong diffluence aloft. *Olaf* was upgraded to a hurricane, then, whilst turning and gradually accelerating east-southeast, out of the clockwise loop it started 24 hours prior. The cyclone steadily intensified after this, developing a well-defined and warm eye and central deep convection cooling further. In the Special Advisories issued to Samoa, the intensifying cyclone was anticipated to remain to the northeast of Samoa, steered by a deep northwesterly field. Peak intensity was achieved between 16/1200 UTC and 16/1800 UTC with a central pressure of 915hPa and a 10-minute average wind speed of 115 knots near the centre. During this period, Hurricane *Olaf* was moving steadily southeast passing very close, but just to the east of the Manu'a Islands (Tau and Ofu), in American Samoa

Weakening began around 17/1200 UTC as shear began to increase, aided by an approaching upper-level trough from the west. Dry air entrainment was also evident, gradually eroding convection in the cyclone's southwest quadrant. *Olaf* was then steadily trekking southeast, and located about 200 miles west-northwest of Palmerston, Southern Cooks. The destructive part of the cyclone was steered clear of the Southern Cooks as it accelerated southeast. Primary responsibility for warnings was handed over to Wellington TCWC as *Olaf* moved into Wellington's AOR at 19/0000 UTC, approximately 330 nm south-southwest of Rarotonga. TC *Olaf* became extra-tropical by 20/0000 UTC as it accelerated further south at up to 25 knots, re-intensifying as a powerful 968-hPa extra-tropical system two days later. At 0000 UTC on the 23rd it was a weakening 40-knot gale, centre crossing the 50th parallel roughly 1700 miles southwest of lonely Pitcairn Island.

In Independent Samoa, winds sustained damage on power lines on Savai'i. Extensive tidal damage was also reported in coastal areas. Faleolo International Airport in Apia was also closed during and after the cyclone. On Tutuila, American Samoa, the National Disaster Council reported that no injuries or major damage was sustained. However, on Manua'a islands, damage was severe on homes, crops, infrastructure, public utilities and coastal environment. Lack of electricity and healthy drinking water created health concerns, making the US President George W. Bush to declare a major disaster in the Manu'a island group after being advised by the territory's Governor. Twenty-three people were rescued from the sea, with two people reported as missing from a fishing boat that sank. At the time of this report, it is not clear whether they had been accounted for.

Despite passing well to the west of the Southern Cooks, there were reports of damage to homes and businesses with disruptions to power and communications on Rarotonga. On the island of Palmerston, heavy swells were reported to have inundated up to 100 meters inland as *Olaf* passed by. There were no reports of death or injury on land from *Olaf*.

Percy (10F) : 24 February – 05 March 2005

Percy was the seventh tropical cyclone of the Southwest Pacific for the 2004/2005 season and the final intense cyclone in a wave of storms to affect the region in February.

10F was first identified as a tropical disturbance embedded in an active monsoon trough at 23/0000 UTC, approximately 380 miles to the west of Funafuti and moving eastwards about 05 to 10 knots. The system was then located just south of a 250-hPa ridge axis, in a diffluent region. Shear and diurnal variations were evidently influencing development. SST was around 31°C. Later on the 24th, shear had decreased markedly. Outflow was favourable and developing in all quadrants. Overnight, the depression underwent explosive development with the deep convection increasing spatially and in organization whilst cooling. Spiral bands were also wrapping tightly around the lcc. By 24/1800 UTC, TD10F was named Tropical Cyclone *Percy*, while located roughly 100 miles to the east of Funafuti and moving east-southeast at 14 knots under a deep west-northwest steering flow.

12 hours later, with organization increasing markedly and suggestions of an eye forming, though only briefly, *Percy* was upgraded to a storm. 24 hours after being named, the cyclone had attained hurricane intensity, as a ragged but warming eye persisted. *Percy* was then located about 360 miles northwest of Apia or roughly 210 miles west of Nukunono, Tokelau, and beginning to turn slightly more towards the southeast. Between 26/0600 UTC and 26/1800 UTC, the cyclone was at its closest proximity to the Tokelau group, but remaining within 60 to 70 miles to the west and south of the Atoll as it accelerated slightly east-southeast. In the 24 hours ending at 28/0000 UTC, the system adjusted to an eastward track, and decelerated, near Pukapuka, and later on, Nassau, in the Northern Cook Islands, with 85 to 90 knots close to the centre. Hereafter, the cyclone's structure became somewhat asymmetric under the influence of increasing northeasterly vertical wind shear forcing a slight weakening trend between 27/0000 UTC and 28/0600 UTC, but maintaining intensity at hurricane force. The closest *Percy* neared Pukapuka was about 10 to 20 miles to the south at 27/2100 UTC and near or over Nassau at around 28/0300 UTC. After 28/0600 UTC, the cyclone recommenced intensification as deep convection re-organised over the CDO with the cloud pattern regaining a symmetrical pattern and an eye soon re-appearing in EIR imagery. This re-intensification was enhanced by a jet entrance region to the south as the cyclone turned sharply south at 10 knots around the western periphery of a mid-level ridge to the east. Because of this, *Percy* remained at least 110 miles to the west of Suvarrow, and similarly Palmerston, Southern Cook Islands, as the cyclone continued poleward. After March 02/1200 UTC, the cyclone began to turn towards the southeast and gathered speed under a strengthening northwest steering regime, enhanced by a mid-level ridge to the east. It maintained this track before turning again towards the east-southeast at 04/000 UTC and sped towards Nadi's southern border with the approach of an upper trough. Primary responsibility for future warnings was handed over to Wellington TCWC after 04/1200 UTC, while moving into Wellington's AOR. *Percy* apparently attained two peaks in intensity, the first around 27/0600 UTC with central pressure of 925hPa and winds of 100 knots close to centre. The second was achieved at 02/0600 UTC with a central pressure of 900 hPa and maximum winds estimated at 125 knots.

Percy severely battered Tokelau, damaging hospital facilities, schools, office and community buildings, homes, roads and power lines and leaving widespread debris. Surge/swells coinciding with king tides swamped the atolls in up to a metre of sea water and damaged coastlines and seawalls. Live coral formations were covered by sand and debris. The

agricultural sector suffered severely with destruction of staple crops, including fruit-bearing and root crops.

Communications on Swain's Island, north of Samoa, was severed for a week. Severe damage was also sustained on buildings, including one in which residents took shelter. Surge/swell also took its toll with very heavy damage on coastal ecosystem.

All homes in Pukapuka and Nassau in the Northern Cook Islands were either destroyed or suffered heavy damage forcing residents to stay in churches and schools. In Pukapula, schools were severely damaged and water tanks as well as catchment areas polluted by seawater. In Palmerston, Southern Cooks, communications to and from the island was severed during the cyclone.

Rae (12F) : 05 – 06 March 2005

Rae was a short-lived storm that just managed to reach cyclone status, in the wake of its intense predecessor, *Percy*. An easterly-moving tropical disturbance TD12F was first identified at February 28/1800 UTC to the northeast of Rotuma along the SPCZ. The disturbance was then located under a 250-hPa outflow with relatively weak environmental shear. Deep convection remained detached from the centre, apparently active in the northern and eastern quadrants. SST was around 30°C. The system's close proximity to *Percy*, lying to the east, somewhat suppressed development for the following three to four days, despite existence under diffluent flow. All this while the system was steadily moving east before acquiring a southeast track on the 3rd, but keeping to the northeast of Samoa as it continued generally towards the Southern Cooks. It was not until 04/1815 UTC that convective organization rapidly improved with the development of a primary convective band. With some shear and diurnal influences suppressing development, the depression was steadily steered by deep monsoon westerlies towards the south-southeast at 10 knots, into an area of reduced shear, good outflow to the north and the jet entrance region to the south. 24 hours later, 12F was named *Rae*, as convection erupted about the IICC and gales developing in most quadrants near the centre. The cyclone was then located approximately 200 miles west-southwest of Rarotonga and moving southeast at 13 knots. At 06/0000 TC, primary bands were wrapping around the IICC. Peak intensity was also achieved during this time with a central pressure of 990 hPa and wind of 40 knots near the centre. 6 hours later, with the increasing vertical wind shear and drier air entrainment, weakening commenced. By 06/1200 UTC, *Rae* was downgraded to a tropical depression as deep convection was significantly detached to the south of the IICC. 12F was then located approximately 180 miles south of Mangaia, and decelerating east-south against a low-level ridge to the south, which helped sustain gales between the depression and the high pressure ridge to the south, for a couple of days, yet.

There were no reports of damage or casualties as a direct consequence of *Rae*. The cyclone remained over open waters throughout its lifetime.

Sheila (15F) : 22 April 2005

Sheila was the ninth and last tropical cyclone to form in the region during the 2004/2005 season. TD15F was first identified embedded in a persistent monsoonal trough extending from north of the Solomon Islands to Fiji on the 20th of April. At 20/0600 UTC, it was located south of Labasa, Fiji, and moving northeast. Shear was moderate with diurnal influences quite apparent. SST was about 28-29°C. On the 21st, the depression began to turn and eventually accelerated towards the southeast at 20 knots, just north of the Niuaus, Tonga. Overnight of the

21st convection about the IICC, erupted. In so doing, resultant shear over the system was reduced sufficiently to allow some development. 15F was named *Sheila* at 22/0000 UTC with winds of 35 knots near the centre, whilst located to the northwest of Niue and steadily shuttling southeast. With the persistence of shear which was steadily increasing, the cyclone soon began to weaken. It was downgraded to a tropical depression at 22/1800 UTC as shear virtually tore away the cyclone structure and while located to the southeast of Southern Cooks. The cyclone peaked with central pressure of 990 hPa and winds of 40 knots close to the centre at 22/1200 UTC. (CP of 990 hPa, maximum 10-min avg winds of 40 knots) near 19.3S/166.4W. There were no reports of damage associated with *Sheila*.



References:

1. **Australian Bureau of Meteorology web site**, <http://www.bom.gov.au/>, for Monthly SOI values and 5-month running mean, from 2000 to 2005.
2. **2005 Global Tropical Cyclone Summaries**, Gary Padgett