HEALTHY WATERS PARTNERSHIP dry tropics

Townsville Dry Tropics
Waterways Report Card 2025

TECHNICAL REPORT

PART 2: Climate and Land Use

Reporting on data collected 2023 - 2024

JULY 2025 | Written by Adam Shand, Healthy Waters Partnership (HWP)

3 Environmental Stressors in The Townsville Dry Tropics Region

Environmental stressors such as extreme climate and intensive land use are influential factors for almost every indicator measured in the Technical Report. Between 1st July 2023 and 30th June 2024, the Townsville Dry Tropics region experienced two cyclones (Severe Tropical Cyclone Jasper approx. 450km away, and Severe Tropical Cyclone Kirrily approx. 50km away), weather events (wind, swell) as a result of TC Kirrily, and entered a neutral El Niño–Southern Oscillation (ENSO) (Bureau of Meterology 2025). Key influences for the 2023–2024 reporting period are summarised below.

- Grazing and conservation remain the two largest land use types by area. (Ross: 30.6% Conservation, 45.3% Grazing. Black: 43.0% Conservation, 39.9% Grazing).
    - Land use data has not been updated since the previous technical report (data for 2021, released 2023). The next update (2025 data) is expected to be released in 2027.
- Total rainfall was 930mm in the Ross Basin, and 1343mm in the Black Basin. Annual rainfall in both basins was classified in the "average" category, however, was less than the long-term mean (calculated from the most recent 30-year block of data: 1991 to 2020) of 1061mm and 1420mm respectively. Compared to the previous year, rainfall was much lower in the Ross Basin (1239mm to 930mm), and slightly lower in the Black Basin (1425mm to 1343mm).
    - Monthly rainfall was largely average throughout the year, ranging from the "below average" category to the "above average" category for 11 months of the year. In comparison, the previous year experienced large peaks and troughs of rainfall.
- The annual average air temperature was 24.9°C in the Ross Basin, and 24.4°C in the Black Basin and was classified in the "very much above average" category in both basins. No month of the year recorded less than the long-term average temperature. Compared to the previous year, air temperatures were slightly higher (24.8°C to 24.9°C in the Ross Basin, 24.2°C to 24.4°C in the Black Basin).
    - Annual mean temperatures exceeded the long-term mean (calculated from the oldest 30-year block of data available in the dataset (from 1911 to 1940) by 1.2°C in the Ross Basin and 1.3°C in the Black Basin.
- The annual average sea surface temperature was 26.8°C, which was 0.6°C above the long-term average of 26.2°C. Compared to the previous year, sea surface temperature was slightly lower (27.1°C down to 26.8°C).
    - For 9 months of the year monthly sea surface temperatures ranged from the "above average" category to the "highest 1%" on record category, with only October, November, and December temperatures falling into the "average" category.
    - The proxy for risk of coral bleaching ranged from "low risk" to "very high risk", with most of the marine zone experiencing between 4 and 8+ Degree Heating Weeks.
    - These high temperatures (as noted by annual SST, and DHW) contributed to the 5th mass coral bleaching event for the Great Barrier Reef since 2016.

3.1 Land Use

Land use data describes what the dominant use for the land is, with nationally consistent descriptions set by the Australian Land Use and Management (ALUM) Classification system (Department of Agriculture, Fisheries and Forestry 2023). Land use in the Townsville Dry Tropics region in 2021 is summarised in Table 16, and Figure 5.

Table 1. Total area and percentage of land use classes in the Townsville Dry Tropics region in 2021.

Land Use (2021)	Ross Basin		Black Basin	
	%	km²	%	km²
Conservation	30.6	538.1	43.0	492.6
Dryland Agriculture	0.0	0.6	0.1	1.1
Forestry	2.6	45.0	6.8	78.0
Grazing	45.3	795.1	39.9	456.9
Irrigated Agriculture	0.6	10.8	1.8	20.3
Mining	0.3	5.5	0.5	5.3
Urban/Intensive	12.7	223.6	5.4	62.1
Water	7.8	137.6	2.6	29.4
Total Area	-	1756.2	-	1145.9

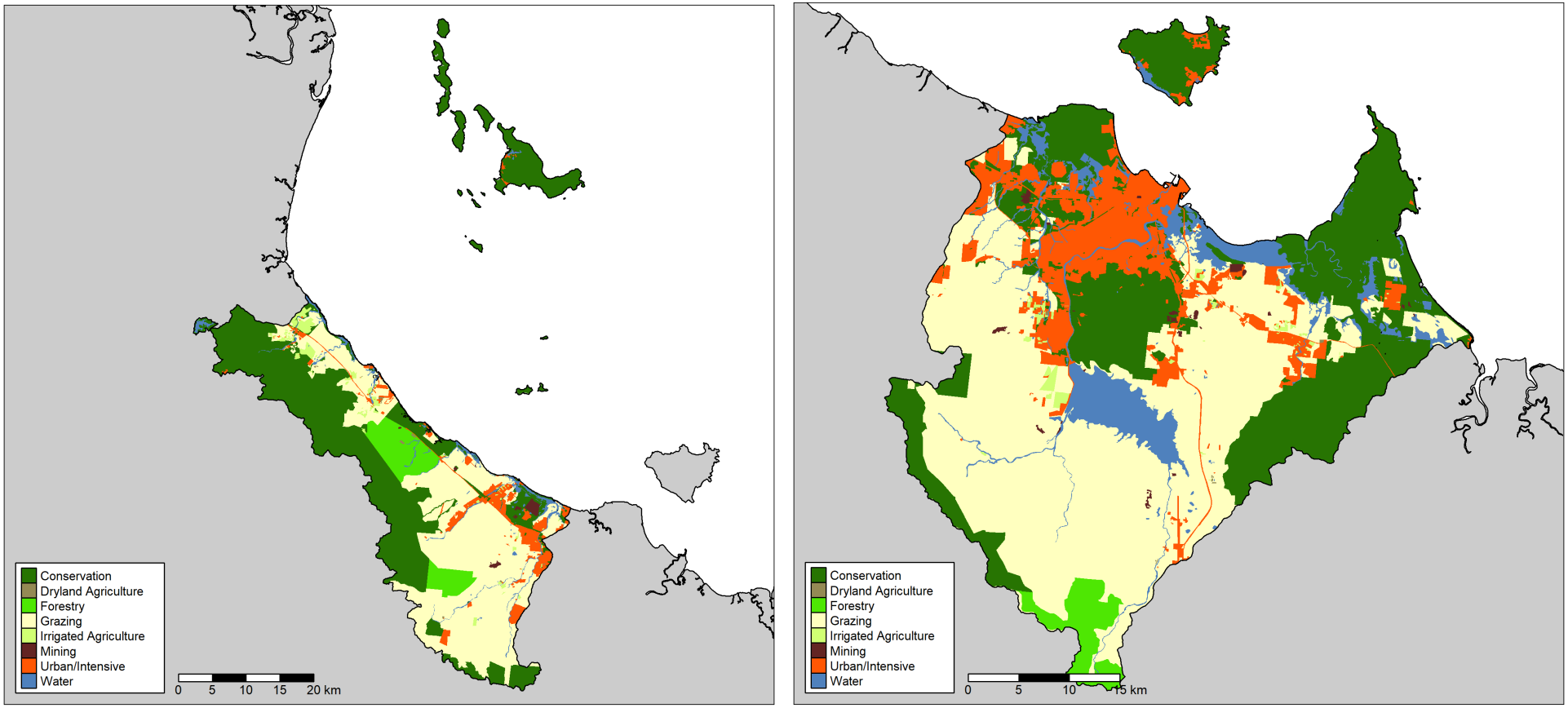

Figure 1. Land use categories in the Ross Basins and Black Basins of the Dry Tropics region in 2021.

3.2 Climate

A changing climate and extreme weather can have a major impact on the health of the environment both globally and within the Townsville Dry Tropics region. These forces directly and indirectly put pressure on local waterways and can influence the results presented in this report (IPCC 2022, United Nations 2023). Between 1st July 2023 and 30th June 2024, the Townsville Dry Tropics region experienced one cyclone, Severe Tropical Cyclone Kirrily (approx. 50km away), and entered a neutral El Niño–Southern Oscillation (ENSO) (Bureau of Meterology 2025). Key influences for the 2023–2024 reporting period are summarised below.

3.2.1 Rainfall

Monthly rainfall across the Townsville Dry Tropics region was largely average, with 11 months of rainfall in the Ross and Black basins ranging from the "below average" category (10th-30th percentile) to the "above average" category (70th-90th percentiles), and only one month of the year (July) falling in the "very much above average" category (90th - 99th percentile) of rainfall. The monthly averages are calculated from the most recent 30-year block of data: 1991 to 2020 (Table 17).

Table 2. Monthly rainfall percentiles in the Ross Basin and Black Basin grouped into seven categories.

Basin	2023						2024						Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Ross													
Black													

■ = Lowest 1% | ■ = Very much below average | ■ = Below Average | ■ = Average | ■ = Above Average | ■ = Very much above average | ■ = Highest 1%

Interestingly, despite the occurrence of a severe tropical cyclone rainfall did not show any notable spikes and followed closely with season trends seen in the line plots below (Figure 7).

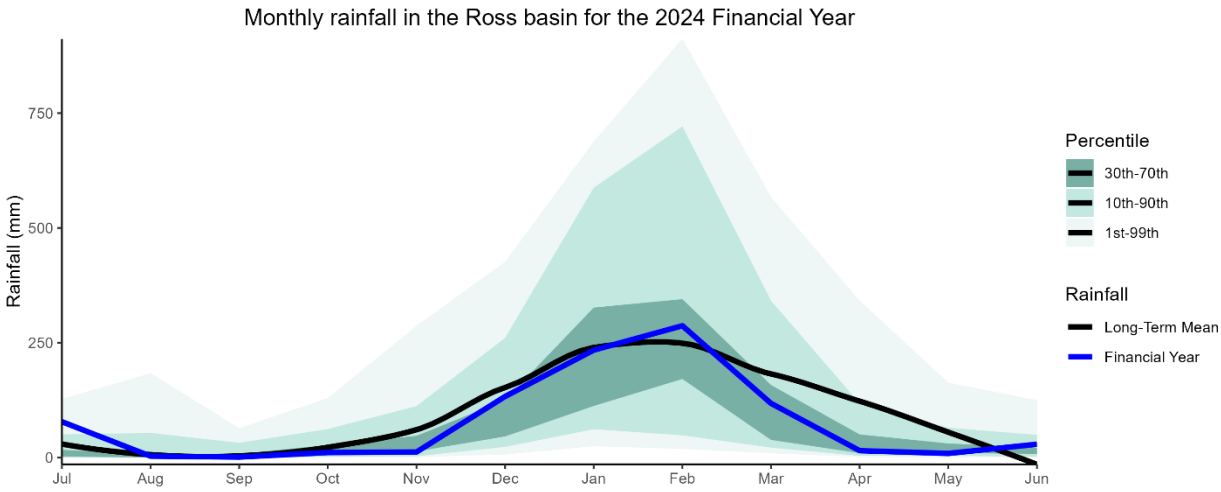

Figure 2. Monthly rainfall in the Ross Basin in comparison to the long-term mean (calculated from 1991 to 2020). The Blue line indicates rainfall for the current financial year. The black line indicates the long-term rainfall. The dark green shading represents the 30th to 70th percentiles of the long-term mean, the medium green shading represents the 10th to 90th percentiles of the long-term mean, and the light green shading represents the 1st to 99th percentiles of the long-term mean.

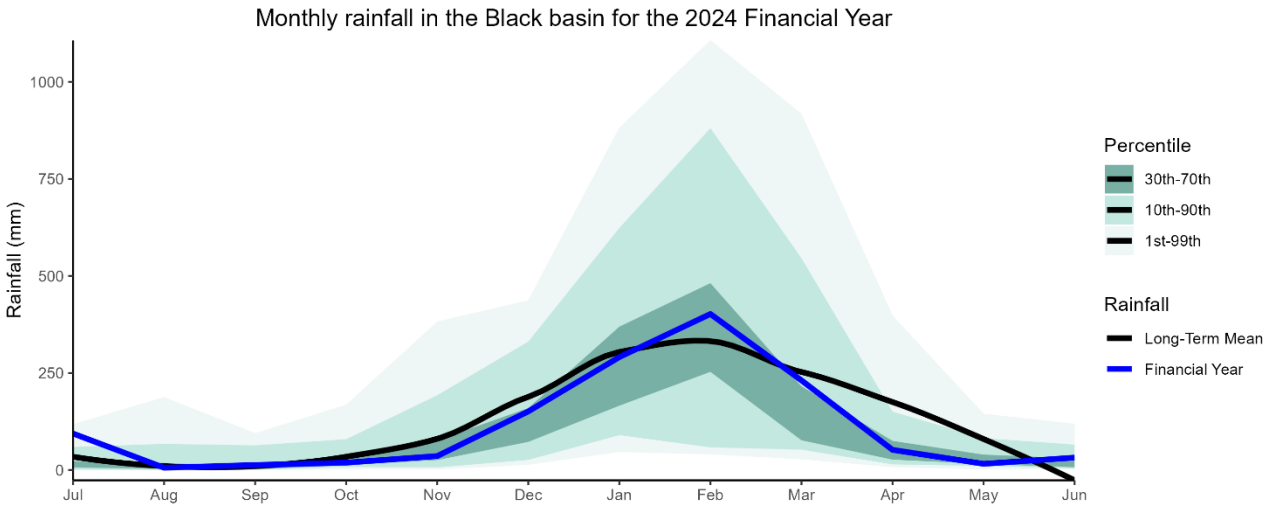

Figure 3. Monthly rainfall in the Black Basin in comparison to the long-term mean (calculated from 1991 to 2020). The Blue line indicates rainfall for the current financial year. The black line indicates the long-term rainfall. The dark green shading represents the 30th to 70th percentiles of the long-term mean, the medium green shading represents the 10th to 90th percentiles of the long-term mean, and the light green shading represents the 1st to 99th percentiles of the long-term mean.

Total annual rainfall was 930mm in the Ross Basin, and 1343mm in the Black Basin. This was less than the long-term mean (calculated from the most recent 30-year block of data: 1991 to 2020) by 131mm and 77mm respectively (Table 18).

Table 3. Annual rainfall summary statistics for the Ross Basin and Black Basin.

Basin	Annual Rainfall	Long-term mean 1991-2020 (ltm)	Anomaly (+/- ltm)	Percentage of the ltm
Ross	930mm	1061mm	-131mm	87.7%
Black	1343mm	1420mm	-77mm	94.6%

Annual rainfall was the greatest in the north of the Black Basin with just over 2000mm, while the least amount of rainfall was recorded on the western ridge of the Ross and Black Basins with only 800 to 1000mm. Across both basins, only the furthest northern reaches of the Black Basin received more rain than average. (Figure 8, Figure 9). Historic annual rainfall trends for each basin are presented in Appendix A and Appendix B. Season specific annual rainfall trends for each basin are presented in Appendix C.

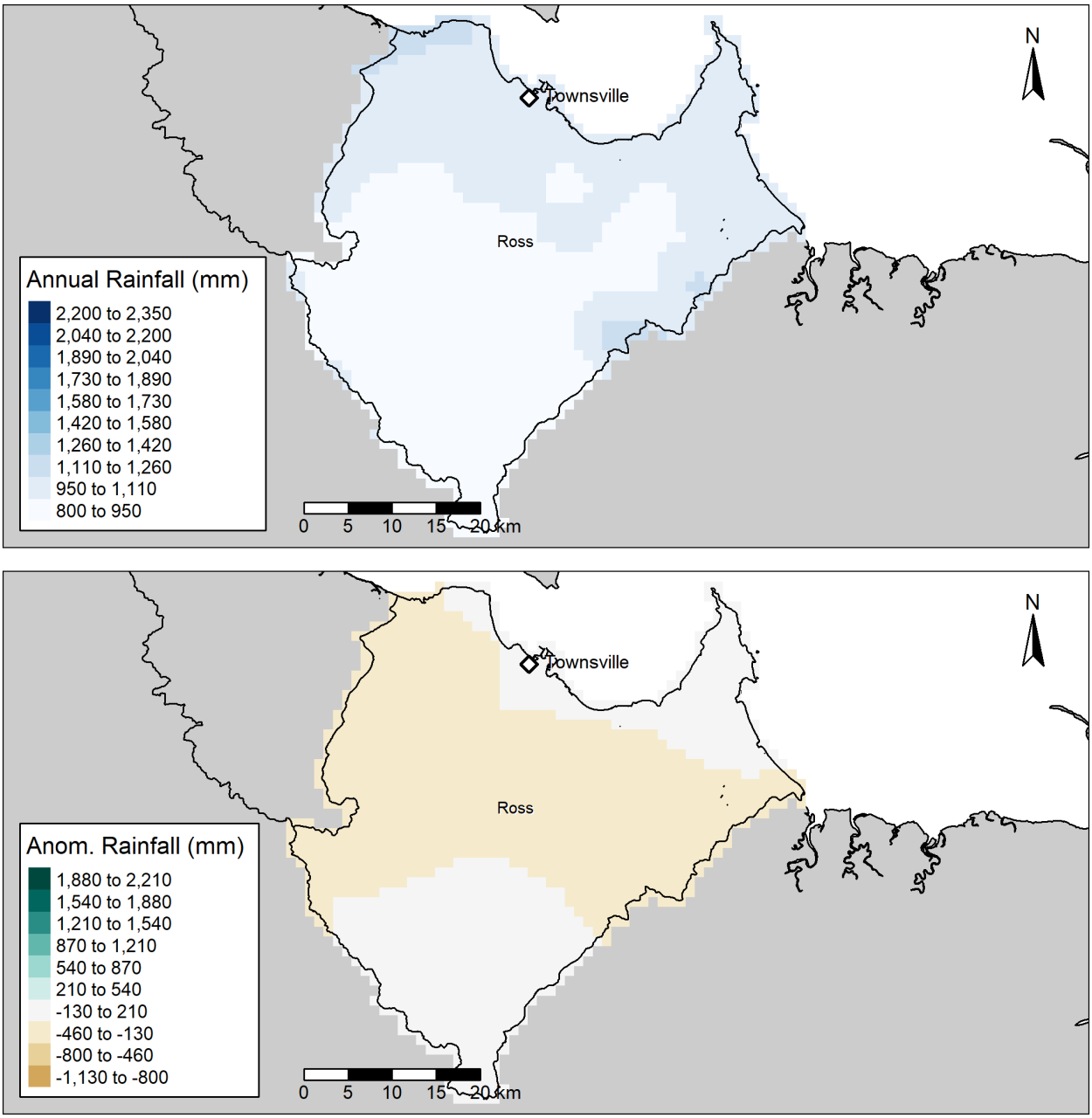

Figure 4. Total annual rainfall for the Ross Basin, of the Dry Tropics region for 2023-2024, and the anomaly of the 2023-2024 rainfall from the long-term mean (i.e., how much more or less (mm) was the 2023-2024 rainfall in comparison to the long-term historic average. Rainfall values were derived by summing monthly averages calculated across spatial grid sub-sets of each basin. The long-term mean was calculated from the most recent 30-year block (climate normal), which is 1991-2020. The scale for the annual rainfall map is based on the actual rainfall recorded for the financial year across the entire Dry Tropics Region (inclusive of the Black Basin). The scale for the anomaly rainfall map is based on the absolute min and max anomaly values recorded within the 30-year reference period inclusive of the current financial year.

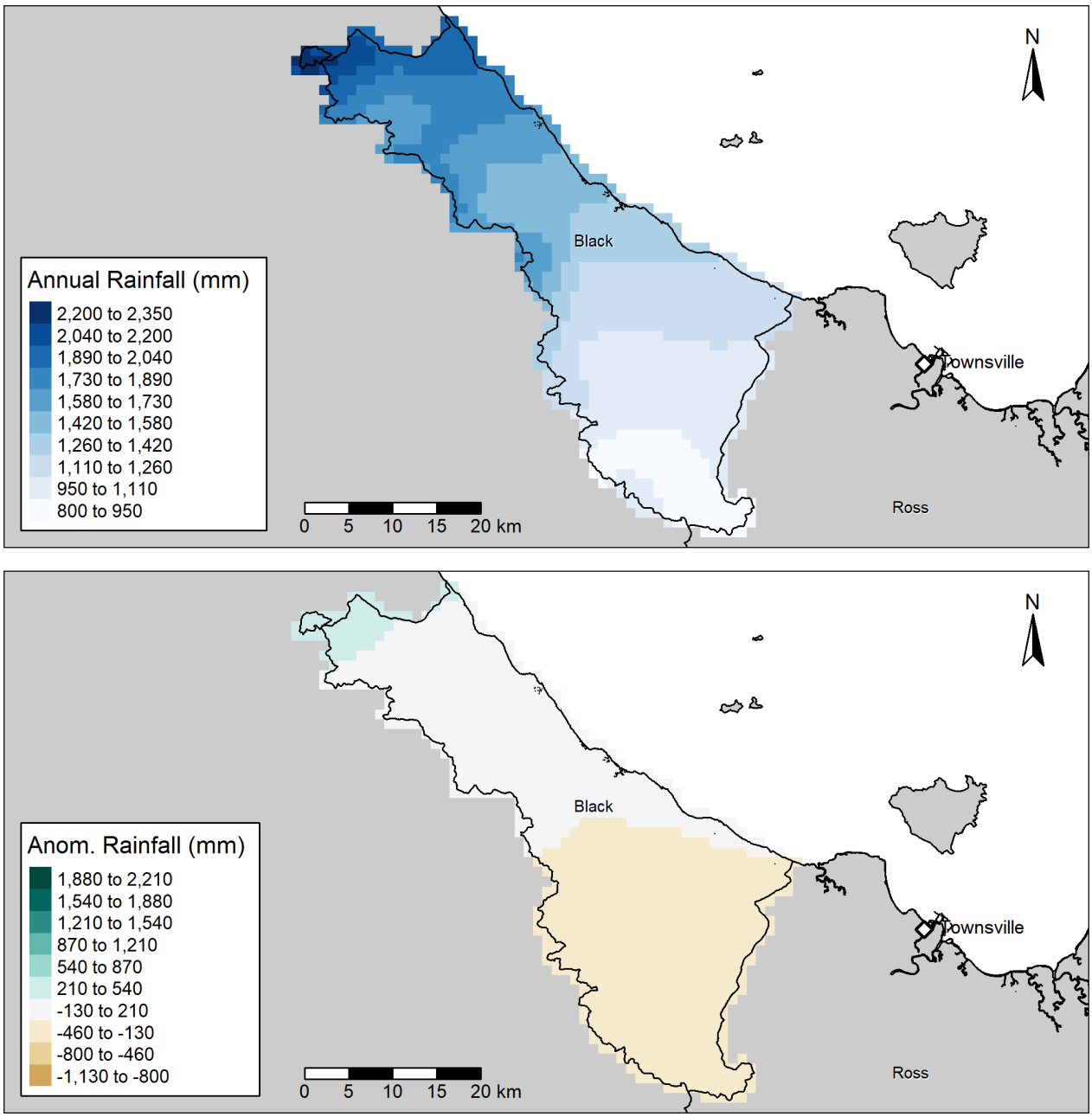

Figure 5. Total annual rainfall for the Black Basin, of the Dry Tropics region for 2023-2024, and the anomaly of the 2023-2024 rainfall from the long-term mean (i.e., how much more or less (mm) was the 2023-2024 rainfall in comparison to the long-term historic average. Rainfall values were derived by summing monthly averages calculated across spatial grid sub-sets of each basin. The long-term mean was calculated from the most recent 30-year block (climate normal), which is 1991-2020. The scale for the annual rainfall map is based on the actual rainfall recorded for the financial year across the entire Dry Tropics Region (inclusive of the Ross Basin). The scale for the anomaly rainfall map is based on the absolute min and max anomaly values recorded within the 30-year reference period inclusive of the current financial year.

3.2.2 Air Temperature

Mean monthly air temperature remained at or above the respective monthly means in both basins throughout the entire reporting period, with several months placed into the “highest 1%” of temperatures category for the month (Table 19). The monthly averages which are compared to the current year of data are calculated from the oldest 30-year block of data available in the dataset (from 1911 to 1940). This dataset was selected to reflect a “pre-industrial” baseline for comparison.

Table 4. Monthly air temperature percentiles in the Ross Basin and Black Basin grouped into seven categories.

Basin	2023						2024						Annual
	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	
Ross													
Black													

■ = Lowest 1% | ■ = Very much below average | ■ = Below Average | ■ = Average | ■ = Above Average | ■ = Very much above average | ■ = Highest 1%

The mean annual air temperature was 24.9°C in the Ross Basin, and 24.4°C in the Black Basin. This was greater than the long-term mean (calculated from the oldest 30-year block of data available in the dataset (from 1911 to 1940) by 1.2°C and 1.3°C respectively (Table 20).

Table 5. Annual air temperature summary statistics for the Ross Basin and Black Basin.

Basin	Annual Air Temperature	Long-term mean 1911-1940 (ltm)	Anomaly (+/- ltm)	Percentage of the ltm
Ross	24.9°C	23.7°C	+1.2°C	105.1%
Black	24.4°C	23.1°C	+1.3°C	105.6%

Mean annual temperatures ranged from 20.7°C along the hinterlands of the Black Basin, to 25.6°C along the coastal regions of each basin. All areas within the Townsville Dry Tropics region consistently recorded a mean annual temperature greater than that of the long-term mean (calculated from 1991-1940), of approximately 1°C (Figure 10 and Figure 11). Historic annual temperature trends for each basin are presented in Appendix C and Appendix E.

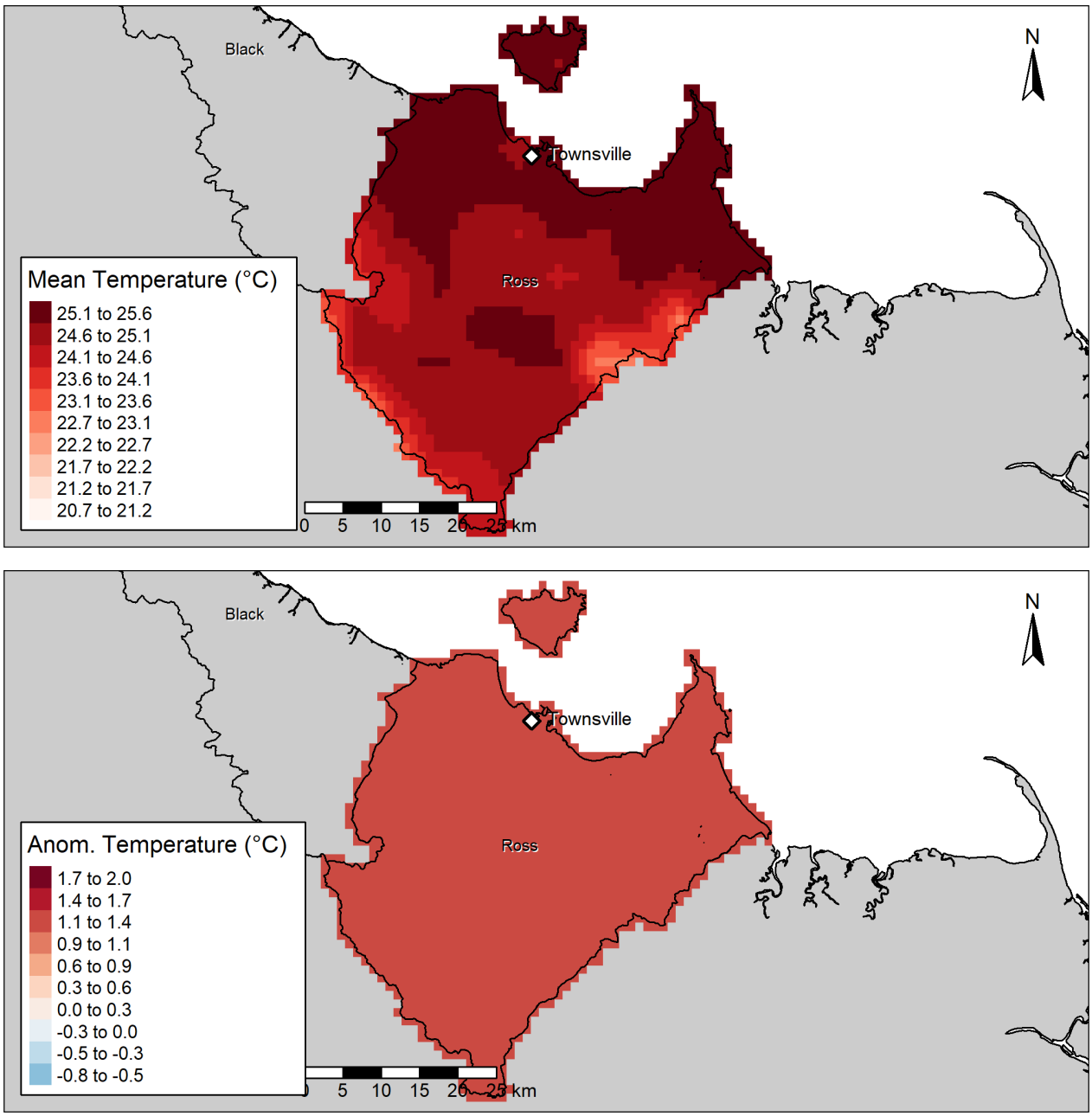

Figure 6. Mean annual air temperature for the Ross Basin, of the Dry Tropics region for 2023-2024, and the anomaly of the 2023-2024 air temperature from the long-term mean (i.e., how much more or less (C) was the 2023-2024 air temperature in comparison to the long-term historic average. Air temperature values were derived by taking the mean of monthly averages calculated across spatial grid sub-sets of each basin. The long-term mean was calculated from the oldest 30-year block (climate normal), which is 1911-1940. The scale for the annual air temperature map is based on the actual air temperature recorded for the financial year across the entire Dry Tropics Region (inclusive of the Black Basin). The scale for the anomaly air temperature map is based on the absolute min and max anomaly values recorded within the 30-year reference period, or, within the past 5-years (as the greatest anomalies mostly occurred during recent reporting years).

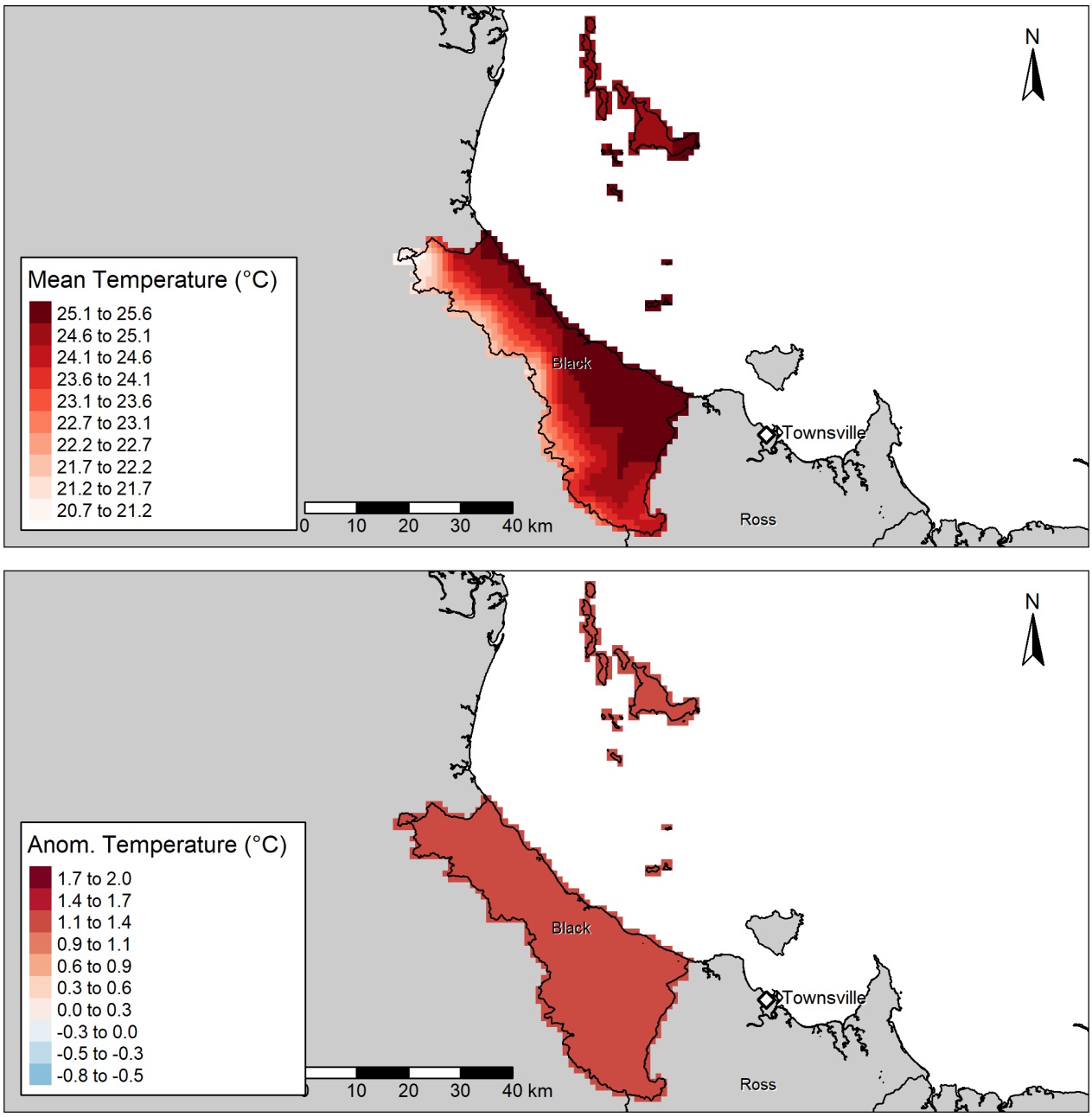

Figure 7. Mean annual air temperature for the Black Basin, of the Dry Tropics region for 2023-2024, and the anomaly of the 2023-2024 air temperature from the long-term mean (i.e., how much more or less (C) was the 2023-2024 air temperature in comparison to the long-term historic average. Air temperature values were derived by taking the mean of monthly averages calculated across spatial grid sub-sets of each basin. The long-term mean was calculated from the oldest 30-year block (climate normal), which is 1911-1940. The scale for the annual air temperature map is based on the actual air temperature recorded for the financial year across the entire Dry Tropics Region (inclusive of the Ross Basin). The scale for the anomaly air temperature map is based on the absolute min and max anomaly values recorded within the 30-year reference period, or, within the past 5-years (as the greatest anomalies mostly occurred during recent reporting years).

3.2.3 Sea Surface Temperature

Monthly sea surface temperature in the Townsville Dry Tropics marine region fell into the "average" or "above average" category for every month of the reporting period. In October, November, and December, sea surface temperatures for the month were in the "average" category, and for every other month of the year, the month was above its own monthly average. The monthly averages are calculated from the most recent 30-year block of data: 1991 to 2020 (Table 21).

Table 6. Monthly sea surface temperature percentiles in the Ross Basin and Black Basin grouped into seven categories.

	2023						2024						
Region	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Annual**
TSV													

■ = Lowest 1% | ■ = Very much below average | ■ = Below Average | ■ = Average | ■ = Above Average | ■ = Very much above average | ■ = Highest 1%

There were notable peaks in sea surface temperatures during the summer months of the year, with temperatures clearly exceeding 29°C in both January and February; this peak is connected to the likelihood of coral bleaching noted under Section 3.2.4 (Figure 12).

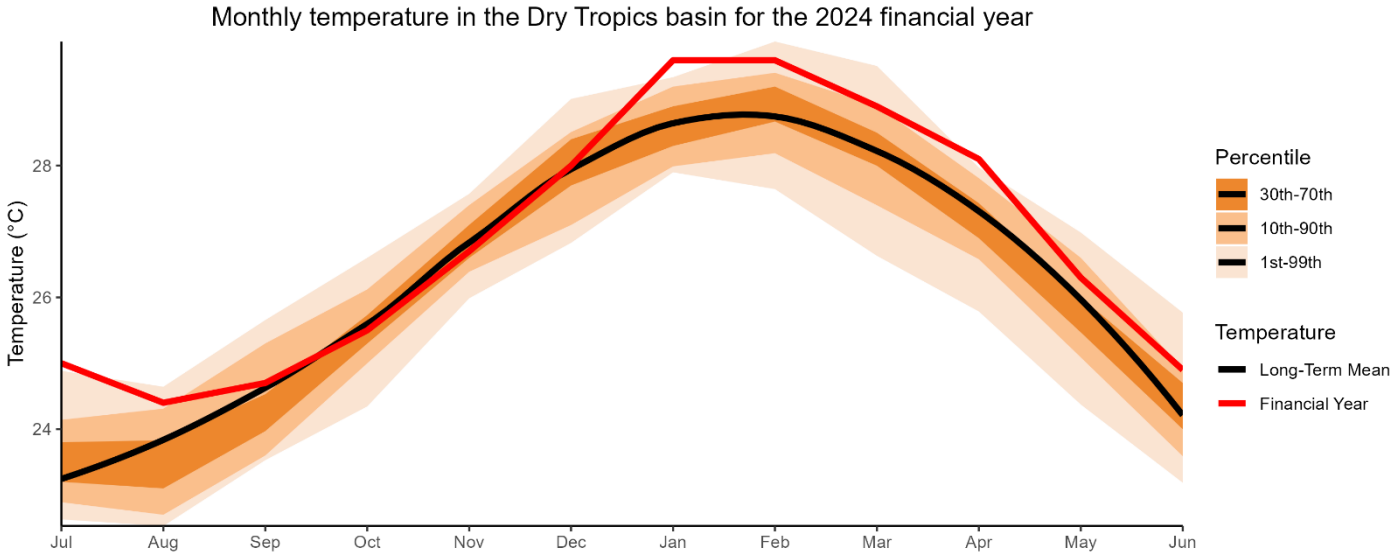

Figure 8. Monthly sea surface temperature in the Dry Tropics marine environment in comparison to the long-term mean (calculated from 1991 to 2020). The red line indicates the temperature for the current financial year. The black line indicates the long-term temperature. The dark orange shading represents the 30th to 70th percentiles of the long-term mean, the medium orange shading represents the 10th to 90th percentiles of the long-term mean, and the light orange shading represents the 1st to 99th percentiles of the long-term mean.

The mean annual sea surface temperature in the Townsville Dry Tropics marine region was 26.8°C, which was 0.6°C greater than the long-term mean (calculated from the most recent 30-year block of data: 1991 to 2020) (Table 22). The highest temperatures were recorded in the northern most reaches of the marine region and gradually decreased southward. Annual sea surface temperature anomalies highlighted that increased temperatures were consistent across the region (Figure 13). Historic annual sea surface temperature trends are presented in Appendix F.

Table 7. Annual sea surface temperature summary statistics for the Townsville Dry Tropics marine region.

Region	Annual Sea Surface Temperature	Long-term mean 1991-2020 (ltm)	Anomaly (+/- ltm)	Percentage of the ltm
Townsville Dry Tropics	26.8°C	26.2°C	+0.6°C	102.3%

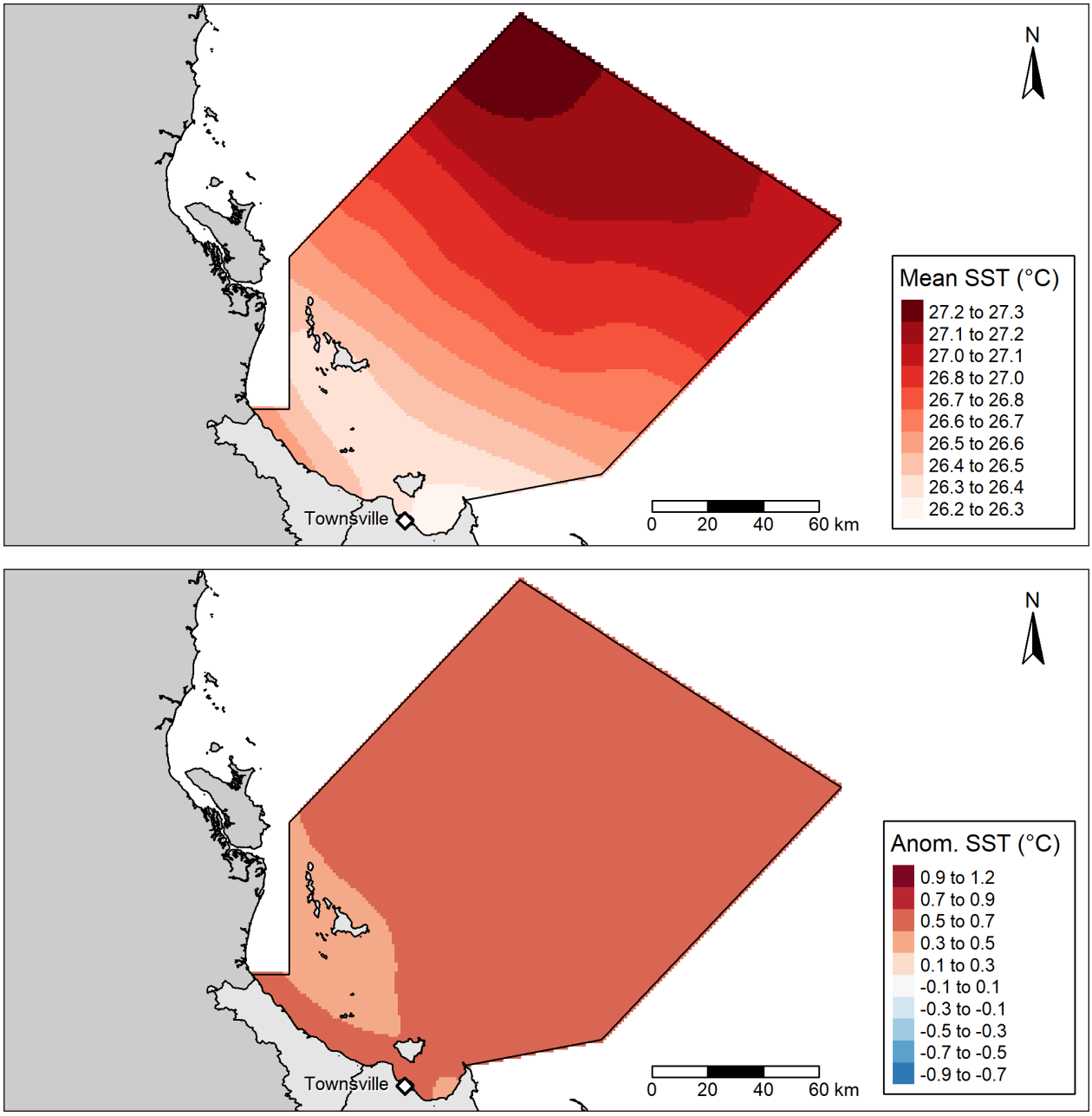

Figure 9. Total annual sea surface temperature for the Dry Tropics Region for 2023-2024, and the anomaly of the 2023-2024 sea surface temperature from the long-term mean (i.e., how much more or less (C) was the 2023-2024 sea surface temperature in comparison to the long-term historic average. Sea surface temperature values were derived by taking the mean of monthly averages calculated across spatial grid sub-sets of each basin. The long-term mean was calculated from the most recent 30-year block (climate normal), which is 1991-2020. The scale for the annual sea surface temperature map is based on the actual sea surface temperature recorded for the financial year across the entire Dry Tropics Region. The scale for the anomaly sea surface temperature map is based on the absolute min and max anomaly values recorded within the 30-year reference period inclusive of the current financial year.

3.2.4 Degree Heating Weeks

Mass coral bleaching has been linked to prolonged periods of heat stress (Glynn and D'Croz 1990). NOAA's Coral Reef Watch degree heating weeks (DHW) dataset provides a measure of this heat stress and acts as a proxy for the likelihood of coral bleaching (NOAA 2023). In 2023–2024, coral beaching risk in the Townsville Dry Tropics marine region ranged from "bleaching warning likely (2-4 DHW)" aka low risk, all the way to "severe bleaching likely (>8 DHW)" aka very high risk, with only a very small part of the marine region recorded DHW's of 4 or less (Figure 14). Historic degree heating weeks are presented in Appendix F.

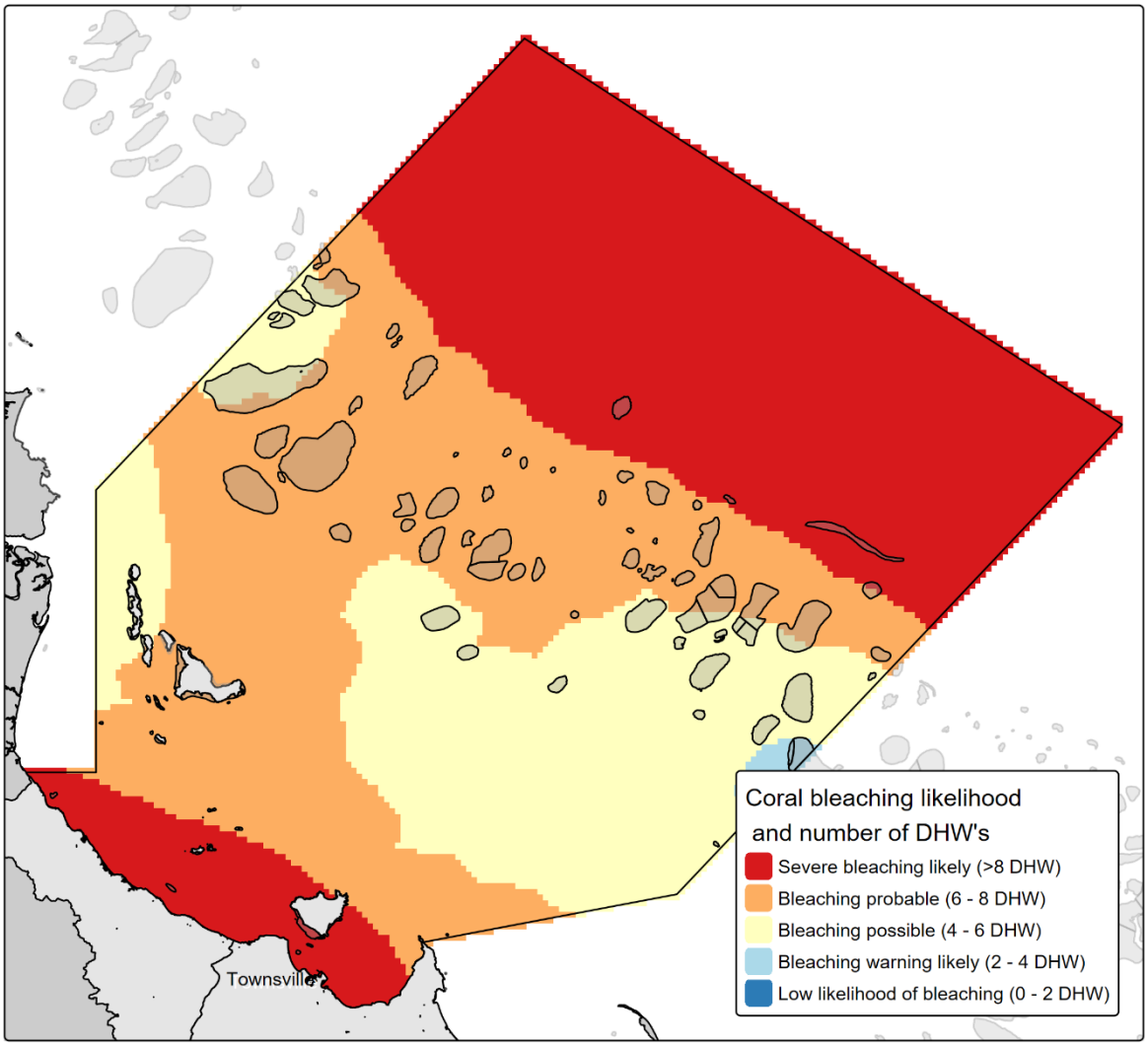

Figure 10. Total annual degree heating weeks (DHWs) in the Dry Tropic marine region for the 2023-2024 financial year. Coral reef outlines presented in grey.