Australian Government
Bureau of Meteorology

Tropical Cyclone Uriah

11 – 14 February 2016

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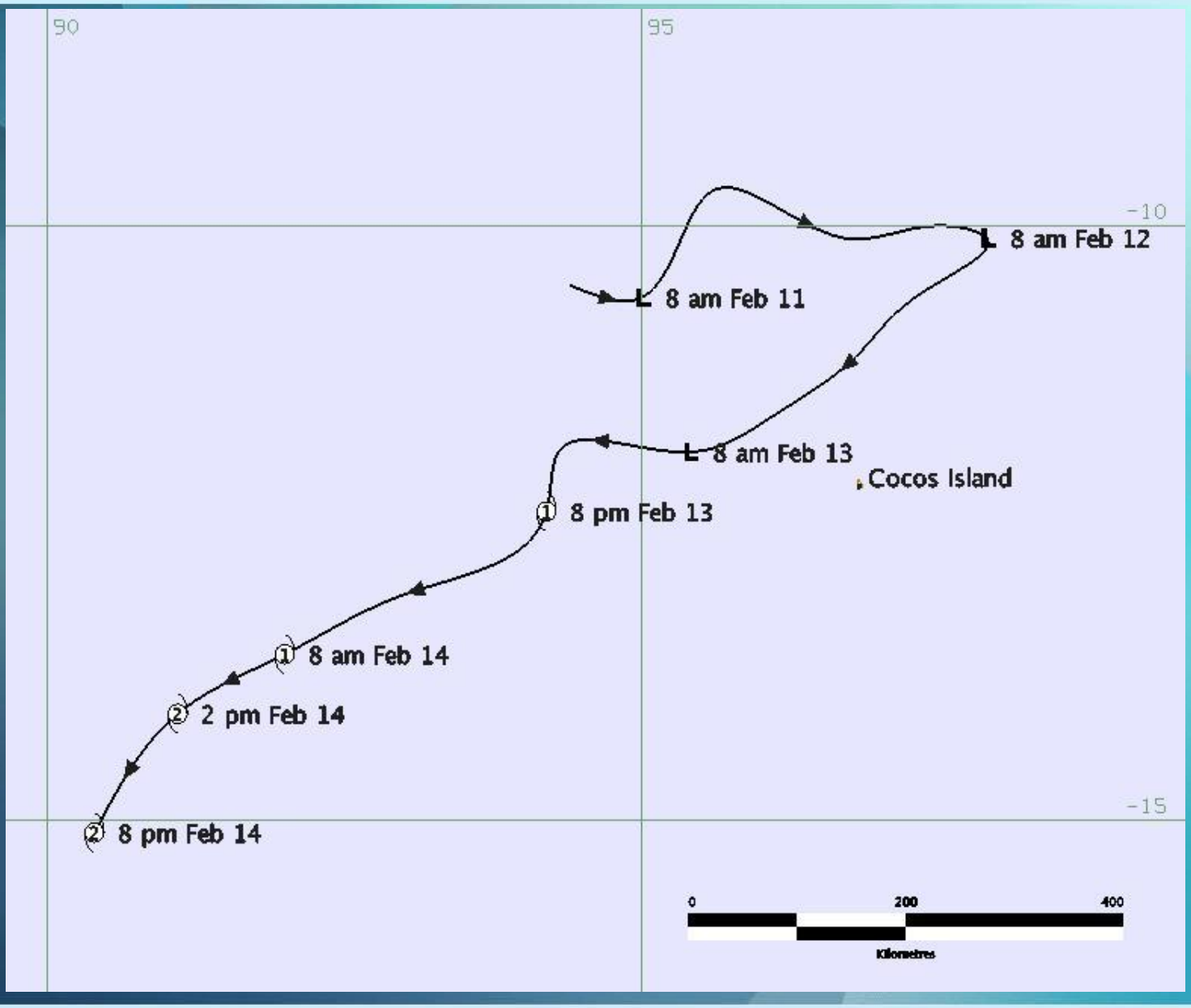

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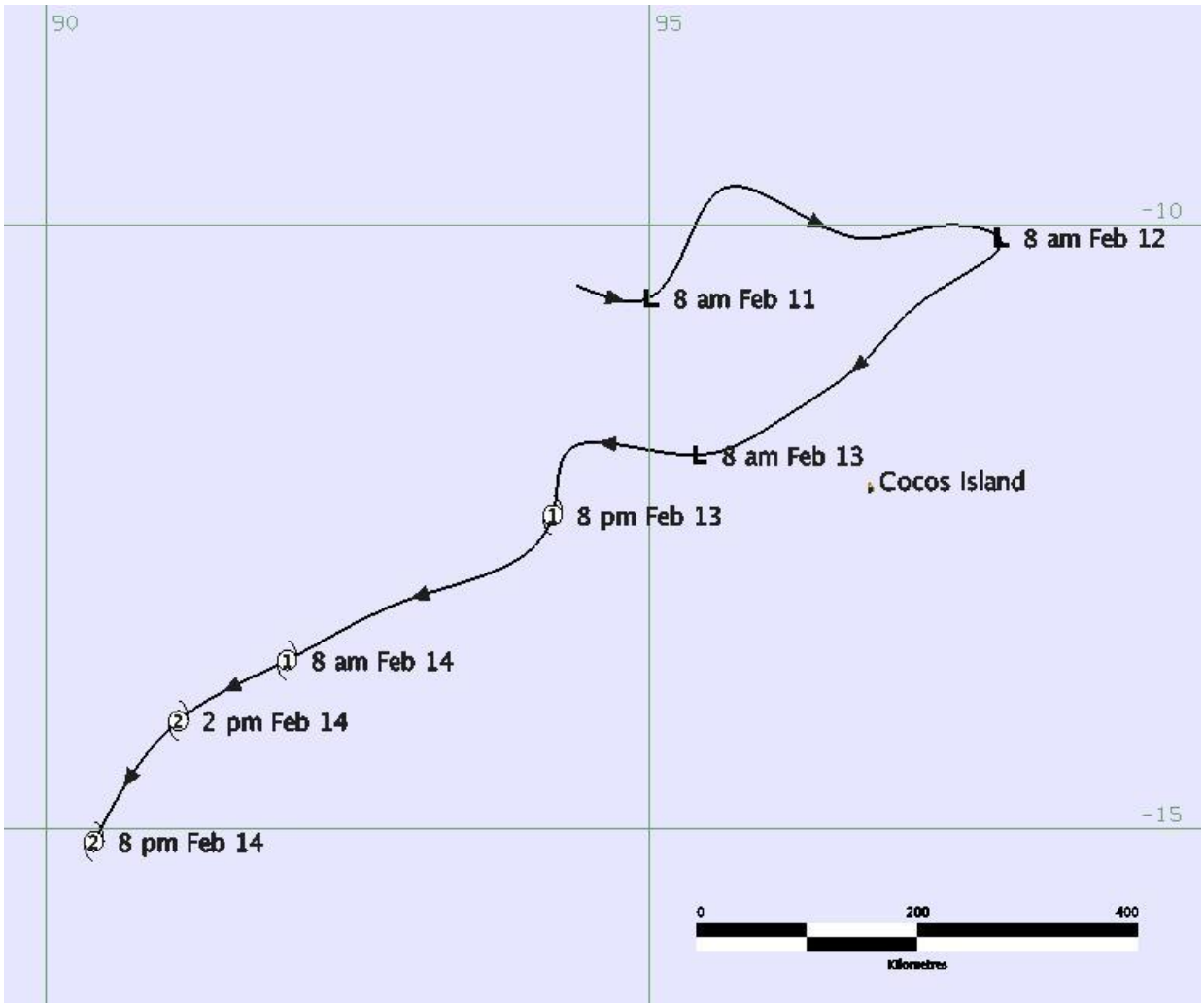
1 Summary

A low formed in an active monsoon trough about 325 km to the north-west of Cocos Island around 1800 UTC 10 February. The low drifted east before being steered back to the south-west on 12 February. Uriah reached tropical cyclone strength at 1200 UTC 13 February and reached a ten-minute mean wind intensity of 50 kn (93 km/h) at 0600 UTC 14 February before responsibility was handed to La Reunion Meteorological Agency at 1200 UTC as the system crossed 90°E and moved out of the Australian region.
The low passed about 100 kilometres to the north-west of the Cocos (Keeling) Islands during the early hours of 13 February and the Islands experienced a period of strong to near gale force winds. There was some minor damage experienced on the Cocos (Keeling) Islands as the system passed by.

Figure 1. Best Track of Tropical Cyclone Uriah 11 - 14 February 2016 (times in WST, UTC +8)



2 Meteorological Description

2.1 Intensity Analysis

A low developed in an active monsoon trough during 11 February and an initial Dvorak Data T-number (DT) of 1.0 was assigned at 0600 UTC. A 1449 UTC ASCAT partial pass (refer Figure 2) showed a circulation with 30 kn (55 km/h) westerly winds on the northern side. Over the next 24 hours the system showed limited signs of development and ASCAT passes failed to capture the circulation but showed a broad area of 20-25 kn (35 – 45 km/h) winds on the periphery of the system. A low-level centre was intermittently exposed on visible (VIS) satellite imagery as the system experienced easterly shear.

Early on 13 February DT numbers increased to 2.5 as shear decreased and the curved banding became more organised. The circulation reached tropical cyclone intensity at 1200 UTC, when DT numbers had reached 3.0. A 1545 UTC ASCAT (refer Figure 3) pass showed a well-developed circulation with 35 kn (65 km/h) winds extending around the centre, increasing to 40 kn (75 km/h) winds on the south-eastern side. Satellite imagery through the 14 February showed Uriah continuing to strengthen with Dvorak estimates increasing to 50 kn (95 km/h) at 1200 UTC before the system moved west of 90°E and responsibility for the system was handed over to La Reunion Meteorological Agency.

Objective guidance from Satellite Consensus (SATCON) and Cooperative Institute for Meteorological Satellite Studies (CIMSS) and National Environmental Satellite, Data, and Information Service (NESDIS) advanced Dvorak Techniques (ADT) are shown in Figure 5. The techniques provided reasonable guidance throughout although the NESDIS ADT initially over developed the system while analysing a CDO pattern from around 1200 UTC on 12 February. It then temporarily weakened the system from 0000 UTC till 1200 UTC on 13 February when it changed to a Curved Band pattern. The system was reasonably sheared throughout this 24 hour period before the shear reduced.

2.2 Structure

Uriah initially had gales form on the southern side at 0000 UTC 13 February. As the system developed, gales extended around the centre from 1200 UTC and the radius of gales expanded on the southern side from 60 to 120 nm (110-220 km). At 0600 UTC on 14 February Uriah had developed storm-force winds and the radius of gales on the southern side extended to 180 nm (330 km) by 1200 UTC before the Uriah moved west of 90°E. The radius maximum winds remained steady at 40 nm (75 km).

2.3 Motion

Uriah was initially steered in a slow eastward direction as the monsoonal westerly flow to the north of the system was partially countered by a mid-level ridge. The mid-level ridge began to strengthen from 12 February ahead of a slow moving mid latitude trough that was in the western Indian Ocean. As a result Uriah turned towards the south-west and continued tracking in this direction as it passed west of 90°E.

Table 1. Best track summary for Tropical Cyclone Uriah.

Refer to the Australian Tropical Cyclone database for complete listing of parameters.
*Not at tropical cyclone intensity using Australian definition as gales in two or less quadrants.

Year	Month	Day	Hour UTC	Pos. Lat S	Pos. Long. E	Pos. Acc. nm	Max Wind 10 min kn	Max gust kn	Cent. Press. hPa	Rad. of gales (NE/SE/ SW/NW)	Rad. of storm (NE/SE/ SW/NW)	RMW nm
2016	02	10	1800	10.5	94.4	20	25	45	1005			
2016	02	11	0000	10.6	95.0	20	25	45	1004			
2016	02	11	0600	9.7	95.6	30	25	45	1005			
2016	02	11	1200	10.1	96.7	40	30	45	1003			
2016	02	11	1800	10.0	97.6	60	30	45	1002			
2016	02	12	0000	10.1	97.9	40	30	45	1001			
2016	02	12	0600	10.6	97.3	40	25	45	1005			
2016	02	12	1200	11.1	96.8	40	25	45	1004			
2016	02	12	1800	11.6	96.1	60	30	45	1003			
2016	02	13	0000	11.9	95.4	40	35*	50	1000	-/60/90/-		40
2016	02	13	0600	11.9	94.3	30	35*	50	999	-/90/90/-		40
2016	02	13	1200	12.4	94.2	30	40	55	994	90/120/120/90		40
2016	02	13	1800	13.1	93.0	30	40	55	996	90/150/150/90		40
2016	02	14	0000	13.6	92.0	30	45	65	991	120/180/150/90		40
2016	02	14	0600	14.1	91.1	20	50	70	988	120/180/150/90	60	40
2016	02	14	1200	15.1	90.4	20	50	70	987	120/180/180/90	60	40

Figure 2. METOP-A ASCAT pass at 1449 UTC 11 February 2016.

Image courtesy of https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php

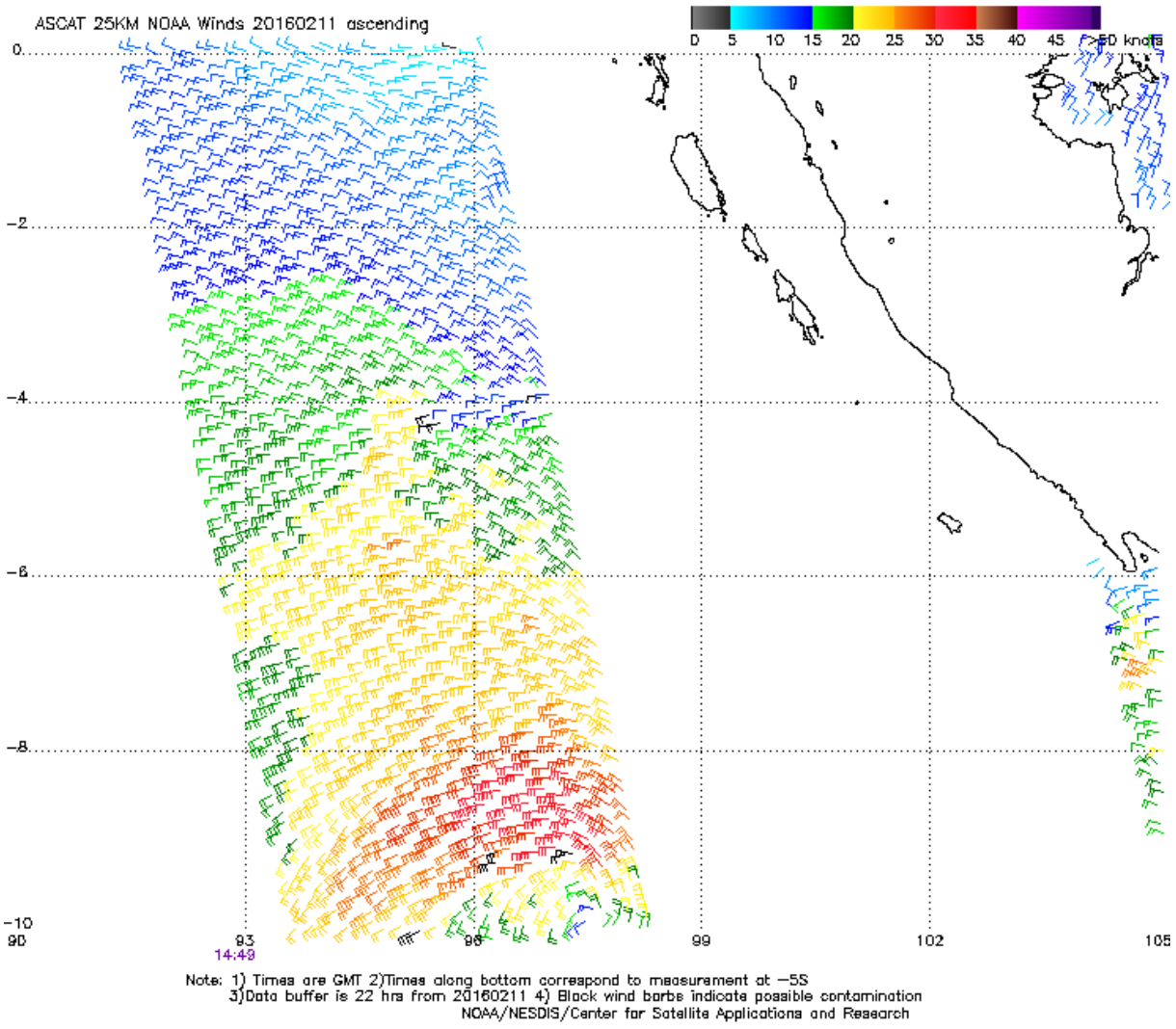


Figure 3. METOP-A ASCAT pass at 1545 UTC 13 February 2016.

Image courtesy of https://manati.star.nesdis.noaa.gov/datasets/ASCATData.php

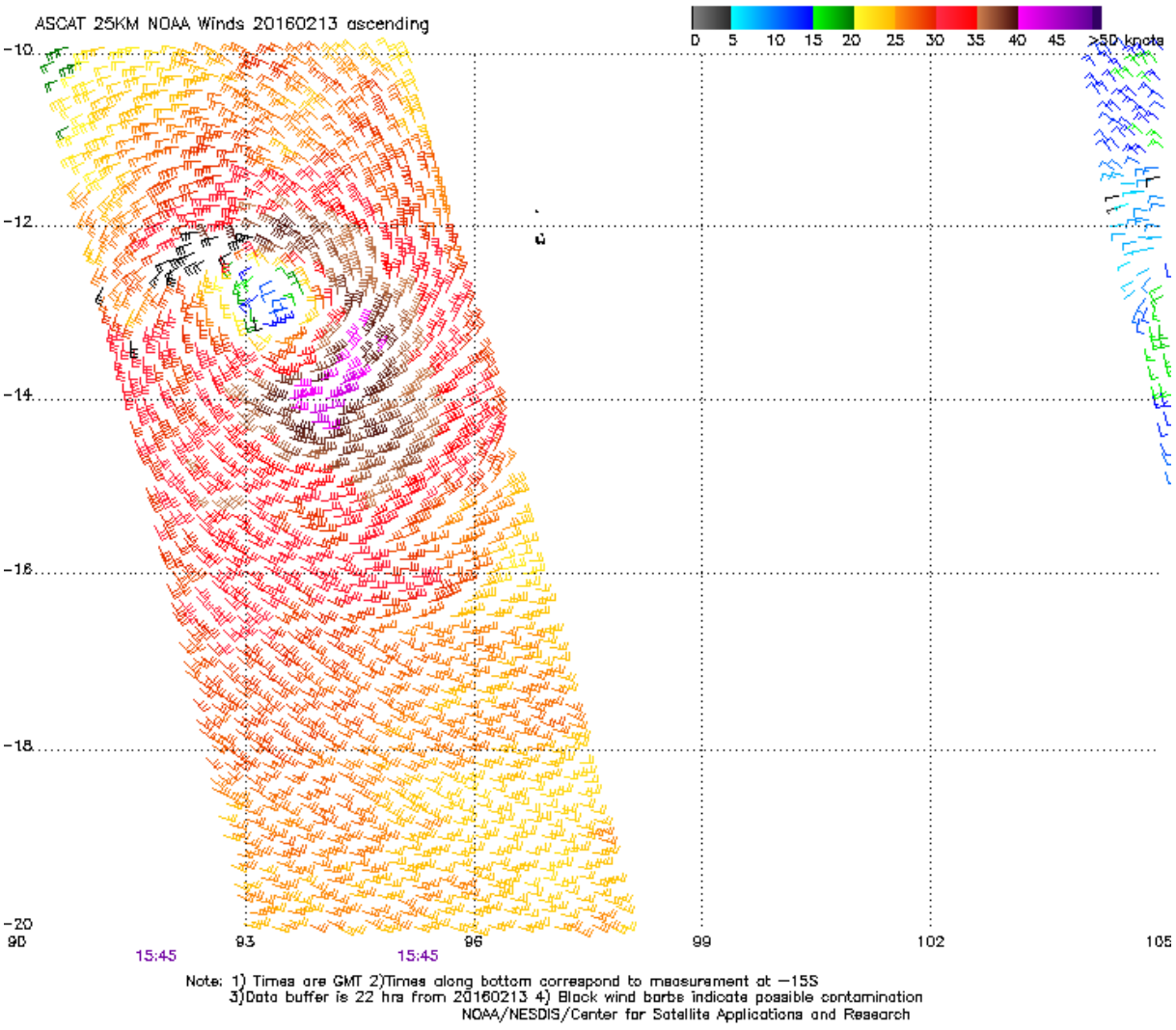


Figure 4. Himawari-8 Visible imagery at 0900 UTC 14 February 2016 shortly before Uriah moved west of 90°E.

Image courtesy of **https://www.fnmoc.navy.mil/tcweb/cgi-bin/tc_home.cgi**

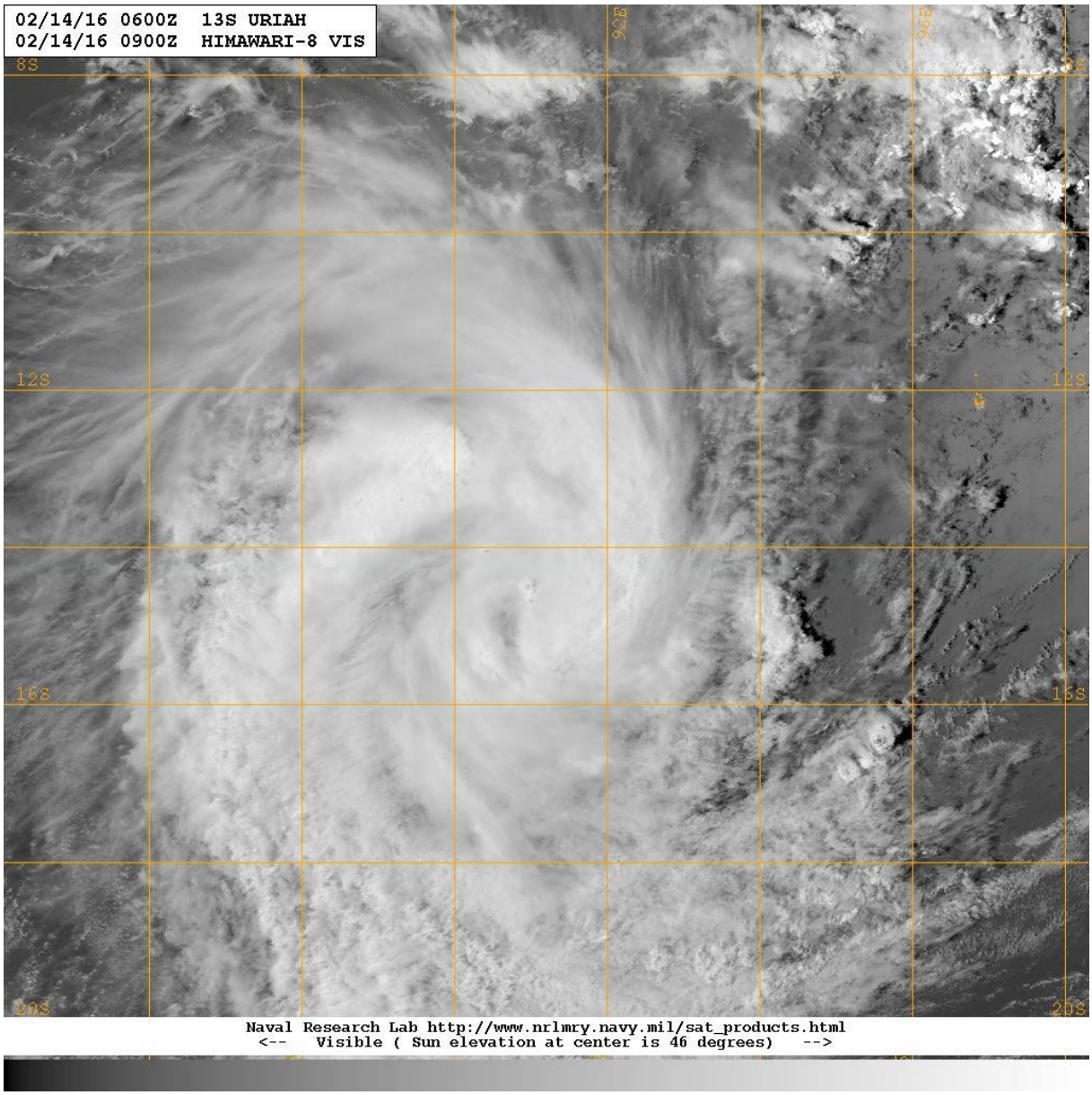
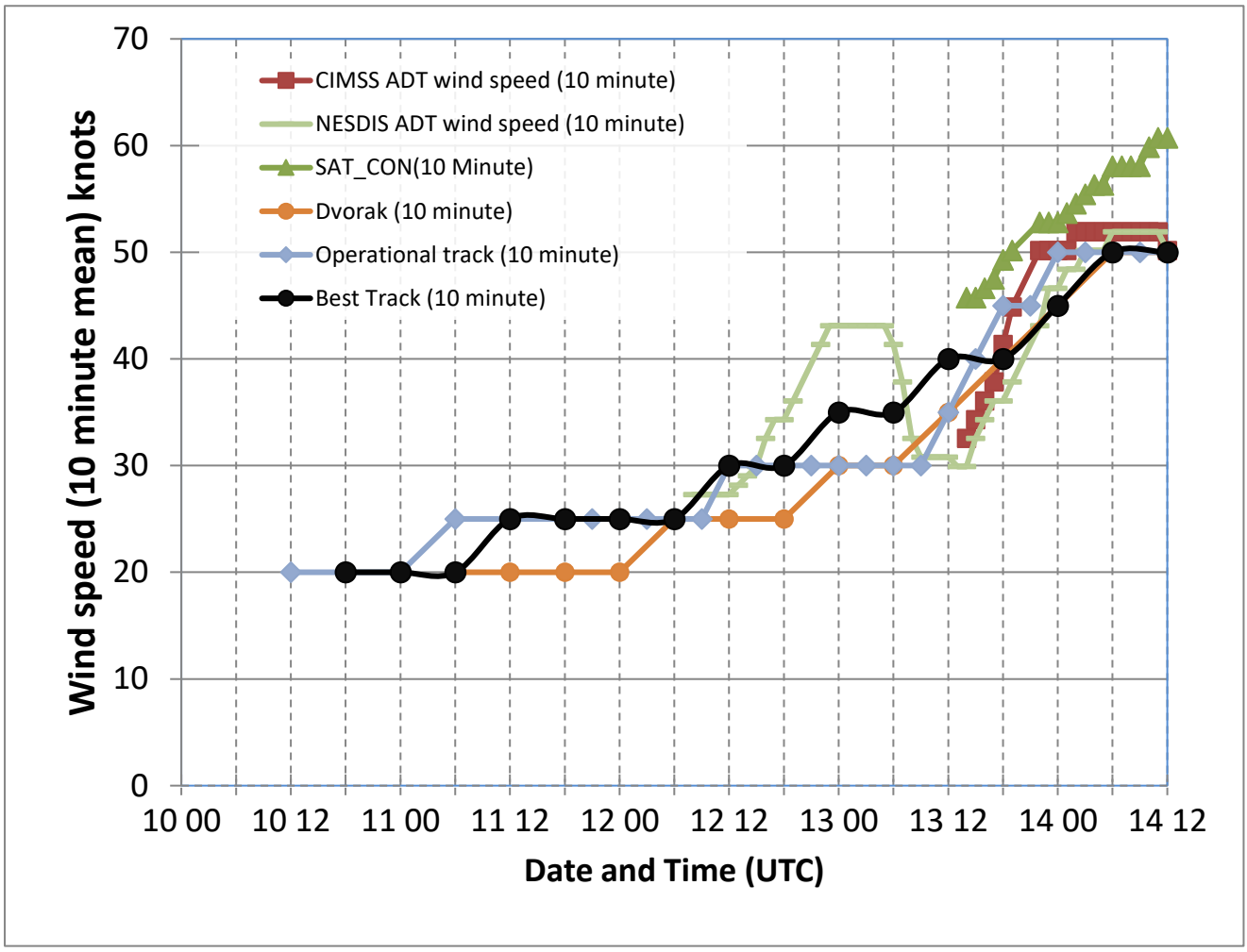


Figure 5 Comparison of objective and subjective intensity analysis techniques.



3 Impact

There was some minor damage experienced on the Cocos (Keeling) Islands as the system passed by, road erosion due to rainfall and some fallen trees.

4 Observations

Before reaching tropical cyclone strength Uriah passed about 100 kilometres to the north-west of the Cocos (Keeling) Islands as a tropical low during the early hours of 13 February and the Islands experienced a period of strong to near gale force winds. The strongest gust recorded was 44 kn (81 km/h).

5 Forecast Performance

The accuracy statistics obtained by comparing the forecast positions against the best track positions for Uriah are shown in the table below.

Figures 6 and 7 are plots of the position and intensity accuracy for Uriah compared to the five-year mean. Values for 96 and 120h lead time are excluded as the number of data were insufficient to make conclusions. The position errors were higher than the five-year average but the intensity errors were less.

	0	6	12	18	24	36	48	72	96	120
Position Absolute error (km)	69	107	148	175	226	286	360	587	886	1235
Intensity Absolute error (kn)	3.1	2.1	3.3	4.1	3.0	4.4	4.3	12.1	29.0	37.5
Sample Size	13	12	12	11	10	9	7	7	5	4

Figure 6. Position accuracy figures (Mean Absolute Error) for Tropical Cyclone Uriah.

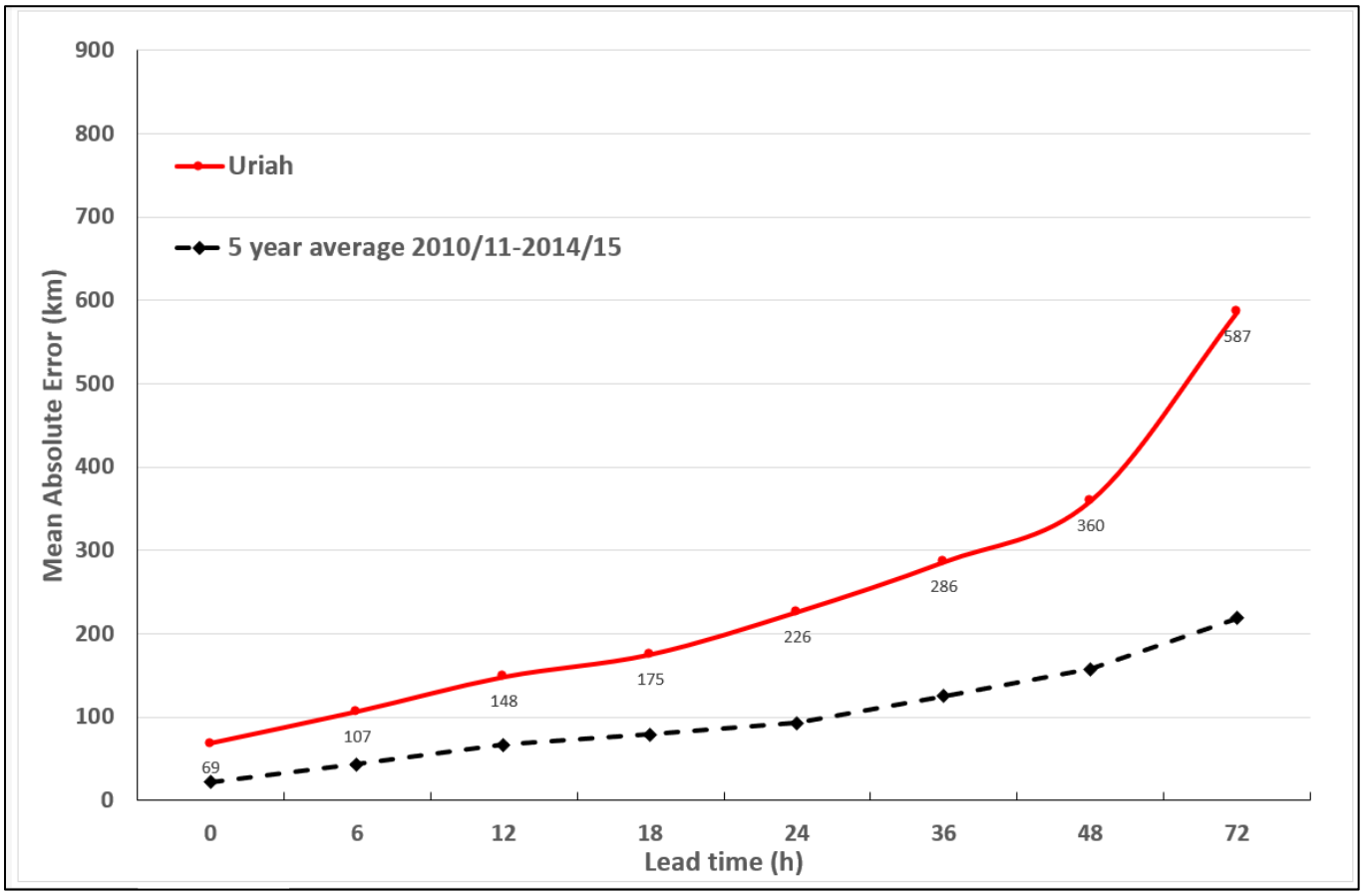
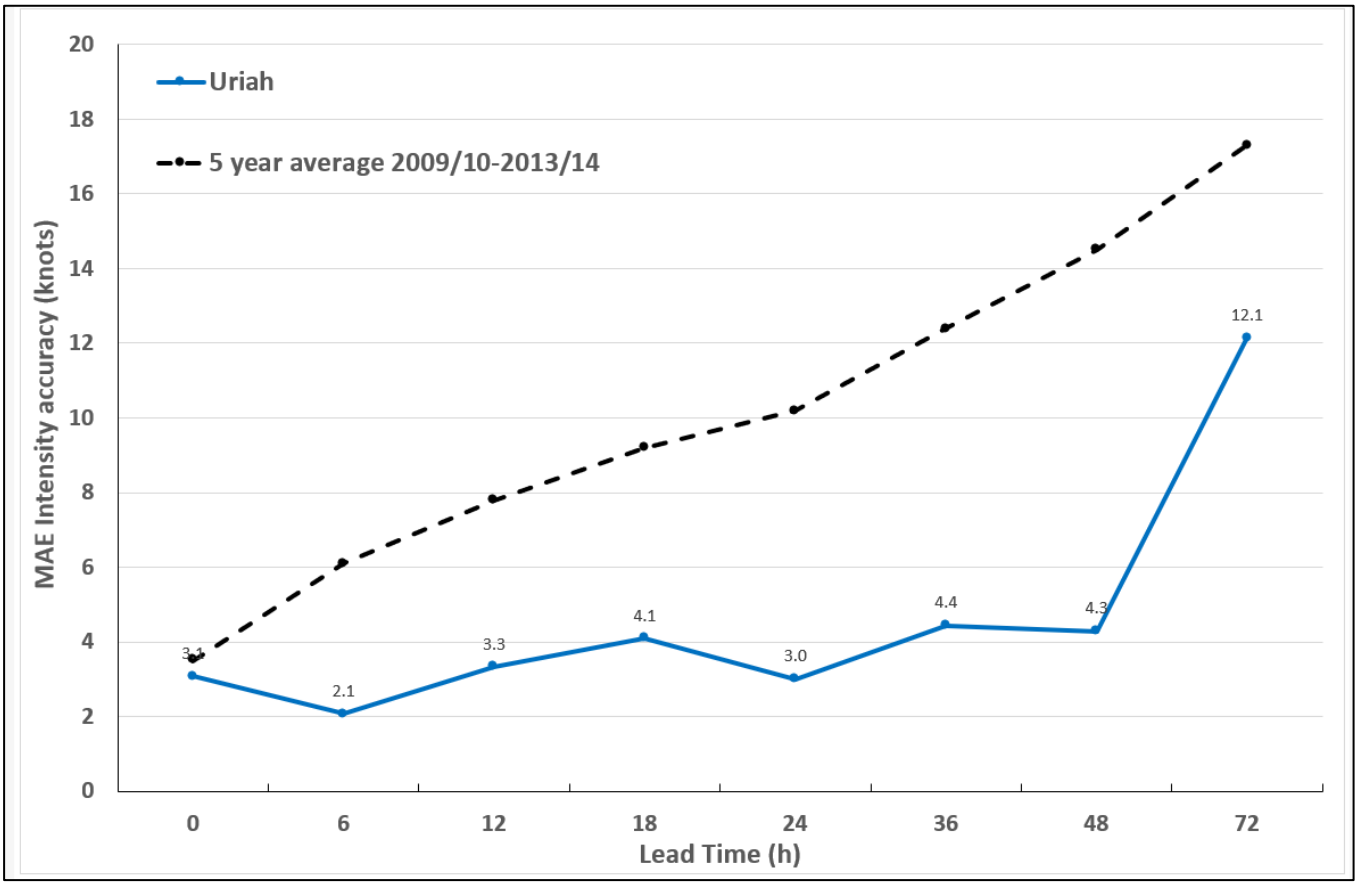


Figure 7. Intensity accuracy (Mean Absolute Error) figures for Tropical Cyclone Uriah.



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6. Appendix: List of abbreviations

ADT	Advanced Dvorak Technique	km/h	kilometres per hour
ACST	Australian Central Standard Time	kn	knot
AEST	Australian Eastern Standard Time	LLCC	low level cloud centre
AMSR2	Advanced Microwave Scanning Radiometer	MET	Model Expected T-number
ASCAT	Advanced Scatterometer	METOP	Meteorological Operational Satellite
ATMS	Advanced Technology Microwave Sounder	MJO	Madden-Julian Oscillation
AWS	automatic weather station	mm	millimetres
AWST	Australian Western Standard Time	MSLP	mean sea level pressure
C	Celsius	nm	nautical mile
CI	Current intensity	NOAA	National Oceanic and Atmospheric Administration
CIMSS	Cooperative Institute for Meteorological Satellite Studies (USA)	NRL	Navy Research Lab (USA)
CIRA	Cooperative Institute for Research in the Atmosphere (USA)	PAT	Pattern T-number
EIR	Enhanced InfraRed	RH	relative humidity
ERC	eyewall replacement cycle	RMW	radius of maximum winds
FNMOC	Fleet Numerical Meteorology and Oceanography Centre (USA)	RSMC	Regional Specialised Meteorological Centre
FT	Final T-number	SAR	Synthetic Aperture Radar
GCOM	Global Change Observation Mission	SATCON	satellite Consensus
GHz	Gigahertz	SMAP	Soil Moisture Active Passive
GMI	Global Precipitation Measurement Microwave Imager	SMOS	Soil Moisture and Ocean Salinity
h	hour	SSMIS	Special Sensor Microwave Imager/Sounder
hPa	hectopascal	TC	Tropical Cyclone
HSCAT	Hai Yang 2 Scatterometer (HY-2B, HY-2C)	TCWC	Tropical Cyclone Warning Centre
km	kilometres	UTC	Universal Time Co-ordinated