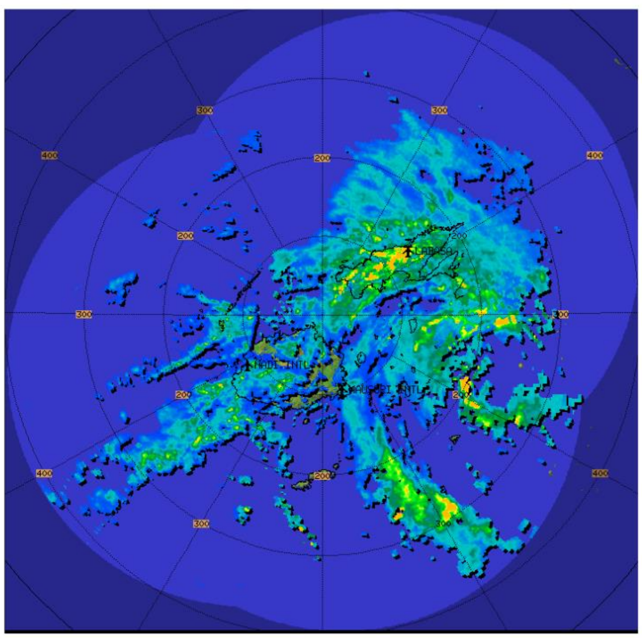
Fiji Meteorological Service

Report on Tropical Cyclone RAE

23^{rd} - 25^{th} February, 2025.



Radar image of TC RAE over Lau Waters at 0000 UTC on 24th February.

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1.0 Introduction

Tropical Cyclone (TC) Rae, pronounced as "Ray," was the second named system in the Southwest Pacific Region by the Regional Specialized Meteorological Center (RSMC) Nadi during the 2024/2025 Tropical Cyclone Season. TC Rae reached the higher end of Category[1] 2 intensity, with sustained winds of up to 110 km/h and gusts reaching 155 km/h at its peak within Fiji waters. The system maintained TC intensity from 0600 UTC on the 23rd to 1200 UTC on the 25th.

Throughout February 2025, the South Pacific Convergence Zone[2] (SPCZ) and Maiden Julian Oscillation[3] (MJO) remained highly active within the Fiji Area of Responsibility (AoR), leading to the formation of several low-pressure systems. Out of all the tropical low-pressure systems, four tropical low-pressure systems were numbered (TD06F, TD07F, TD08F and TD09F), while TD09F further intensified to TC Rae.

TC Rae originated from a tropical low-pressure system embedded within the SPCZ, initially forming to the far northeast of Fiji at 1800 UTC on February 20. The Nadi RSMC monitored the system closely throughout its early development as a tropical disturbance, tracking its evolution until its eventual dissipation within Fiji’s AoR.

The tropical low pressure intensified and was officially designated Tropical Disturbance 09F (TD09F) at 2100 UTC on February 21. It subsequently strengthened into a tropical depression at 1500 UTC on February 22, approximately 350 km northeast of Cikobia.

By 0600 UTC on February 23, TD09F had reached tropical cyclone (category 1) status while positioned 160 km east-northeast of Cikobia or 265 km northeast of Labasa, leading to be named as TC Rae. The cyclone initially tracked south-southwest, moving across Northern Vanua Levu and Northern Lau waters, before shifting southerly over the Koro Sea and Southern Lau waters. As it continued its trajectory, TC Rae eventually adopted a south-southeasterly path, exiting Fiji waters to the south. The system maintained an average movement of 11 knots while traversing Fiji waters.

This Tropical Cyclone Report aims to provide a historical account of TC Rae’s development, tracking, and dissipation phases, analyzing the environmental influences that shaped its movement through its life cycle. Additionally, the report details all warnings and advisories issued throughout the cyclone’s duration. An assessment of TC Rae’s impacts, including affected regions, infrastructure damage, and operational responses from the Tropical Cyclone Warning Center (TCWC), is included to provide insights into its broader consequences. The appendix section includes verification statistics, best track maps and details, analysis tracks, observational data recorded during TC Rae’s passage, scatterometry and microwave imagery, as well as photographic evidence of the damages caused.

[1] The category system is based on the Australian Tropical Cyclone Category system. Category 1 cyclone has mean winds 34-47 knots, category 2 cyclone has mean winds 48-63 knots, category 3 cyclone has mean winds 64-85 knots, category 4 cyclone has mean winds 86-107 knots and category 5 cyclone has mean winds greater than 107 knots.

[2] The SPCZ plays a crucial role in atmospheric dynamics across the Southwest Pacific, forming where trade winds from the near equatorial ridge and winds associated with the subtropical ridge converge. This interaction fosters significant cloud formation, thunderstorms, and enhanced rainfall. During an active Madden-Julian Oscillation (MJO) phase, eastward-moving convection often induces westerly wind bursts north of the SPCZ, increasing cyclonic vorticity. These wind bursts can initiate the formation of cyclonic circulations, which—under favorable conditions such as warm sea surface temperatures and low vertical wind shear—can develop into tropical cyclones.

[3] The Madden-Julian Oscillation (MJO) is an eastward-moving pulse of tropical convection that propagates across the Indian and Pacific Oceans, influencing large-scale weather patterns. This oscillation consists of alternating phases of enhanced and suppressed convective activity, typically on a 30- to 60-day cycle. During an active MJO phase, increased convection can generate westerly wind bursts in the tropics. These bursts enhance cyclonic vorticity, promoting the formation of low-pressure systems or disturbances that may evolve into tropical cyclones under favorable environmental conditions.

2.0 History

Active SPCZ affected the weather conditions over most parts of the Southwest Pacific Region during the month of February, 2025. Four tropical disturbances (including TD09F which intensified to the TC status) formed within the SPCZ during February. The climate driver influencing formation of these disturbances was mainly the MJO being active over the Fiji AoR. Figure 2.1 below shows (red line) that active MJO signal propagated from the Maritime Continent to Western Pacific and exited into phase 8 (Western Hemisphere).

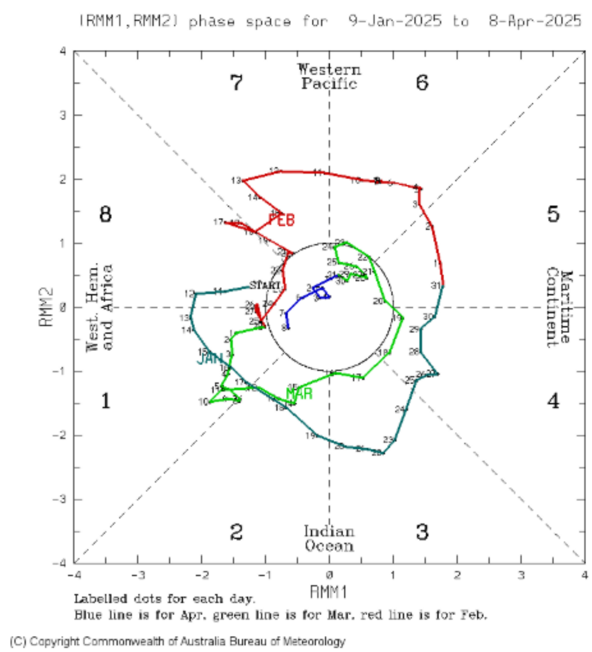


Figure 2.1: RMM reanalysis diagram showing active MJO over Fiji AOR during the month of February, 2025

On 20th February at 1800 UTC, a tropical low-pressure system was analyzed within a broad area circulation within the SPCZ as shown in figure 2.2 below. Initially the low was analyzed to the northwest of Fiji but later developed to the east within the SPCZ, to the northeast of Fiji. At 2100 UTC on the 21st, RSMC Nadi determined that the tropical low-pressure system had met the criteria for classification as a tropical disturbance while positioned 230 km north-northeast of Udu Point. The system was subsequently designated as TD09F. Atmospheric conditions surrounding TD09F were assessed as favorable for further intensification. This included favorable sea surface temperatures of 30°C (Figure 2.3), low vertical wind shear (Figure 2.4), and negative 850 hPa relative vorticity (Figure 2.5). Additionally, an upper-level ridge produced diffluent winds aloft TD09F's center (Figure 2.6), facilitating the formation of outflow channels. Strong upper-level divergence (Figure 2.7) further enhanced atmospheric support for development. Collectively, these factors created a highly favorable environment for further intensification of TD09F.

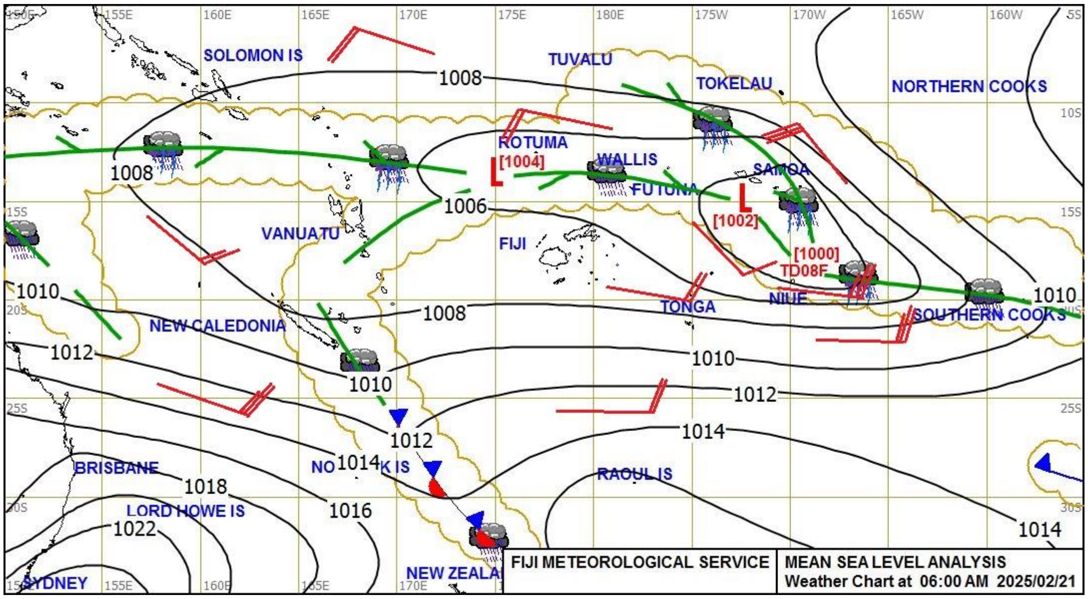


Figure 2.2: Mean Sea Level Pressure chart showing tropical low-pressure system (that later developed into TD09F) being analyzed to the northwest of Fiji at 1800 UTC on 20th February.

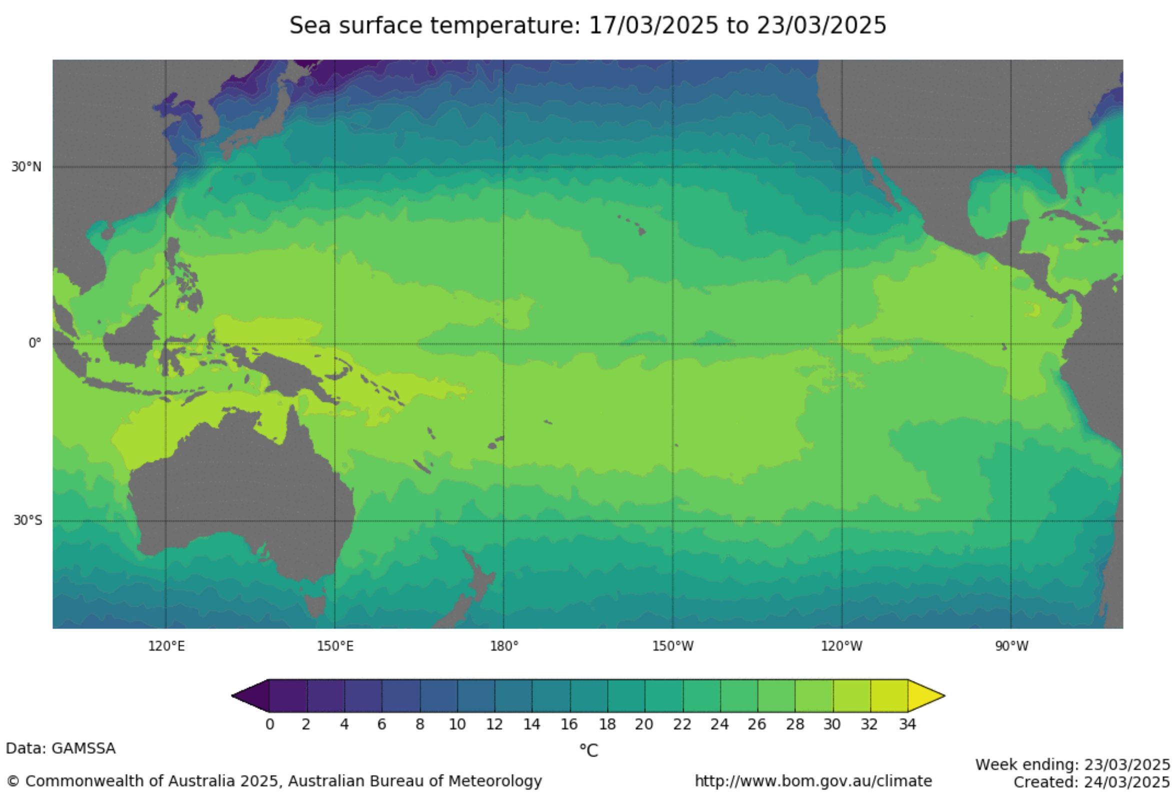


Figure 2.3: Weekly sea surface temperature analysis from Bureau of Meteorology indicating sea surface temperature around 30 degrees Celsius just to the northeast of Fiji, where TD09F was located on 21st February at 2100 UTC.

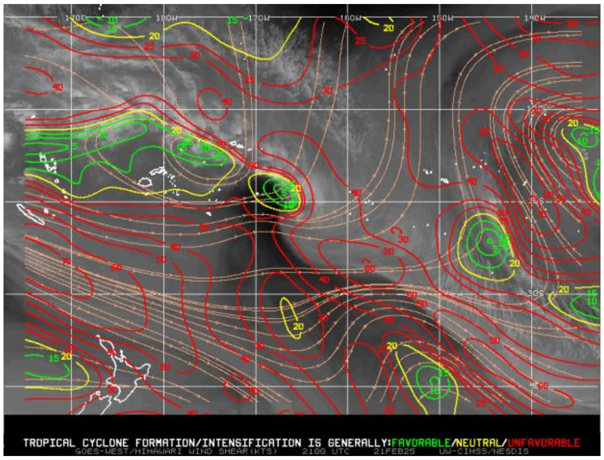


Figure 2.4: CIMSS analysis showing a narrow band of low shear where TD09F was analyzed (northeast of Fiji, around 12.8S 178.1W) at 212100 UTC.

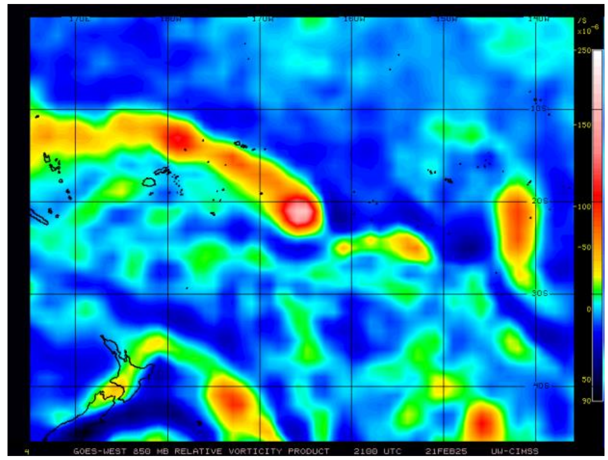


Figure 2.5: CIMSS analysis indicating good negative relative vorticity associated with TD09F (just to the northeast of Fiji, around 12.8S 178.1W) at 212100 UTC.

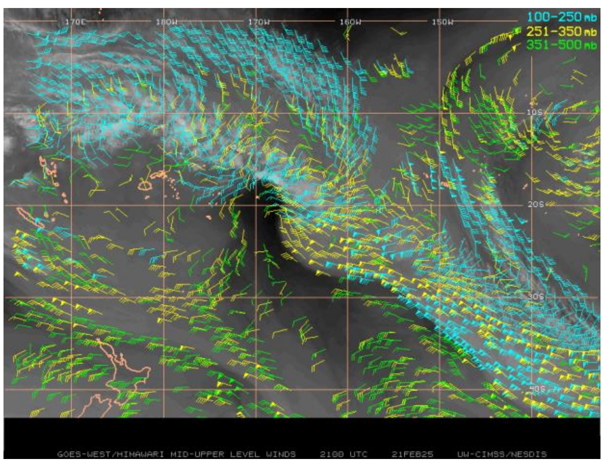


Figure 2.6: CIMSS analysis showing diffluent upper level winds aloft TD09F (northeast of Fiji, around 12.8S 178.1W) at 21210 UTC

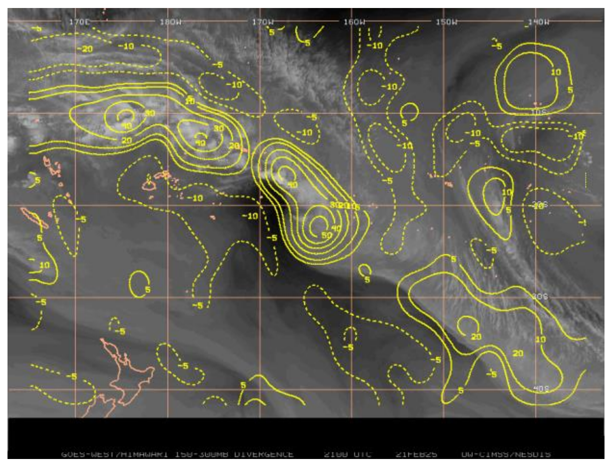


Figure 2.7: CIMSS analysis showing good upper divergence over TD09F (northeast of Fiji, around 12.8S 178.1W) at 212100 UTC

During its disturbance stage, TD09F was slow moving due to its shallow nature with no dominant steering, remaining embedded within the SPCZ. The extent of the system was up to 700 hPa and figure 2.8 shows that the deep layer mean steering up to 750 hPa, where TD09F was located, as weak hence the system was slow moving. The system steadily intensified as it benefited from the favorable environmental conditions conducive to development. At 221500 UTC, it was officially classified as a tropical depression while located 210km northeast of Udu Point near 13.4S 177.7W. Persistent deep convection within the SPCZ near TD09F (Figure 2.9) supported its intensification. Scatterometer data (Figures 2.10 and 2.11) revealed a developing symmetric system, with winds reaching up to 30 knots near the center, particularly in the eastern semicircle.

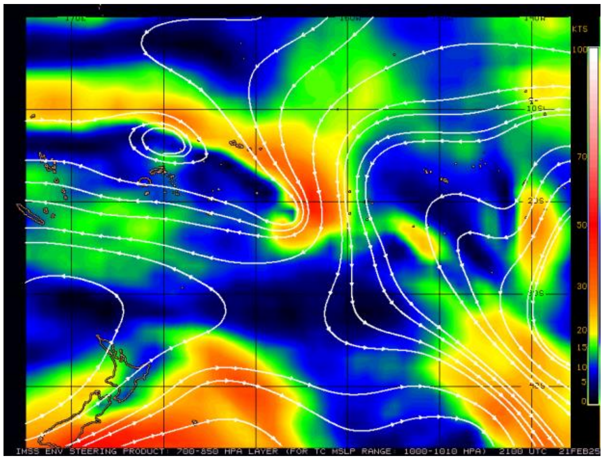


Figure 2.8: CIMSS analysis showing TD09F lying in an area with a weak steering while being embedded within the SPCZ (northeast of Fiji, around 12.8S 178.1W) at 212100 UTC

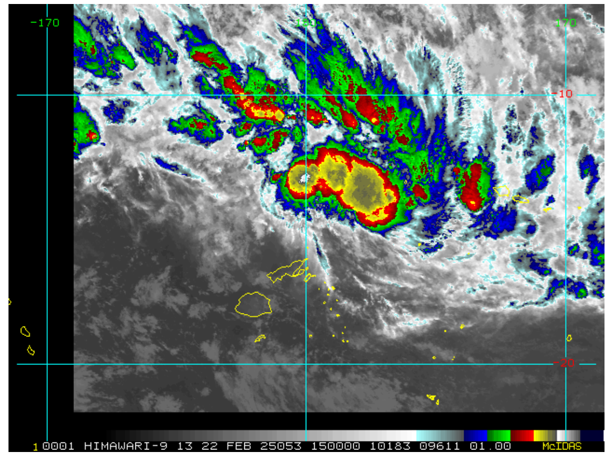


Figure 2.9: Himawari-9 EIR imagery showing deep convection flaring over TD09F at 221500 UTC.

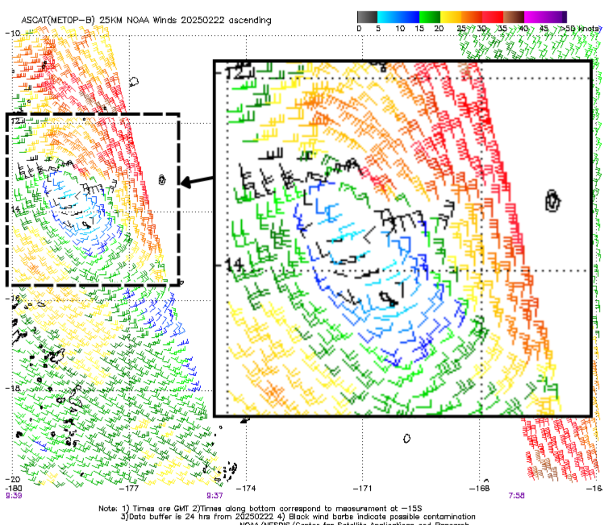


Figure 2.10: ASCAT imagery showing TD09F center at 220935 UTC

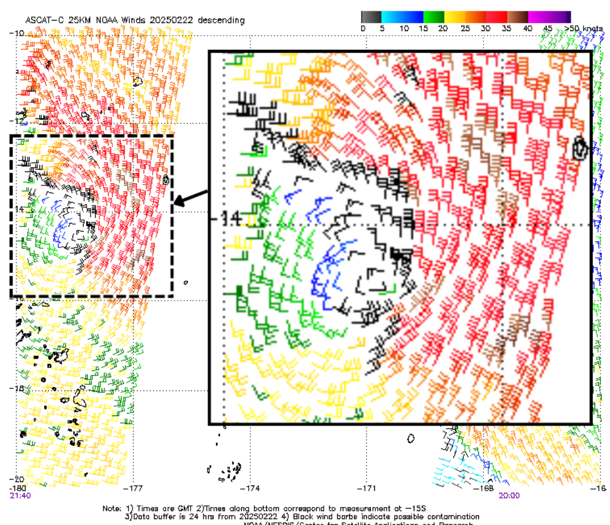


Figure 2.11: ASCAT imagery showing TD09F center with winds up to 30 knots near center within eastern semicircle at 222140 UTC

Tropical Depression TD09F remained in a favorable environment conducive to further intensification. A narrow band of low to moderate shear (Figure 2.12), combined with an upper-level divergence and diffluent flow (Figures 2.13 and 2.14) over LLCC contributed significantly to the system's continued strengthening. The system was positioned on the periphery of the near equatorial ridge as shown in figure 2.15 and was steered south-southeast by deep layer mean winds from 850 to 500hPa towards Fiji waters while intensifying.

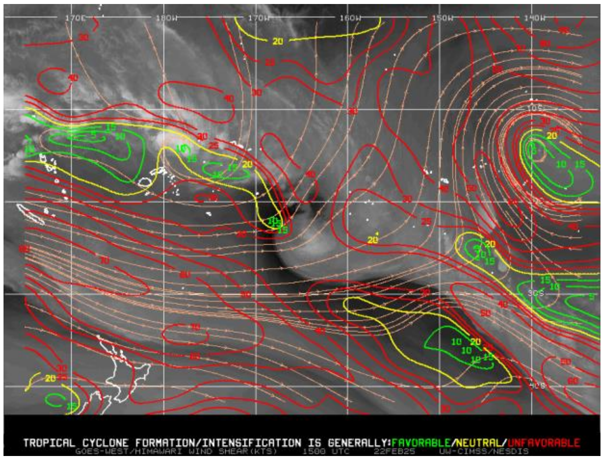


Figure 2.12: CIMSS analysis showing narrow band of low to moderate shear over TD09F center to the northeast of Fiji, located near 13.4S 177.7W at 221500 UTC

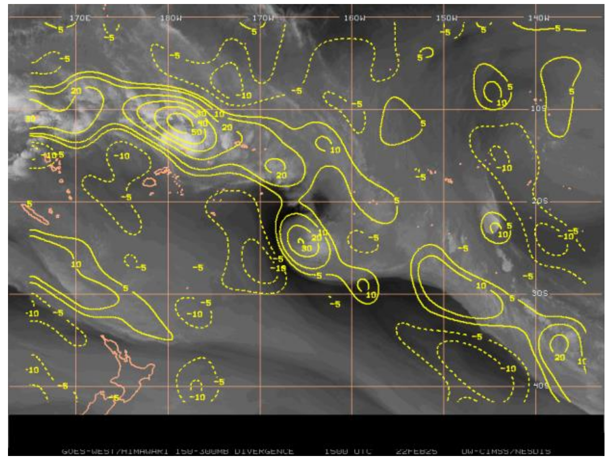


Figure 2.13: CIMSS analysis showing good upper level divergence over TD09F LLCC to the northeast of Fiji, located near 13.4S 177.7W at 221500 UTC

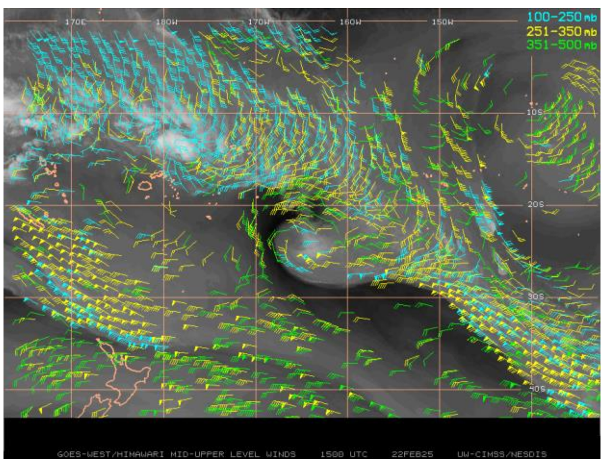


Figure 2.14: CIMSS analysis showing diffluent wind flow over TD09F LLCC to the northeast of Fiji, located near 13.4S 177.7W at 221500 UTC

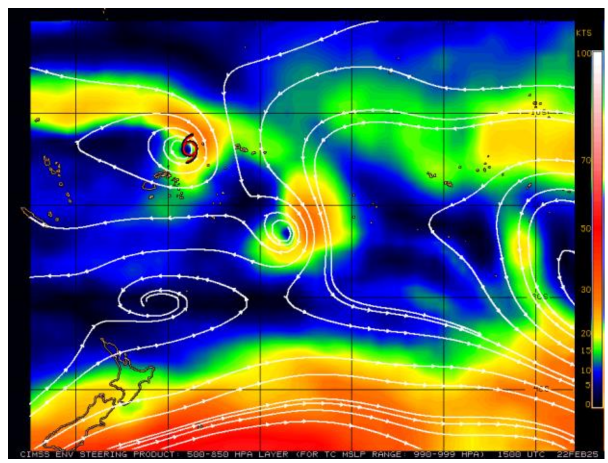


Figure 2.15: CIMSS analysis showing TD09F lying on the periphery of near-equatorial ridge, to the northeast of Fiji, located near 13.4S 177.7W at 221500 UTC

Based on Dvorak analysis of Enhanced Infrared (EIR) imagery (Figure 2.16), a 0.6 wrap on the log 10 spiral indicated that TD09F had intensified with 35 knots winds near the center and gusts up to 50 knots, meeting the criteria for naming. Consequently, RSMC Nadi designated it as Tropical Cyclone Rae (Category 1) at 0600 UTC on February 23. At the time of naming, its center was located approximately 190 kilometers northeast of Udu Point. This system transitioned into a tropical cyclone just 36 hours after initial monitoring began, showing a normal development trend.

TC Rae continued to be steered to the south-southwest by the northwest-southeast oriented near equatorial ridge (figure 2.17) located to the east of the system. As the system headed south-southwest, it was moving into an area of high wind shear (Figure 2.18). However, situated just south of an upper-level ridge within a diffluent region, the system benefited from strong upper-level divergence (Figure 2.19) and favorable outflow through two distinct channels, one to the north and another to the south (Figure 2.20), which was favorable for development.

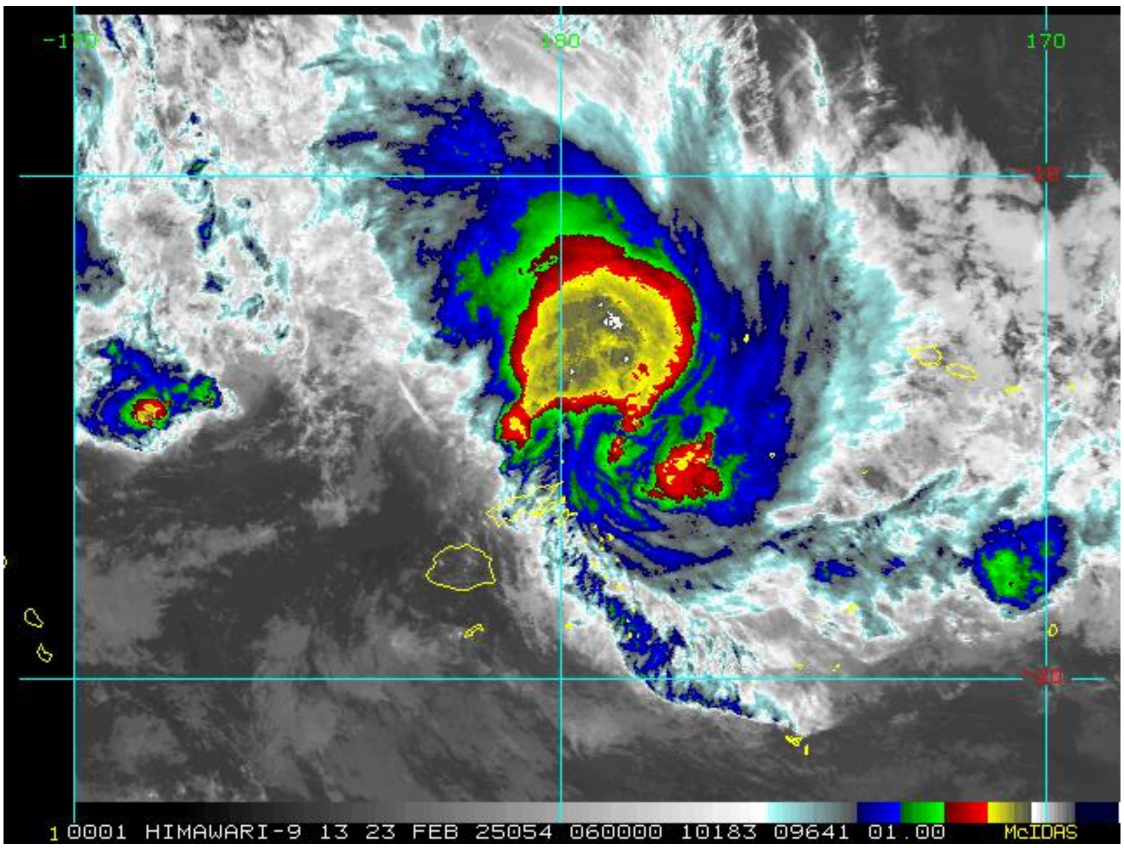


Figure 2.16: Satellite imagery at the time of naming, LLCC located near 15.1S 178.6W.

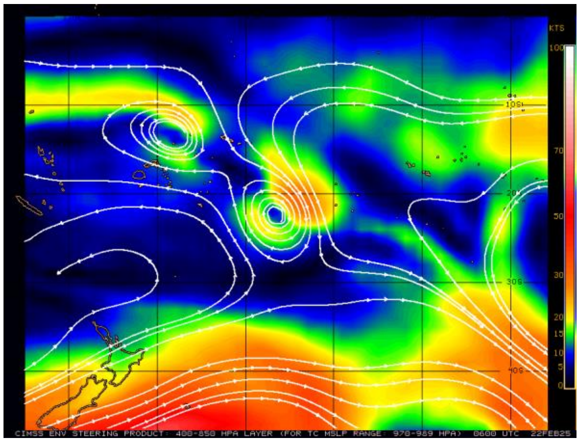


Figure 2.17: CIMSS analysis imagery showing TC Rae positioned on the periphery of the near equatorial ridge at 230600 UTC, and being steered south-southwest.

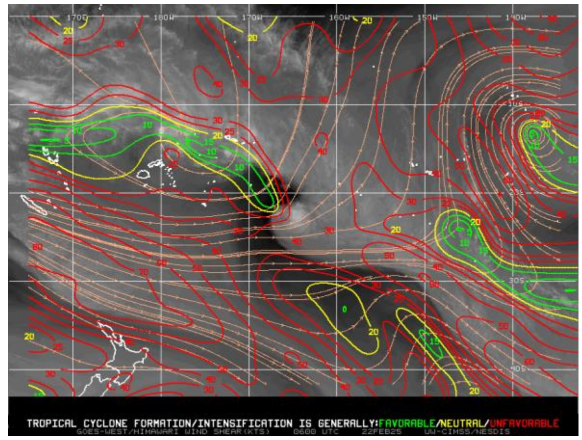


Figure 2.18: CIMSS analysis imagery showing low to moderate wind shear over TC Rae Center at 230600 UTC, while high sheared environment immediately to the south.

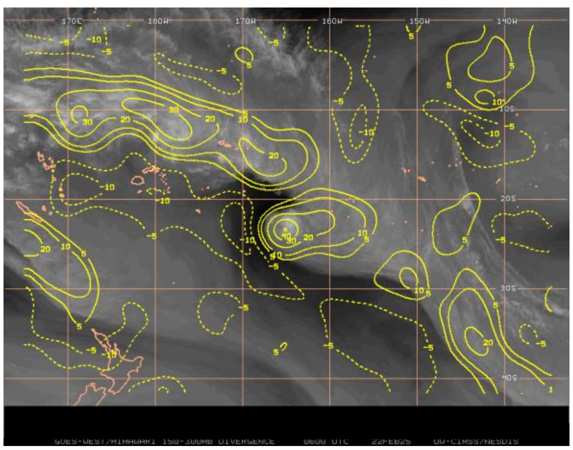


Figure 2.19: CIMSS analysis imagery showing moderate to good upper divergence over TC Rae Center at 230600 UTC.

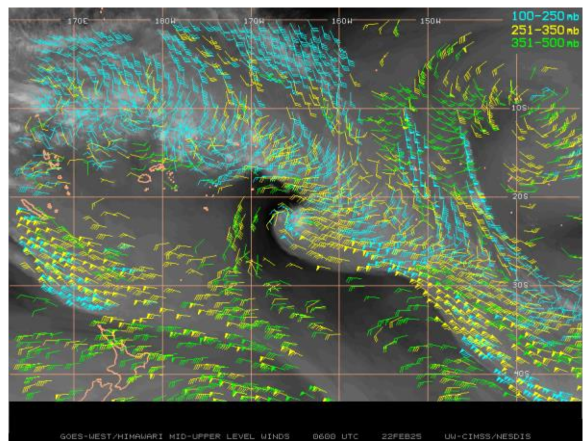


Figure 2.20: CIMSS analysis showing good outflow channels (one to the north and one to the south) providing good ventilation for TC Rae at 230600 UTC.

Within 6 hours of its classification as a TC, Rae intensified into a category 2 system while lying around 125 km east-northeast of Udu Point or near 16.2S 178.8W at 231200 UTC. The cloud system (figure 2.21) analysis using Dvorak analysis yielded a 0.8 wrap on log10 spiral, yielding a DT of 3.5 which corresponds to a category 2 system with 50 knots around the TC center. The system developed within a favorable region of upper-level divergence, which effectively counteracted the influence of higher shear. This dynamic allowed TC Rae to maintain a narrow band of low shear directly over the system (figure 2.22). TC Rae continued to lie on the periphery of the near equatorial ridge (figure 2.23) and be steered to the south-southwest. The system continued to remain within a favorable upper-level divergence area

(Figure 2.24), supporting sustained convective organization. Additionally, well-established outflow channels (Figure 2.25) enhanced ventilation, further contributed to the cyclone's ability to maintain its structure and intensity.

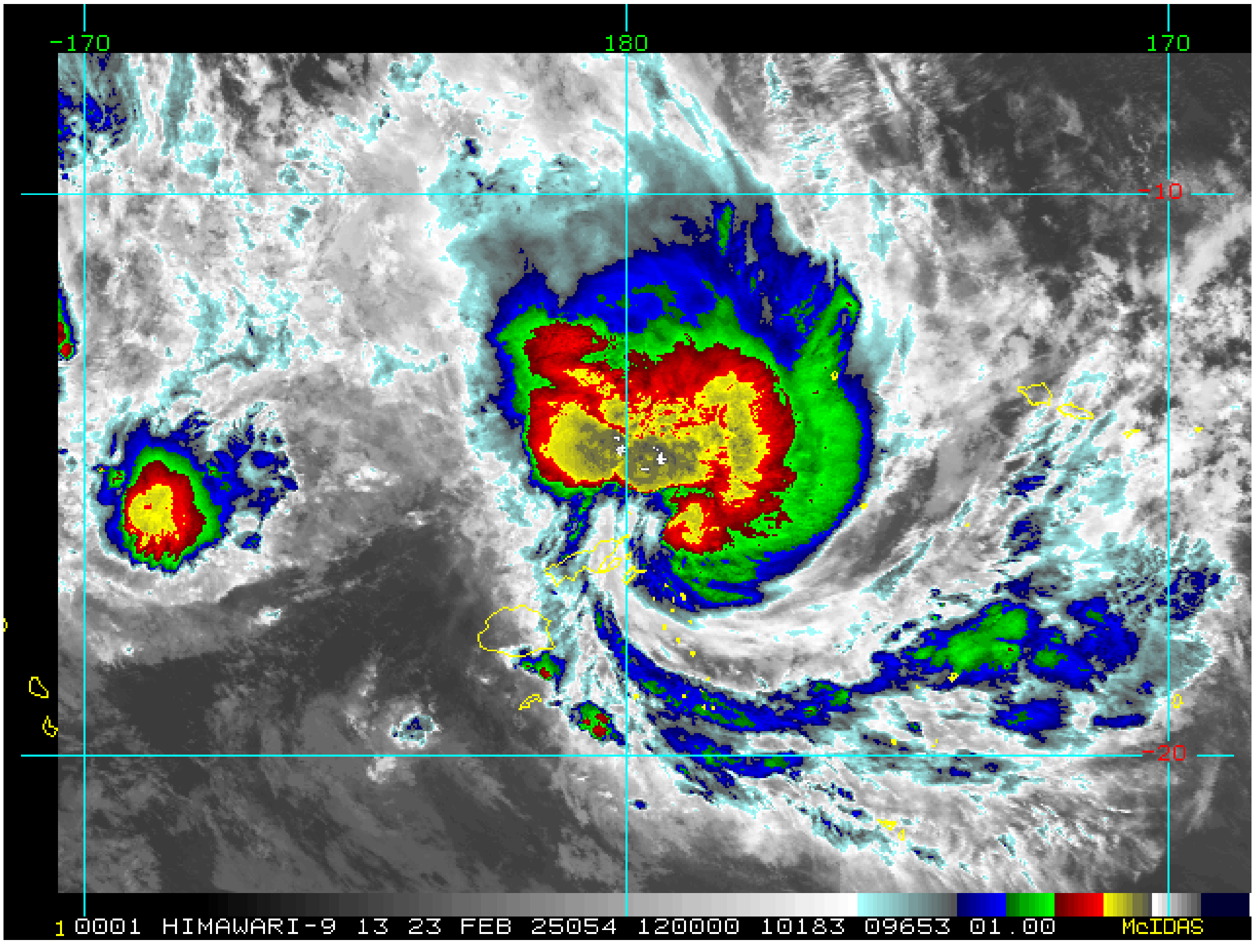


Figure 2.21: Satellite imagery at 231200 UTC showing a well-defined curvature which yields a 0.8 wrap on Log10 spiral.

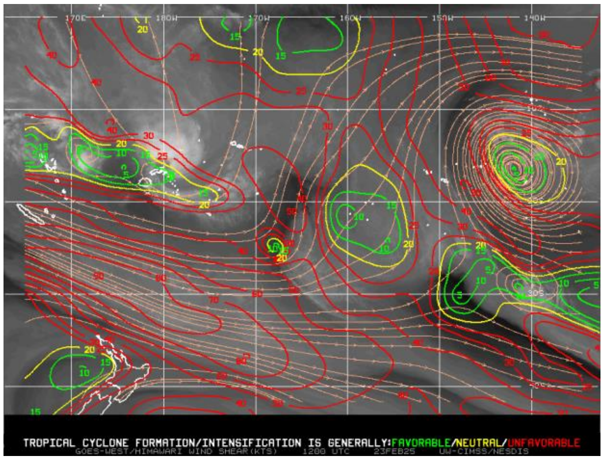


Figure 2.22: CIMSS analysis imagery showing narrow band of low to moderate shear over TC Rae at 231200 UTC.

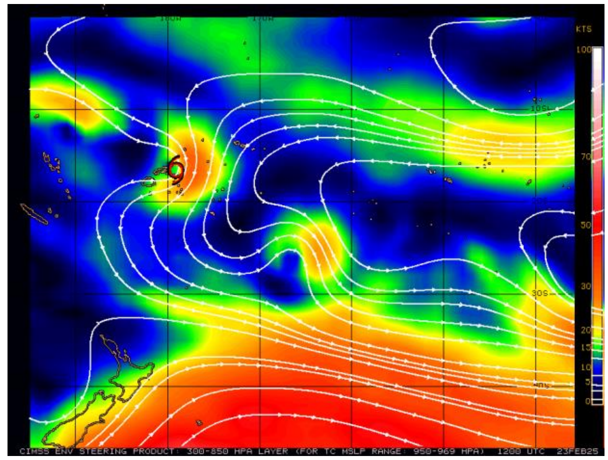


Figure 2.23: CIMSS analysis imagery showing TC Rae positioned at the periphery of the near-equatorial ridge at 231200 UTC.

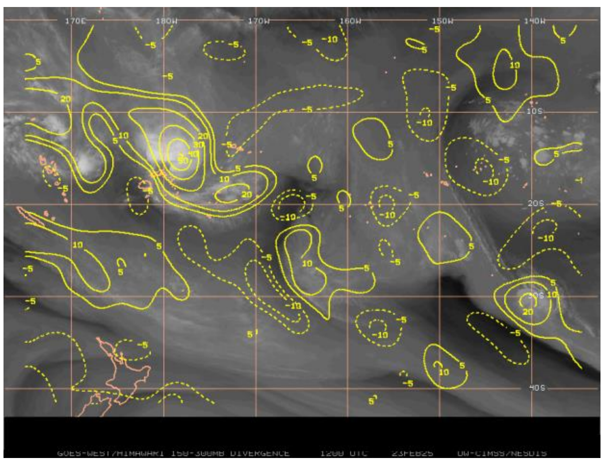


Figure 2.24: CIMSMS analysis imagery showing TC Rae positioned in a moderate to good upper level divergence at 231200 UTC.

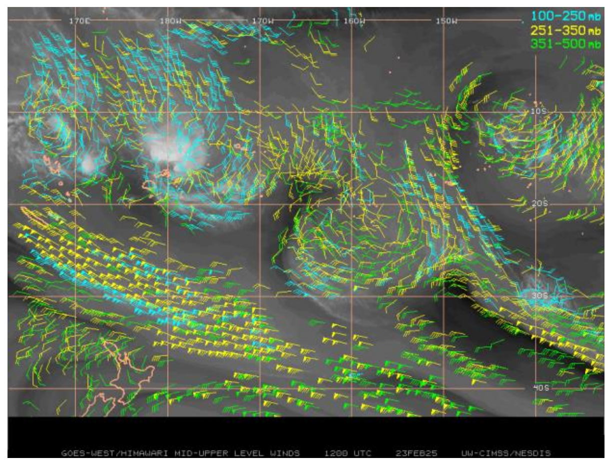


Figure 2.25: CIMSS analysis imagery showing good outflow over TC Rae at 231200UTC.

TC Rae took a southerly track as it entered Southern Lau Waters, maintaining its strength and intensity over the Fiji group. ASCAT imagery (figure 2.26) indicates presence of storm-force winds in the eastern sector of the cyclone center at 2030 UTC on the 23rd. By 1200 UTC on the 24th, TC Rae was positioned just south of the periphery of the near-equatorial ridge (Figure 2.27), and was being steered to the southeast. The cyclone's intensity peaked at 241200 UTC, with sustained winds of 60 knots near the center.

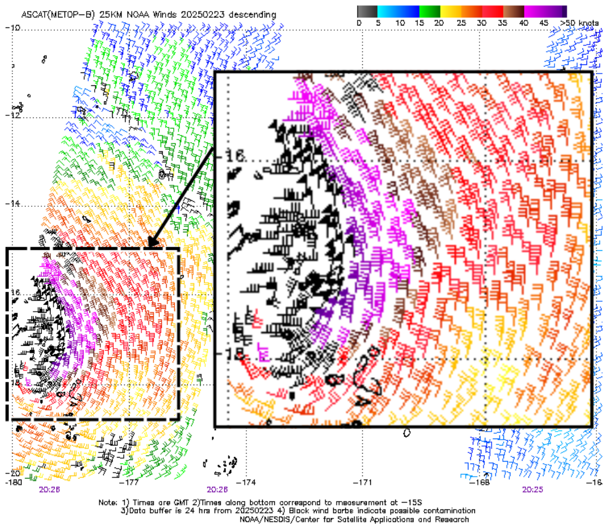


Figure 2.26: ASCAT imagery showing storm force winds (50 knots) present within the system at 232030 UTC.

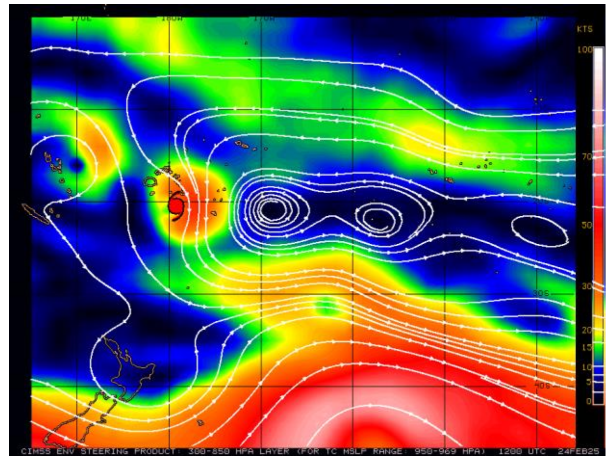


Figure 2.27: CIMSS analysis showing TC Rae positioned just to the south of the near equatorial ridge at 241200 UTC.

The system continued tracking southeast, maintaining its peak category 2 strength until 250000 UTC before beginning to weaken as the main divergent area (figure 2.28) got displaced to the east due to high shear interaction (Figure 2.29). Additionally, TC Rae was moving into a cooler sea surface temperature (SST) environment, further contributing to its weakening trend. At this time, TC Rae was positioned approximately 130 km south-southeast of Ono-I-Lau or near 22.8S 178.2W. The cyclone gradually weakened to a category 1 system within 12 hours, reaching this intensity by 251200 UTC. By 251500 UTC, TC Rae had exited the Fiji AoR while transitioning into an extratropical low-pressure system (figure 2.30).

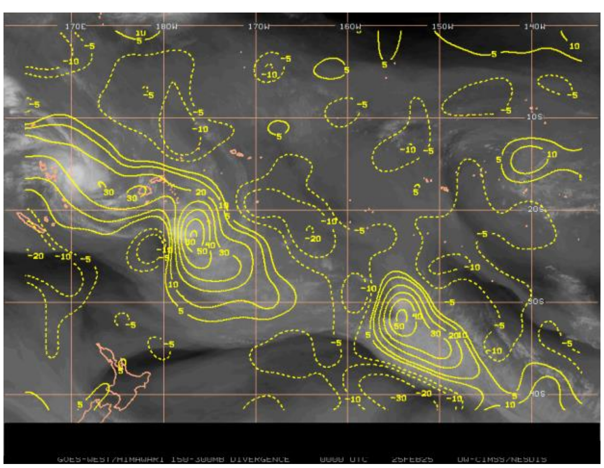


Figure 2.28: CIMSS analysis showing main divergent area displaced to the east of TC Rae center at 250000 UTC.

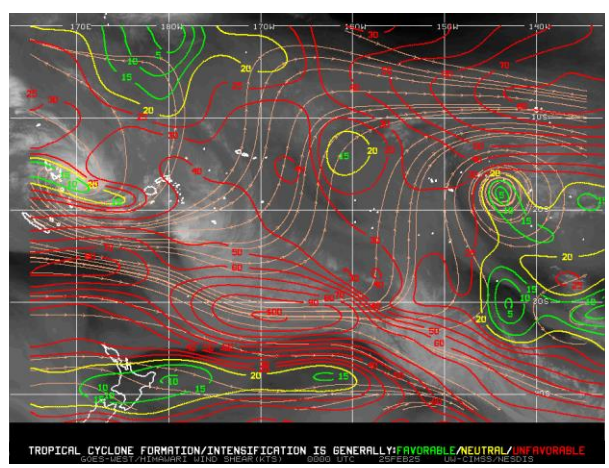


Figure 2.29: CIMSS analysis showing high shear over TC Rae when the system was located just to the southeast of Fiji, near 22.8S 178.2W at 250000 UTC.

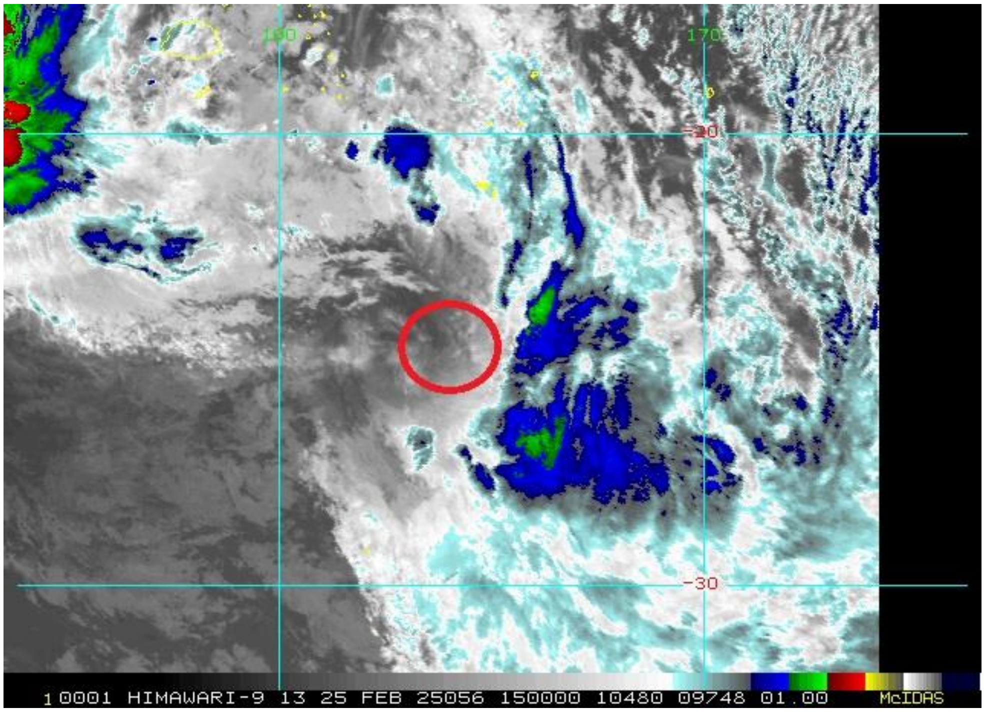


Figure 2.30: Satellite imagery showing deep convection displaced from the center, center in area marked with red circle.

3.0 Warnings and Advisories

Throughout the lifecycle of Tropical Cyclone Rae, a series of warnings, advisories, and alerts were issued to ensure the safety of communities and the protection of infrastructure within the affected regions. These communications, disseminated by the TCWC, were strategically timed and tailored to reflect the evolving nature of the cyclone's intensity and trajectory. The alerts aimed to provide actionable guidance, mitigate risks, and enhance preparedness across vulnerable areas. Below is a detailed list of the specific warnings and advisories issued during TC Rae's progression.

1. **International Marine Warnings**

The first International Marine Warning was issued based on the 211800Z analysis, highlighting the development of winds up to 35 knots within the next 18 to 24 hours in the convergence zone associated with the evolving tropical low. Following this, three warnings were issued for developing gales within the convergence zone, specifying the areas bound by the gale conditions.

As gales began developing away from the center of TD09F during its depression stage, two warnings were issued for gales further away from the TD center, covering a 12-hour period before the transition to WTPS warnings. Upon reaching tropical cyclone status at 230600 UTC and being named TC Rae, two WHPS warnings were issued, anticipating that TC Rae could intensify into a severe Category 3 tropical cyclone. However, analysis after 12 hours indicated that TC Rae would peak at the higher end of category 2, hence transitioned to WTPS warnings, aligning with revised expectations of TC Rae. In total, eight WTPS warnings were issued.

Additionally, gales persisted within the synoptic-scale convergence zone during the system's passage, prompting the issuance of seven WOPS warnings. Altogether, a total of 23 International Marine Warnings were issued throughout TC Rae's lifecycle.

2. **Tropical Disturbance Advisories**

The first Tropical Disturbance Advisory (TDA) for TC Rae was issued at 221711UTC, based on the 221500 UTC analysis. This was followed by an advisory for the 211800UTC analysis, and subsequently issued every 6 hours, approximately 2 hours after the analysis time. These advisories provided critical information, including the location of the tropical cyclone, its intensity, central pressure, movement, current environmental conditions, forecast trajectory, and the rationale behind the assigned intensity. A total of 13 TDAs were issued for TC Rae by TCWC Nadi, with the final advisory released at 251200 UTC, following the system’s classification as an extratropical low.

3. Character Form for the Representation and Exchange of Data (CREX)

To support efficient data exchange during TC Rae's lifecycle, a total of 12 CREX bulletins were issued, providing structured, machine-readable meteorological updates. These bulletins contained essential cyclone parameters, including position, intensity estimates, and environmental conditions, ensuring interoperability across forecasting centers and operational users. The first CREX bulletin was issued following the system's upgrade to a tropical cyclone, with subsequent releases aligned with the advisory schedule to maintain consistency in communication.

4. Tropical Cyclone Advisories

The Tropical Cyclone Advisories (TCA) were issued specifically for the aviation community, beginning when TC Rae was officially named and continuing until the final advisory when the system was declassified. In total, 10 advisories were disseminated, ensuring that aviation stakeholders received critical updates on the cyclone's progression, potential impacts on flight operations, and necessary precautionary measures.

5. Significant Meteorological Information (SIGMET)

Throughout TC Rae's lifecycle, SIGMETs were consistently issued at six hourly intervals following the system's initial classification, ensuring continuous updates for aviation operations until the cyclone exited the Nadi Flight Information Region (FIR). A total of eight SIGMETs were issued by the Nadi Meteorological Watch Office (MWO). Additionally, two SIGMETs were issued by the New Zealand MWO to extend coverage for aircraft operating in adjacent FIRs impacted by the system's progression.

6. Special Weather Bulletins (SWB)

While a series of troughs of low-pressure systems affected the Fiji group in February, heavy rain alerts were already in place before TC Rae impacted Fiji. The first heavy rain alert in anticipation of TD09F was issued at 202230 UTC, primarily for the northern parts. A total of four Special Weather Bulletins (SWB) for heavy rain were released during the alert phase, with subsequent updates expanding coverage to include the eastern parts of the group.

The first SWB for Tropical Cyclone Warning was issued at 221730 UTC, targeting the northern and eastern regions as the system intensified. In the initial warning, gale conditions were anticipated for the eastern parts of Vanua Levu, Cikobia, Taveuni, nearby smaller islands, and the Northern Lau group. Meanwhile, strong wind warnings were issued for the rest of the Northern Division, Lomaiviti group, the remaining areas of Lau group, Kadavu and nearby smaller islands, Yasawa, Mamanuca, and the eastern parts of Viti Levu.

While SWBs for tropical cyclone warning phases in Fiji are typically issued every three hours, an accelerated schedule was implemented while TC Rae's center remained within Fiji RADAR range. From 231430 UTC onward, SWBs were released every two hours until the cyclone's center could no longer be discerned on RADAR imagery. In total, 21 SWBs for Tropical Cyclone were issued by RSMC Nadi, including the final cancellation phase.

7. Track and Threat Maps

Track and threat maps are typically issued every six hours to provide structured updates on a system's projected movement and potential impact areas. However, since TC Rae directly affected the Fiji group, the frequency of these updates was increased to every three hours, ensuring more timely and detailed guidance for decision-makers, emergency responders, and the broader community. In total, 25 track maps and 25 threat maps were issued throughout the cyclone's lifecycle.

8. Official Forecast Track (OFT) data to United Nations Office for the Coordination of Humanitarian Affairs (OCHA)

To facilitate broader humanitarian response efforts, six-hourly track updates for TC Rae were provided to the United Nations Office for the Coordination of Humanitarian Affairs (OCHA) during the lifecycle of TC Rae. These updates were sent via email to a designated address, ensuring that global partners had access to timely cyclone trajectory information for planning and disaster preparedness.

4.0 Observations and Impacts

The direct impacts of TC Rae were observed over the Lau and Lomaiviti groups, where the system made landfall, bringing damaging winds and heavy rainfall. Meteorological observations have been summarized in Table 4.1, detailing key parameters recorded during the cyclone's passage. Wind speeds and gusts exceeding 35 knots, along with Mean Sea Level (MSL) pressure values below 1000 hPa, have been highlighted in yellow for emphasis.

Observations from eight stations were utilized for forecasting and verification, providing crucial data for assessing the system's intensity and trajectory. Udu Point station recorded strong winds as TC Rae passed to its east, with the most intense winds first observed at 232200 when the system was located about 160 km south-southeast of Udu Point. Gale-force winds reached up to 44 knots, with gusts peaking at 47 knots, primarily due to the active convergence zone associated with TC Rae. Savusavu station on the other hand had reported gusts up to 35 knots, which were associated with the convergence zone.

Observations from Matei Airstrip confirm that sustained gale-force winds of 35 knots, with gusts reaching up to 50 knots, were recorded when TC Rae's center was positioned approximately 115 km south-southeast of Taveuni. Four observations at Matei consistently indicated gale-force winds from 0000 UTC on 24th till 0300 UTC on the same day. The minimum recorded pressure at this station was 996hPa at 232200 UTC while the system center was located 60 km east-southeast of Taveuni. However, these may not be the lowest pressure and strongest winds at Matei as the TC had moved to the south, crossing much closer to Matei when the observations started to be recorded.

While TC Rae's center moved approximately 90 km west of Vanuabalavu during its passage through Fiji waters, gales were not recorded at this station. The lowest pressure observed was 991 hPa around 2200 UTC on the 23rd, with recordings ceasing at 0000 UTC on the 24th. This gap in data implies that the strongest winds and lowest pressure values at Vanuabalavu may not have been fully captured.

As TC Rae progressed over the southern parts of Fiji, its center was positioned approximately 70 km east of Matuku at 0600 UTC on the 24th. While gale-force winds were not reported at this station, gusts reached up to 42 knots as the system moved through the vicinity. The lowest recorded MSL pressure was 998 hPa. Observations remained available as TC Rae approached Ono-I-Lau, with gusts peaking at 42 knots. However, data collection ceased while the system's center was still about 130 km northwest of Ono-I-Lau, leaving gaps in capturing its peak intensity at this location.

Date / Time	Labasa		Savusavu		Matei		Lakeba		Ono-I-Lau		Udu Point		Matuku		Vanua-balavu	
	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH
231200	-	-	-	-	-	-	12012	1006	06015	1008	19018	-	12015	1006	08010	1003
231300	-	-	-	-	-	-	12012	1005	06015G25	1007	20018	-	12015	1006	08010	1002
231400	-	-	-	-	-	-	12012	1005	06017	1006	21023	-	14016	1005	09014	1000
231500	-	-	-	-	-	-	12012	1004	06020	1006	-	-	13018	1005	10015	999
231600	-	-	-	-	-	-	12012	1003	-	-	-	-	13015G26	1005	10012	997
231700	-	-	-	-	-	-	12016	1003	08018	1006	22028	-	-	-	07017	997
231800	-	-	-	-	-	-	12016	1003	08020	1006	23028	-	12018	1005	06016	995
231900	18017	1003	-	-	-	-	13016	1003	08015	1007	-	-	12018G30	1006	08023	992
232000	25018	1003	22022	1003	23021G41	996	13020	1004	08010	1008	27030	-	15018G30	1006	02023	993
232100	26019	1004	25018G25	1003	26022G38	997	13020	1002	08015	1008	-	-	15010	1006	08024	991
232200	23017	1005	29011G25	1003	29026G45	999	13016	1002	05015G25	1008	27035G46	-	16025G35	1006	34025	991
232300	25019	1006	30011	1004	32030G45	1001	13022	999	05015G25	1007	-	-	15026G37	1006	36021	996
240000	23013	1006	28013	1004	32035G50	1002	13020	997	05020	1007	29032	-	14015	1003	-	-
240100	23018	1007	31009	1004	32035G50	1002	13022	995	05020	1007	29038	-	15028G38	1001	-	-
240200	24019	1007	31009	1004	32035G48	1004	13024	992	05020	1006	28035G47	-	18021G36	1000	-	-
240300	26014	1007	31009	1005	32035	1005	32044	992	05020	1005	30031	-	18030G40	1000	-	-
240400	27011	1007	30013G35	1006	32030	1005	32044	993	05015G25	1003	-	-	16032G42	998	-	-
240500	-	-	31009G25	1006	-	-	06016G25	1003	05017G27	1002	32044	-	16020G32	998	-	-
240600	-	-	-	-	-	-	32030	1000	05018G28	1003	32024	-	16020	998	-	-
240700	-	-	-	-	-	-	32028	1001	08020G30	1003	31025	-	15030G42	998	-	-

Date / Time	Labasa		Savusavu		Matei		Lakeba		Ono-I-Lau		Udu Point		Matuku		Vanua-balavu	
	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH	Winds Dir, Speed & Gusts (kts)	QNH
240800	-	-	-	-	-	-	32024	1003	08025G35	1003	34018	-	20028G38	999	-	-
240900	-	-	-	-	-	-	32024	1003	08028G38	1002	28013	-	23028	1000	-	-
241000	-	-	-	-	-	-	32024	1006	08028G40	1002	28018	-	30020G30	1002	-	-
241100	-	-	-	-	-	-	32018	1007	08030G42	1000	29010	-	29020	1003	-	-
241200	-	-	-	-	-	-	32018	1007	-	-	-	-	31024	1004	-	-
241300	-	-	-	-	-	-	32016	1007	-	-	-	-	31018G30	1004	-	-
241400	-	-	-	-	-	-	32014	1007	-	-	-	-	31018G30	1005	-	-
241500	-	-	-	-	-	-	32014	1007	-	-	-	-	29023	1006	-	-
241600	-	-	-	-	-	-	32012	1007	-	-	-	-	32018	1006	-	-
241700	-	-	-	-	-	-	32012	1008	-	-	-	-	27020	1007	-	-
241800	-	-	-	-	-	-	32012	1008	-	-	-	-	32023	1008	-	-

The observed impacts were not solely attributed to TC Rae but also to the associated convergence zone, which significantly affected Taveuni, Lau, and Lomaiviti. As the system tracked over the eastern parts of the group, its influence prompted more than 1,400 people to seek shelter in evacuation centers, as noted in NDRMO Situation Reports 3–5 [1]. The most severe impacts were concentrated in the eastern semicircle of TC Rae’s center, where the strongest winds were recorded.

TC Rae inflicted economic losses, with houses being blown off and damage sustained by unshielded structures. Several homes with weak structure in Tuvuca village (Vanuabalavu) were destroyed during the cyclone [2]. The Vanuabalavu Postshop suffered significant damage due to storm-force winds [1]. Additionally, Cicia Jetty was severely impacted [3]

Transportation disruptions were widespread, with domestic flights and shipping services servicing the eastern and northern divisions cancelled during TC Rae's passage [3]. A ship broke free from its mooring and was wrecked against a retaining wall in Taveuni due to storm-force winds [4].

The Northern Division, however, experienced minimal direct impacts, with no major structural damage reported [5]. Nevertheless, damage to crops and trees was evident across the northern and eastern regions, leading to agricultural losses.

The rain bands associated with TC Rae affected most parts of the group. Significant rainfall during the cyclone’s passage on 24th February is summarized in Table 4.2 below. The Northern Division and parts of Viti Levu received substantial rainfall, leading to flooding and road closures in various areas [6].

Table 4.2: Significant rainfall within 24 hours received by various stations during the passage of TC Rae from 9am on 23rd February to 9 am on 24th.

Location	Rainfall (mm)
Narayabale	220.0
Bukuya	160.0
Delawa	137.5
Nadarivatu	112.0
Nanoko	107.5
Koro Island	104.5
Keiyasi	102.0

5.0 Conclusion

Tropical Cyclone Rae was well forecasted and tracked by RSMC Nadi. This system demonstrated clear interactions with the near-equatorial ridge which played a major role in TC Rae’s steering. The cyclone exhibited lower track variability compared to the five-year average, indicating improved forecasting accuracy and model performance, particularly in short to mid-range predictions. While initial intensity projections varied, post-event analysis confirmed that forecasts remained reasonably aligned with observed conditions, reinforcing confidence in operational assessments.

TC Rae's impacts were significant across the Lau and Lomaiviti group, where structural damage, agricultural losses, and disruptions to transportation networks were reported. Over 1,400 individuals were displaced to evacuation centers in preparation for TC Rae, prompting emergency responses to mitigate further risks. Observational data confirmed gusty winds up to storm force, contributing to widespread infrastructure damage, including destroyed homes and damaged public facilities.

6.0 References

[1] S. R, "Situation Report Number 3," National Disaster Risk Management Office, Suva, 2025.

[2] V. Narayan and A. Narawa, "TC Rae intensifies bringing more rain, strong winds and flooding," Communications Fiji Limited, 24 February 2025. [Online]. Available: https://www.fijivillage.com/news/Tropical-Cyclone-Rae-to-bring-heavy-rain-strong-winds-and-flooding-today-r8f4x5/. [Accessed 15 March 2025].

[3] S. R, "Situation Report Number 5," National Disaster Risk Management Office, Suva, 2025.

[4] M. Chand and M. Feroz, "People of Wainikoro, Lagalaga, Wavuwavu and Duavata are experiencing strong winds and heavy rain," Communications Fiji Limited, 24 February 2025. [Online]. Available: https://www.fijivillage.com/news/People-of-Wainikoro-Lagalaga-Wavuwavu-and-Duavata-are-experiencing-strong-winds-and-heavy-rain-x8r4f5/. [Accessed 15 March 2025].

[5] P. Naviticoko, "Minimal impact from TC Rae says Rainima," Fiji Broadcasting Cooperation, 26 February 2025. [Online]. Available: https://www.fbcnews.com.fj/news/minimal-impact-from-tc-rae-says-rainima/. [Accessed 15 March 2025].

[6] K. Kumar, "Severe weather forces road closures in the North," Fiji Broadcasting Corporation, 24 February 2025. [Online]. Available: https://www.fbcnews.com.fj/news/severe-weather-forces-road-closures-in-the-north/. [Accessed 16 March 2025].

Meteorological Data Archives From:

[1] Cooperative Institute for Research in the Atmosphere:

https://rammb-data.cira.colostate.edu/tc_realtime/index.asp

[2] Cooperative Institute for Meteorological Satellite Studies:

https://tropic.ssec.wisc.edu/

[3] Center for Satellite Applications and Research:
https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php

[4] Bureau of Meteorology:

https://www.bom.gov.au/climate/

7.0 Appendices

Appendix 1: Best Tracking data

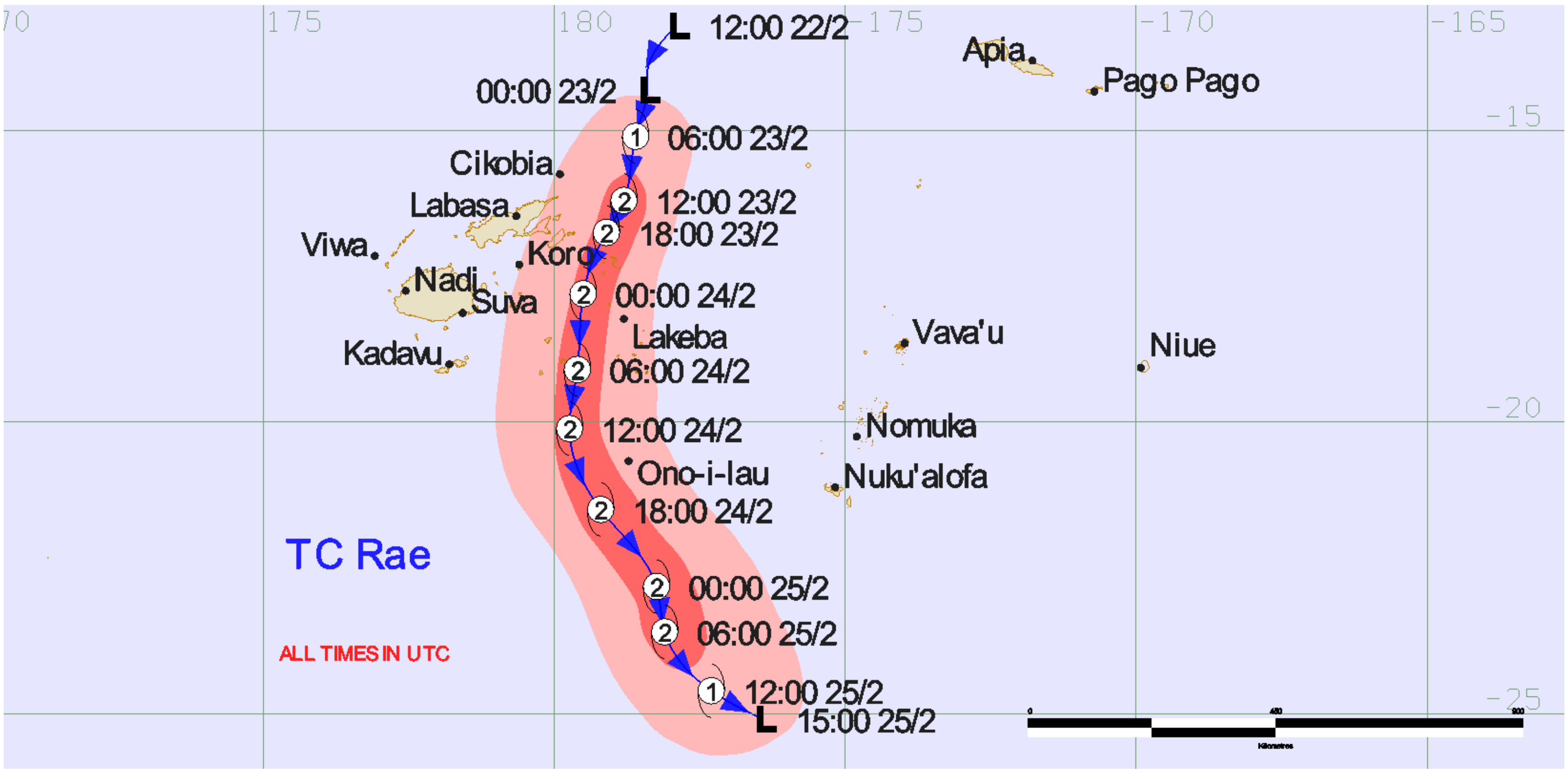


Figure 7.1: Post event analysis best track map with area of gale in lighter shade of red and area of storm force winds in a brighter shade of red.

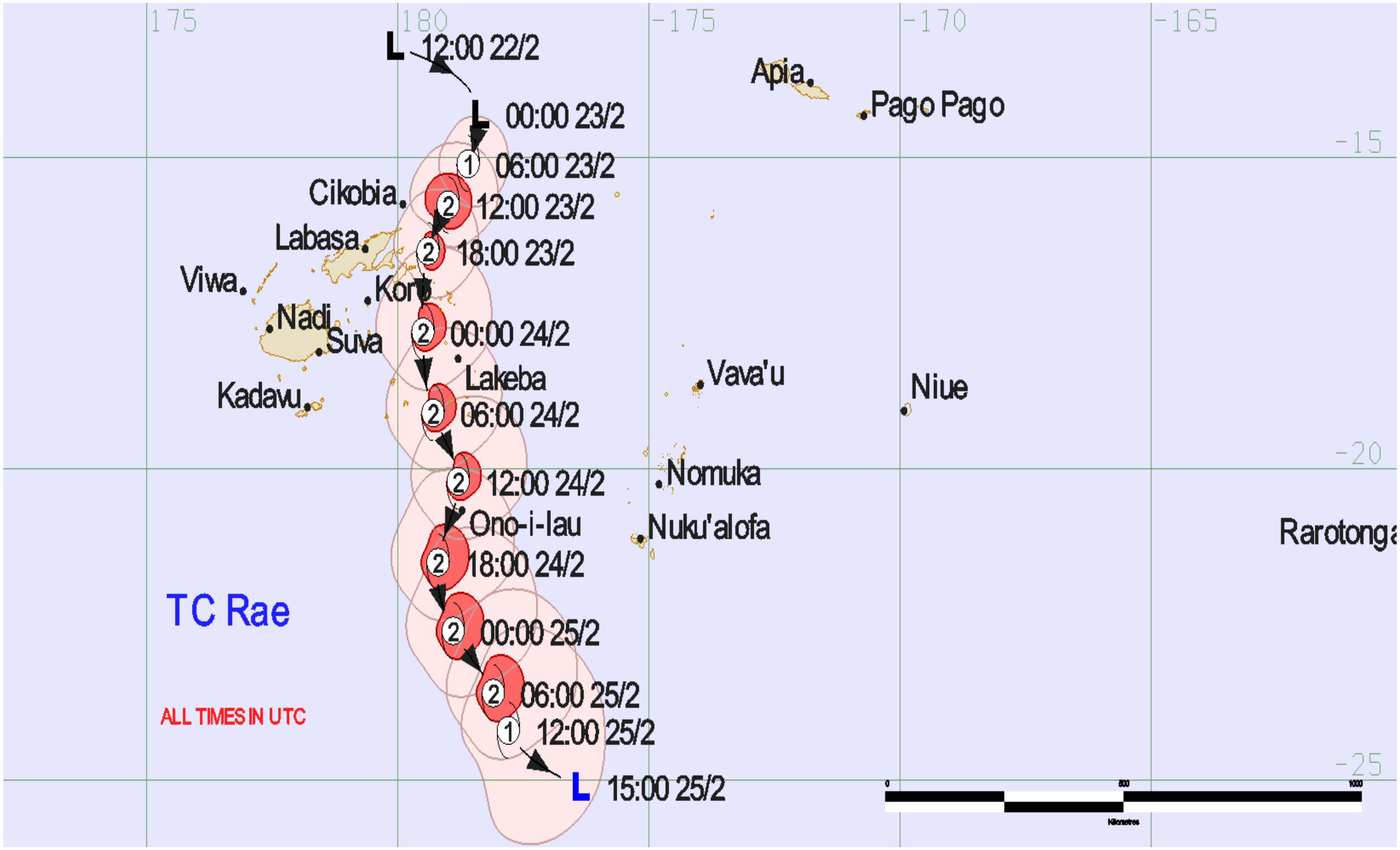


Figure 7.2: Operational analysis track with area of gales in lighter shade of red and storm force winds in darker shade of red at times of analysis.

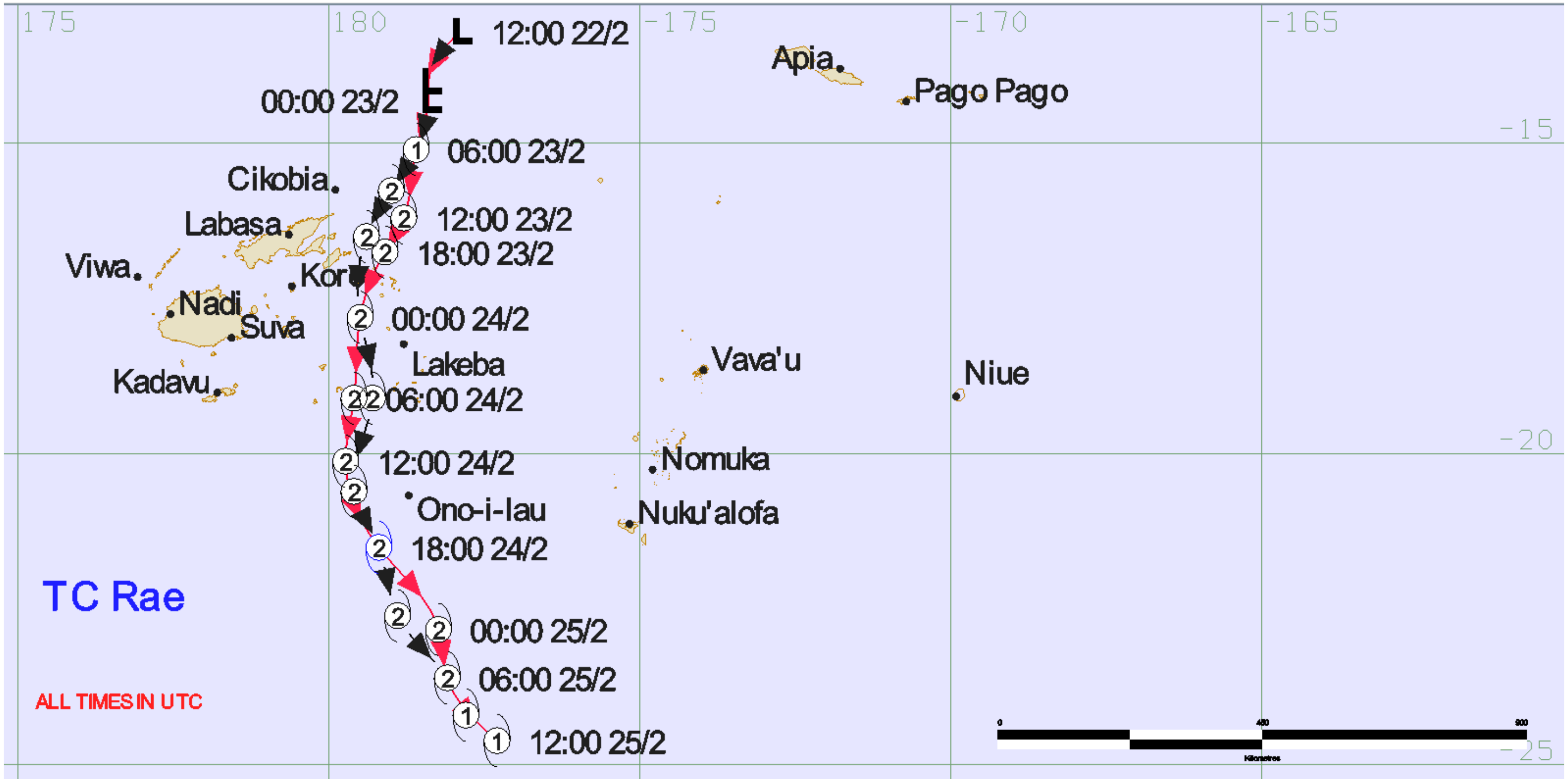


Figure 7.3: Analysis track (black) versus post-event best track (red) throughout the life cycle of Tropical Cyclone Rae.

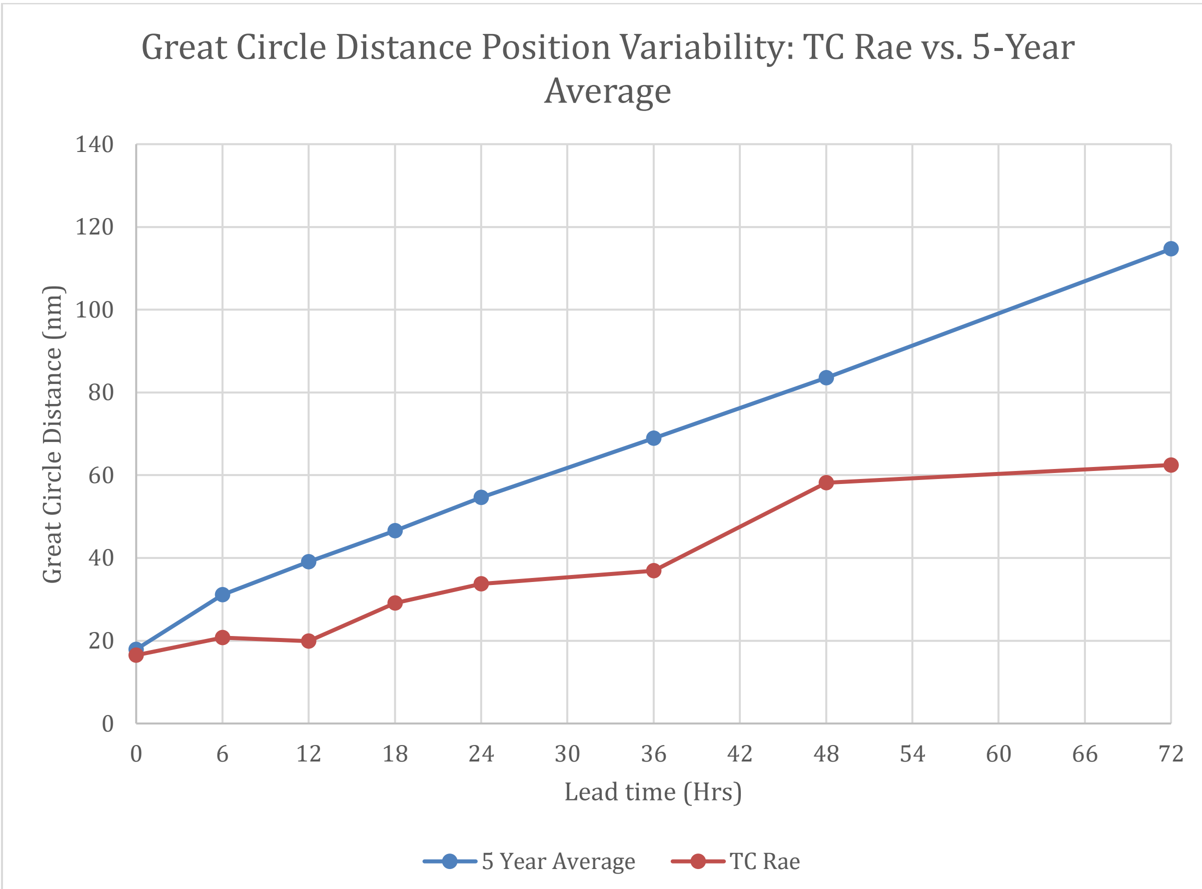
Table 7.1: Best track data for TC Rae, including time (UTC), position, uncertainty range, wind intensities, category, central pressure, and radius of maximum winds.

Time (UTC)	Lat	Lon	Uncertainty (nm)	Mean wind (knots)	Wind Gusts (knots)	Category	Central Pressure (hPa)	Radius of Max winds (nm)
22/1200	-13.2	-177.9	35	25	45	0	1000	30
22/1800	-14.0	-178.4	60	30	45	0	1000	25
23/0000	-14.3	-178.4	60	30	45	0	999	25
23/0600	-15.1	-178.6	40	35	50	1	994	20
23/1200	-16.2	-178.8	40	50	70	2	985	20
23/1800	-16.7	-179.1	45	50	70	2	985	20
24/0000	-17.8	-179.5	45	50	70	2	980	20
24/0600	-19.1	-179.6	45	50	70	2	980	15
24/1200	-20.1	-179.7	45	60	85	2	975	15
24/1800	-21.5	-179.2	60	60	85	2	975	15
25/0000	-22.8	-178.2	45	60	85	2	980	20
25/0600	-23.6	-178.1	45	50	70	2	987	20
25/1200	-24.6	-177.3	45	35	50	1	998	20
25/1500	-25.1	-176.4	60	30	45	0	999	30

Table 7.2: Best track analysis of TC Rae, detailing gale-force and storm-force wind radii across all quadrants during the cyclone's lifecycle

Time (UTC)	Lat	Lon	NE gale radius (nm)	SE gale radius (nm)	SW gale radius (nm)	NW gale radius (nm)	NE storm radius (nm)	SE storm radius (nm)	SW storm radius (nm)	NW storm radius (nm)
22/1200	-13.2	-177.9								
22/1800	-14.0	-178.4								
23/0000	-14.3	-178.4								
23/0600	-15.1	-178.6	50	45	40	50				
23/1200	-16.2	-178.8	65	45	40	60	30	25	20	30
23/1800	-16.7	-179.1	65	50	50	70	20	20	10	10
24/0000	-17.8	-179.5	90	60	50	70	30	20	20	10
24/0600	-19.1	-179.6	90	60	50	70	30	20	20	10
24/1200	-20.1	-179.7	90	60	50	70	30	20	20	10
24/1800	-21.5	-179.2	100	60	50	70	40	30	20	20
25/0000	-22.8	-178.2	110	70	50	70	40	30	20	20
25/0600	-23.6	-178.1	110	70	50	70	40	30	20	20
25/1200	-24.6	-177.3	110	120	50	70				
25/1500	-25.1	-176.4								

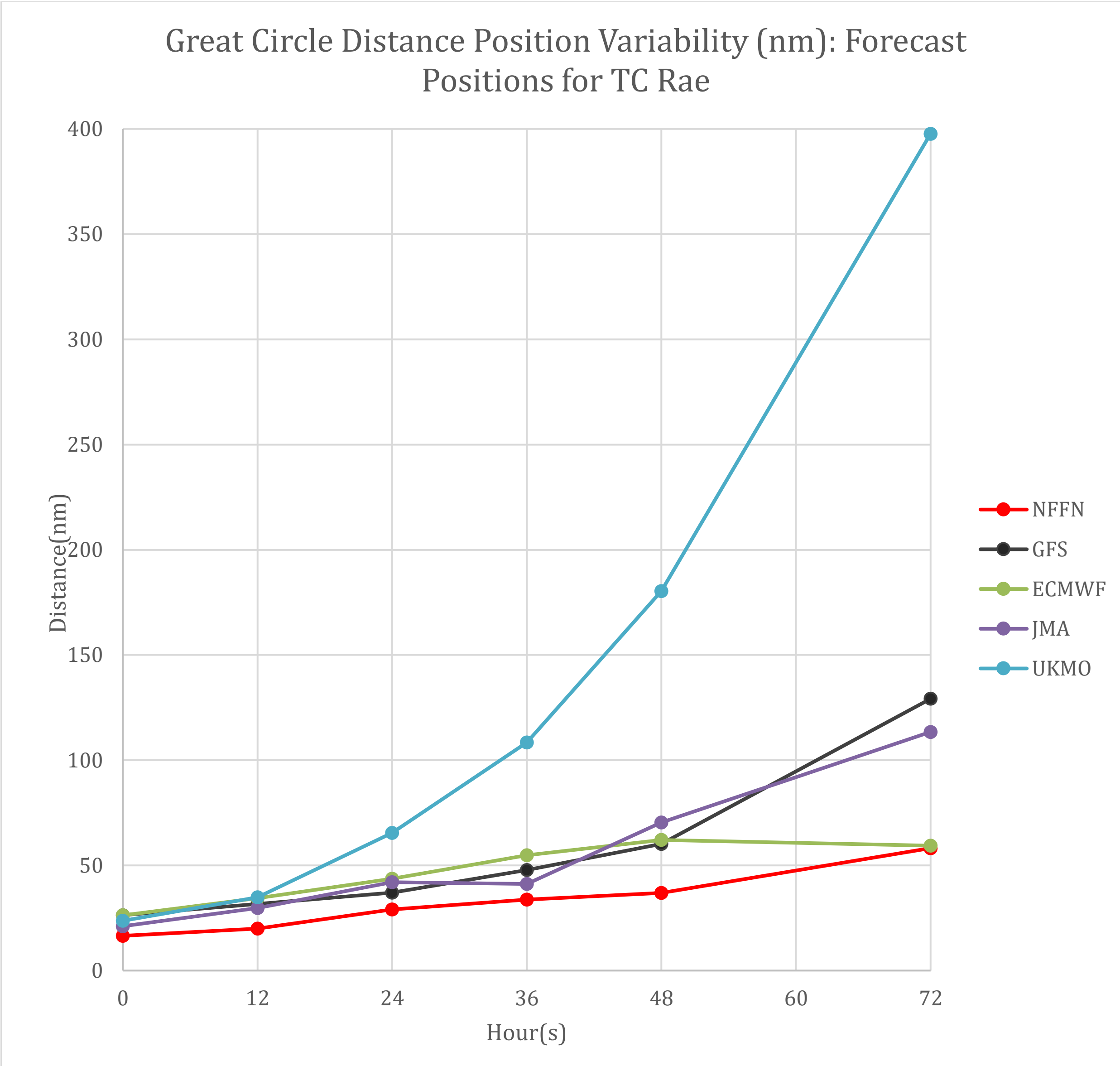
Appendix 2: Verification Statistics



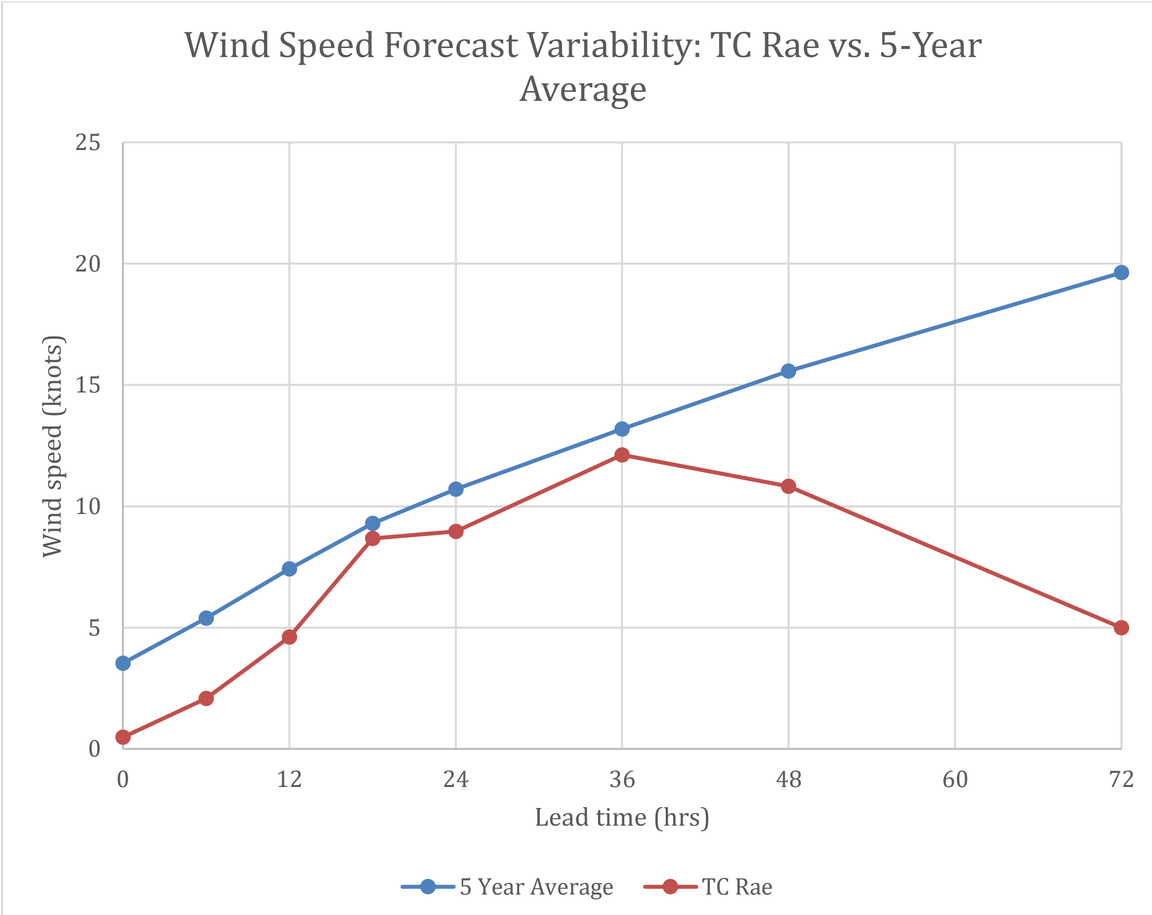
Graph showing the great circle distance position variability for 5 (2020/2021 to 2024/2024) year average versus TC Rae. Position variability was slightly less for TC Rae compared to the 5-year average at the time of analysis. Moreover, forecasts for TC Rae maintained a significantly lower variability, suggesting forecasts up to 72 hours have improved. This is attributed to a dominant near equatorial ridge being the steering mechanism and models did well in terms of forecasting track for this system.

Table 7.3: Great Circle Distance Position Variability in nautical miles: Forecast positions for TC Rae.

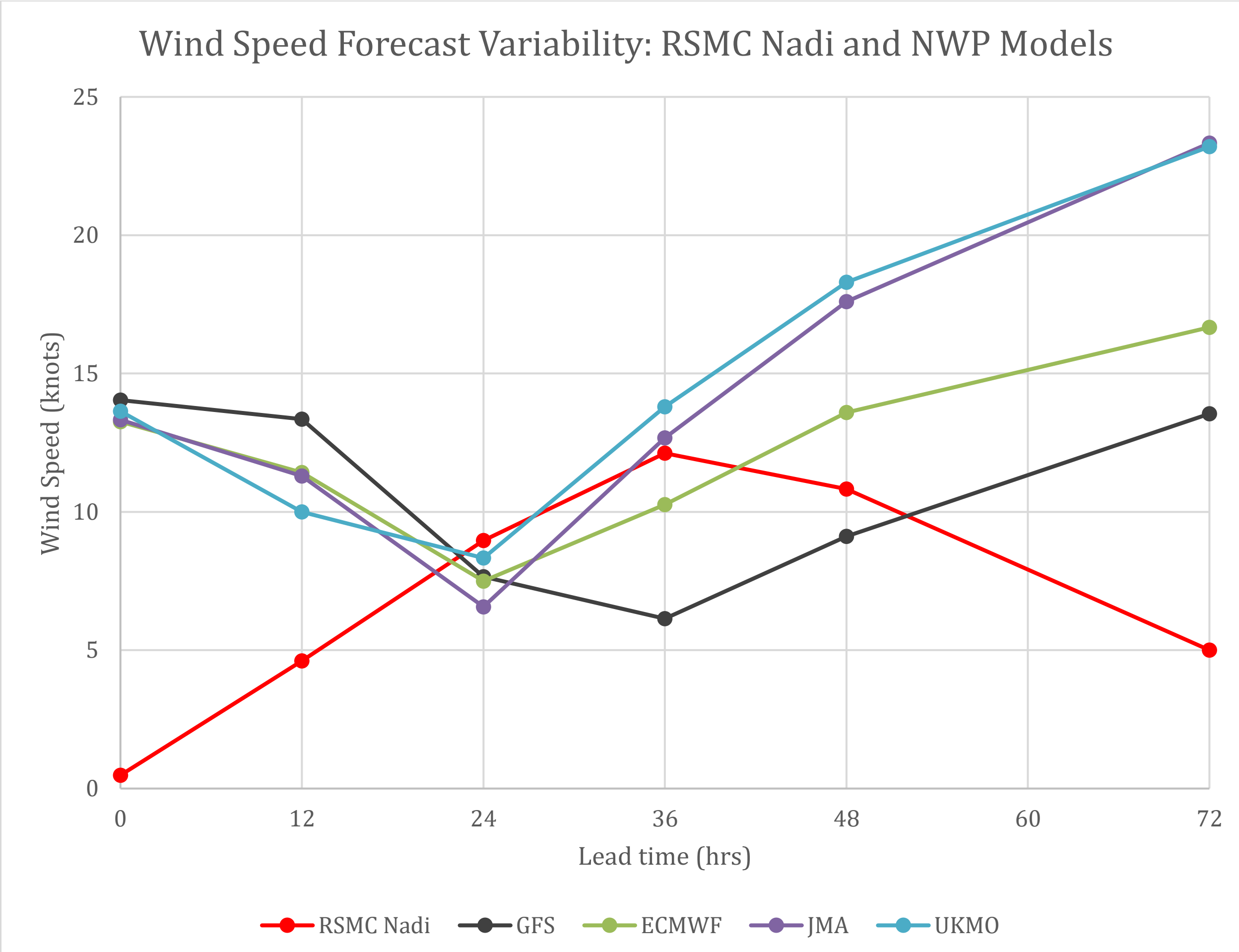
	Distance (nm)	0hr	6hr	12hr	24hr	36hr	48hr	72hr
NFFN	Mean	16.51	20.73	19.92	29.07	33.75	36.9	58.19
	Std Dev	16.02	10.93	11.01	16.35	20.9	27.8	31.8
	Sample size	24	24	24	24	20	13	6
GFS	Mean	26.35	13.22	31.64	37.09	47.76	60.18	129.18
	Std Dev	12.62	-	15.73	19.28	25.39	34.04	40.69
	Sample size	25	-	26	23	22	19	11
ECMWF	Mean	26.25	-	34.42	43.65	54.87	62.07	59.38
	Std Dev	13.55	-	24.03	28.68	25.55	25.28	34.48
	Sample size	43	-	48	43	36	28	13
JMA	Mean	21.09	-	29.7	42	41.14	70.36	113.43
	Std Dev	7.58	-	25.75	14.56	23.59	41.49	27.75
	Sample size	6	-	7	7	6	5	3
UKMO	Mean	23.67	-	34.9	65.39	108.45	180.41	397.75
	Std Dev	11.18	-	19.95	33.29	52.18	79.58	61.69
	Sample size	11	-	12	12	10	8	5



This graph illustrates the forecast position variability in nautical miles relative to reanalysis positions from TCWC Nadi and several major NWP centers. The data highlights that Nadi exhibited the least variability across all forecast lead times (12 to 72 hours), indicating strong consistency in its trajectory predictions. In contrast, UKMO showed increasing deviations as lead time extended, suggesting greater forecast uncertainty in longer-range projections. Meanwhile, GFS, ECMWF, and JMA exhibited slightly higher variations than Nadi, though their forecasts remained relatively aligned.



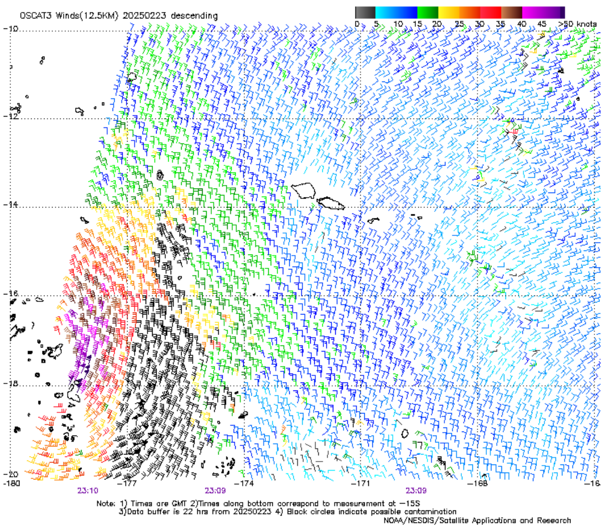
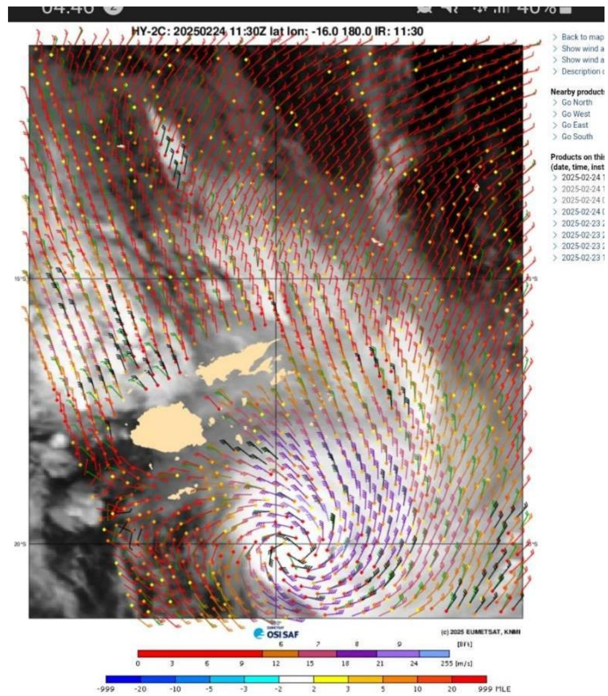
This graph illustrates the wind speed forecast variability over a 72-hour period, comparing TCWC Nadi's predictions for TC Rae against the five-year climatological average. The historical trend shows a steady increase in forecasted wind speed, reaching approximately 20 knots as lead time progresses. However, TC Rae's wind intensity forecasts exhibited lower variability, indicating improved consistency and accuracy compared to past trends.

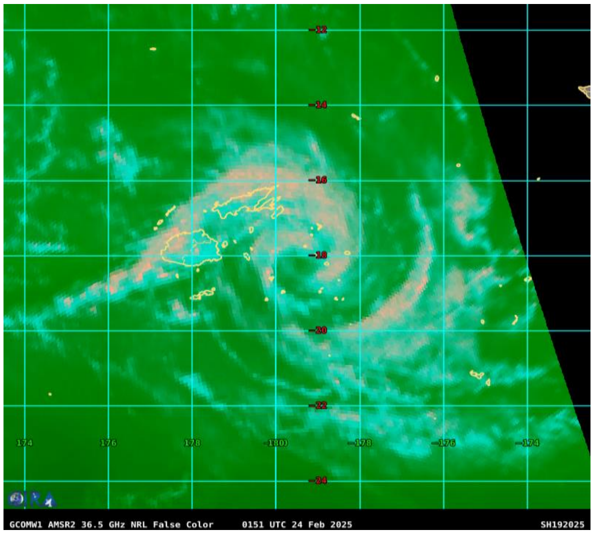


This graph shows the wind speed forecast variability from 0 to 72 hours, comparing RSMC Nadi's predictions against major NWP models. In the short-term (0–24 hours), RSMC Nadi forecasted wind intensity more accurately, exhibiting lower variation compared to NWP models. Beyond 24 hours, both RSMC Nadi and NWP models demonstrated similar forecasting skill, indicating a convergence in prediction reliability. However, after 48 hours, RSMC Nadi's forecasts proved more aligned with observed intensities, performing better than the NWP models. The models initially overpredicted wind speeds, leading to higher variability, but gradually stabilized as lead times extended.

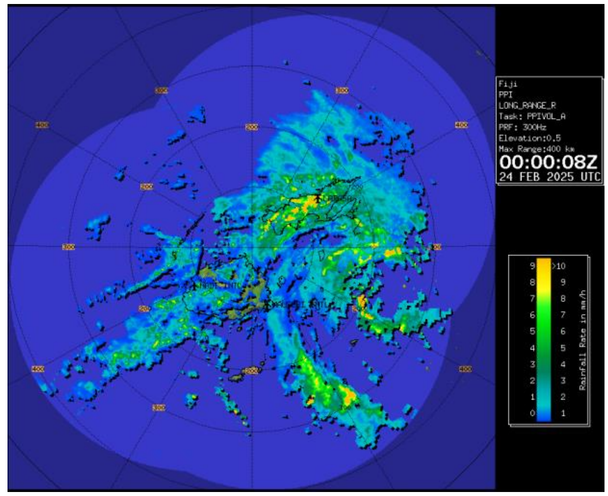
Appendix 3: Observations and Impacts Photographs

Observations

 *Ascat imagery showing 50 knots winds present near TC Center at 2310 UTC on 23rd.*	 *HY-scat imagery TC Rae Center about 125km west-northwest of Ono-I-Lau at 11:30 UTC on 24th.*



37GHZ microwave imagery showing TC Rae center about 80 km west of Lakeba at 0150 UTC on 24th



TC Rae center visible on Fiji Composite radar imagery at 0000 UTC on 24th

Impacts

Winds from TC Rae Cause Structural Damage in Vanua Balavu
Image courtesy of JKL-Media via Facebook

Uprooted and broken trees on Komo island.
Image courtesy of Mai TV via Facebook

Flooding in Labasa due to heavy downpour from rainbands associated with TC Rae
Image courtesy of Fiji Sun via Facebook

Structural damages due to strong winds from TC Rae
Image courtesy of Sea Mercy Fiji via Facebook

Structural damages due to strong winds from TC Rae in Komo Island
Image courtesy of FBC News via Facebook

Blown off church roof due to severe winds from TC Rae in Komo Island
Image courtesy of FBC News via Facebook

Cyclone Impact: Trees Uprooted and Crops Devastated
Image courtesy of Fiji One News via Facebook

Aftermath of TC Rae in Cicia Village
Image courtesy of Fiji Sun via Facebook