WASTAC

2016 Annual Report

Western Australian Satellite Technology and Applications Consortium

Western Australian Satellite Technology and Applications Consortium (WASTAC) Members

Australian Bureau of Meteorology (Bureau)
GPO Box 1289
MELBOURNE VIC 3001

Curtin University
GPO Box U1987
PERTH WA 6845

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
Earth Observation Informatics Future Science Platform
GPO Box 664
CANBERRA ACT 2601

Geoscience Australia
GPO Box 378
CANBERRA ACT 2601

Landgate
PO Box 2222
MIDLAND WA 6936

Murdoch University
90 South Street
MURDOCH WA 6150

Postal:
The Secretary
WASTAC
c/o Landgate
PO Box 2222
MIDLAND WA 6936

Telephone:	(08) 9387 0330
Facsimile:	(08) 9250 3187
International:	(+618) 9387 0330

Email:
wastac@landgate.wa.gov.au

Web site:
http://www.wastac.wa.gov.au

Front Cover: The image depicts the north west coast of Western Australia, where there are commercial aquaculture activities for barramundi in Cone Bay. It is a Sentinel 2A image from 2 November 2016, bands 842 (rgb) at 10 m resolution.

Editor: W Thompson - Landgate

Table of Contents

Chairman's Report	4
WASTAC Board and Standing Committee	5
WASTAC Strategic Plan	6
Operations	7
WASTAC Data Archive	8
Vale Curtin Dishes	11
Future of WASTAC	13
Operational Applications	15
Landgate	15
Bureau of Meteorology	21
Research and Development	26
Curtin University	26
Auditor's report – L-Band	35
WASTAC L-Band Budget 2016	39
Income Statement L-Band	40
Balance Sheet L-Band	41
Cash Flow Statement L-Band	42
Notes to the Financial Statements L-Band	43
Auditor's report – X-Band	47
WASTAC X-Band Budget 2016	51
Income Statement X-Band	52
Balance Sheet X-Band	53
Cash Flow Statement X-Band	54
Notes to the Financial Statements X-Band	55

Chairman's Report

2016 was one of the most significant years in WASTACs 27 year history. It started with the retirement of WASTAC's first Secretary in February alongside the critical failure of the L-band dish at Curtin and ended with a roadmap to wind down the existing WASTAC over the next couple years. More on that later.

As mentioned, the L-band receiver at Curtin University failed on 7 February 2016. The X-band receiver at Murdoch University had a demodulator power supply failure on 17 February, which was repaired on 24 February. The X-band receiver also had increasing reception problems from November 2016, which was eventually traced to a problem with the level cage motor (the motor was replaced in April 2017).

Total number of passes received in 2016 was 9,851, which was approximately 5,000 less than 2015 and reflects the loss of the Curtin dish early in the year. Software updates funded in 2014 have resulted in WASTAC being able to process FY-3B data and some of our partners are generating products from that data source. No additional satellites were added to the reception list in 2016.

As the Operational Applications reports show, data sourced from WASTAC is contributing to worldwide numerical weather forecasting, the tracking and monitoring cyclones in Australia, as well as tracking a changing climate (Willmott et al., BOM). It is noted that the new generation of geostationary satellites will displace low earth orbit satellites in the monitoring of cyclones.

Landgate continues to exploit polar earth orbiting satellite datasets to supply near real time fire information datasets to land managers across Australia (McMillan, Landgate), as well as assisting Western Australia's (WA) Department of Fisheries to determine sites around the WA coastline suitable for aquaculture (Steber, Landgate).

PasturesfromSpace® was redeveloped and released as PasturesfromSpace® Plus (PFS+) in 2016 (Abbott, Landgate). PasturesfromSpace® utilised MODIS data to estimate pasture growth rates and feed on offer that was originally developed with CSIRO and the Department of Agriculture and Food Western Australia between 1999 and 2009. The redevelopment was aimed at making the information easier to use by famers. PFS+ recently won the 2017 New Agricultural Release Award at Wagin Woolorama in WA.

Curtin University researchers are using MODIS data to monitor impacts on water quality from increased oil and gas exploration activity in the north west of WA (Dorji and Fearns, Curtin University) and investigating temporal variability of turbidity in the Kimberley region as a baseline study (Fearns and Chedzey, Curtin University). The article on vegetation classification in Port Hedland (Bos and Fearns, Curtin University) is a lead in to possibilities that the Ocean and Land Colour Instrument on Sentinel-3 can provide to WASTAC members in the future.

WASTAC remains in a strong financial position with sufficient reserves to make modifications to existing systems, as needed.

The WASTAC partners have contributed generously to the efficient running of WASTAC. Ron Craig, Mike Steber, Jackie Marsden, and Joe Cudmore (Landgate), along with Denis Margetic and Kelly Desker (BOM), have kept the stations and processing systems operating. Ed King (CSIRO) makes available state vectors for geolocation of AVHRR imagery, as well as production of the NOAA Stitched Archive utilizing WASTAC data at the NCI in Canberra. Our Secretary, Richard Stovold (Landgate), retired early in 2016. He has been replaced by Dan Sandison, who organised our Strategic Workshop in Melbourne in late August. Curtin University continues to manage our accounts. Murdoch University maintains an excellent site for the X-band antenna. Geoscience Australia provides valuable national coordination and access to MODIS data from Alice Springs for WASTAC members. Lastly, I would like to welcome Dr Wendy Thompson, who agreed to pick up the Annual Report editing role this year as well as support a number of actions from the Strategic Workshop conducted at the end of August 2016.

Strategically, it is important that any organisation review its role and relevance regularly in an ever changing world. The WASTAC Board held a Strategic Workshop in Melbourne to discuss WASTAC's future in the current policy and operational environment. The Board had an early draft of the Siting Study to assist with its deliberations. At its November meeting, the Board decided to wind up WASTAC by the end of 2018, if possible. The Board has agreed to fund a new reception capability in regional Western Australia and transfer the ongoing operations to the Bureau of Meteorology with the existing capability to be disposed of or transferred. Some supporting projects to provide a national, moderate resolution reception capability will also be funded by WASTAC. The Board is also investigating how WASTAC can invest in sustainable research, education and coordination in earth observation in Western Australia. A summary of this workshop will be found within this Annual Report.

As Chairman, I take pride in the major contributions WASTAC is making to advance our understanding of land, ocean and atmospheric processes across Australia.

Dr Matthew Adams
Chairman, WASTAC 2016

WASTAC Board and Standing Committee

WASTAC Board for 2016

Dr Matthew Adams – Chairman	Landgate
Mr Richard Stovold – Secretary	Landgate (retired in 2016)
Mr Dan Sandison – Secretary	Landgate
Adjunct Prof. Merv Lynch	Curtin University (School of Science – Physics)
Prof. David Antoine	Curtin University (School of Science – Physics)
Dr Robert Corner	Curtin University (WA School of Mines – Spatial Sciences) (retired in 2016)
Dr Tom Cudahy*	CSIRO
Dr Edward King	CSIRO
Ms Agnes Lane	Bureau of Meteorology
Mr Mike Bergin	Bureau of Meteorology
Dr Adam Lewis	Geoscience Australia
Mr Guy Royal	Geoscience Australia
Dr Jatin Kala	Murdoch University
Dr Halina Kobryn	Murdoch University

WASTAC Standing Committee and proxy to the Board

Dr Matthew Adams – Chairman	Landgate
Mr Dan Sandison – Secretary	Landgate
Adjunct Prof. Merv Lynch	Curtin University (School of Science – Physics)
Dr Peter Fearns	Curtin University (School of Science – Physics)
Dr Robert Corner	Curtin University (WA School of Mines – Spatial Sciences) (retired in 2016)
Dr Ulan Turdukulov	Curtin University (WA School of Mines – Spatial Sciences)
Mr Denis Margetic*	Bureau of Meteorology
Ms Kelly Desker	Bureau of Meteorology
Dr Jatin Kala	Murdoch University
Dr Halina Kobryn	Murdoch University
Dr Margaret Andrew	Murdoch University
Dr Peter Caccetta	CSIRO
Dr David Hudson	Geoscience Australia
Dr Medhavy Thankappan*	Geoscience Australia
Dr Vincent Rooke	Geoscience Australia

WASTAC Technical Committee

Adjunct Prof. Merv Lynch (Chairman)	Curtin University (School of Science – Physics)
Mr Ronald Craig	Landgate (retired in 2016)
Dr Jackie Marsden	Landgate
Mr Denis Margetic*	Bureau of Meteorology
Dr David Hudson	Geoscience Australia

*Resigned from WASTAC during 2016

WASTAC Strategic Plan

Vision:

Improve the economy, society and environment through the acquisition of satellite observations of Western Australia and its oceans for research and near real-time applications

Mission:

- Provide high speed access to Aqua, Terra, National Oceanic and Atmospheric Administration (NOAA), Sea-Viewing Wide Field-of-View Sensor (SeaWiFS) and FengYun-1D FY-1D) satellite data to members on a non-profit basis.
- Contribute these data for national and international initiatives in remote sensing.
- Adopt recognised data formats to ensure wide access to WASTAC data.
- Maintain the integrity of archived data for research and operational applications.
- Promote the development and calibration of value-added products.
- Prepare for utilisation of information from new technically and scientifically advanced sensors.
- Promote educational and research uses of WASTAC data.
- Promote use of Aqua, Terra, NOAA, SeaWiFS and FY1D data in climate studies, environmental and renewable resource management.
- Encourage WASTAC to promote awareness of products.

Current strategies:

- Upgrade existing reception and processing capabilities and upgrade Meteorological Operational (METOP) geolocation processing to utilise CSIRO's CAPS software. FY3.
- Continue to improve the products derived from Moderate Resolution Imaging Spectroradiometer (MODIS), AVHRR, and VIIRS sensors.
- Advance the processing of AIRS data from Aqua and Terra.
- Improve the management and access of the WASTAC archive through collaboration with the Pawsey Centre.
- Provide network access to other Earth Observation Satellite receiving stations in Australia.

Operations

WASTAC maintains an L-band reception facility at Curtin University and a dual X- and L-band facility at Murdoch University. The L-band facility has been operational since 1983, although satellite tracking at Curtin (then the WA Institute of Technology) began in the late 1970s. The X-band facility has been operating since 2001. WASTAC members make use of the satellite data for weather prediction, vegetation and fire monitoring, and research. WASTAC maintains an ongoing near real-time archive of L-band images beginning in 1983, and X-band images from 2001.

Curtin University – L-band

The L-band facility at Curtin University in Bentley consists of a 2.4m antenna and an antenna controller supplied by Environmental Systems and Services (ES&S) and dual ingestor computers running an AVHRR ingest and display system developed by the Bureau of Meteorology (Bureau). This data was ingested into the central processing computers at the Bureau's Head Office.

The L-band facility typically received 500 to 600 passes per month from 3 satellites: NOAA-15, NOAA-18 and NOAA-19. Refer to the WASTAC DATA archive for the full list of received passes (Figures 1-3; Tables 1-2). However in February 2016, critical equipment failure resulted in the L-band facility brought offline permanently.

The Curtin University satellite reception facility was maintained by Bureau staff.

Murdoch University – X- and L-band

The X- and L-band reception facility was supplied by SeaSpace Corporation in 2001. It consists of a 3.6m antenna in a fiberglass dome, and an antenna controller computer. This facility receives data from the Aqua, Terra, MetOp, Suomi-NPP, FY3-B and FY3-C, as well as the L-band satellites such as NOAA-15, NOAA-18 and NOAA-19. The dual band reception capability at Murdoch is particularly beneficial following the L-band facility at Curtin having been brought offline.

The Murdoch University satellite reception facility is maintained by Landgate and Murdoch University staff.

Applications

Sea Surface Temperature (SST) products are produced by Landgate. Landgate also produces vegetation indices, fire scar mapping and agricultural applications in real-time.

WASTAC Data Archive

The WASTAC archive of satellite passes continues to be managed and maintained by Landgate's Satellite Remote Sensing Services (SRSS) group. The SRSS group was based at the Leeuwin Centre at Floreat until August 2016, when it was relocated to the Perth suburb of Midland. The SRSS Group actively manages the daily archive and management systems that have been installed to ensure rapid and reliable delivery of WASTAC satellite data for research and wider community use.

The archive forms the basis for the development, processing and delivery of a range of products listed in the Operational and Research Applications sections of this report.

A total of 9,851 passes were archived at Curtin and Murdoch in 2016.

The near real-time quick-look archive of VIIRS, MODIS and NOAA-AVHRR data continues to be maintained on the web. This digital archive extends back to 1983 (for NOAA-AVHRR). A similar archive of SeaWiFS quick-look data is also held on the web. The archive of MODIS, NOAA, VIIRS and SeaWiFS data can be viewed at:

www.rss.landgate.wa.gov.au/noaaql

www.rss.landgate.wa.gov.au/modisql

www.rss.landgate.wa.gov.au/seawifsql

www.rss.landgate.wa.gov.au/viirsql

Landgate currently holds the archive on 8mm Exabyte and 4mm DAT tapes. 20Gb DLT tapes were introduced as the archive medium in late 2000 for the L-band data and since the commissioning of the facility in 2001, X-band data has been archived on DLT 35Gb tapes and more recently LTO5 tapes.

Duplicate copies of the raw data archive are produced for a national archive program hosted at the National Computing Infrastructure (NCI) in Canberra that is coordinated by CSIRO.

Total Archived Passes 1981-2016

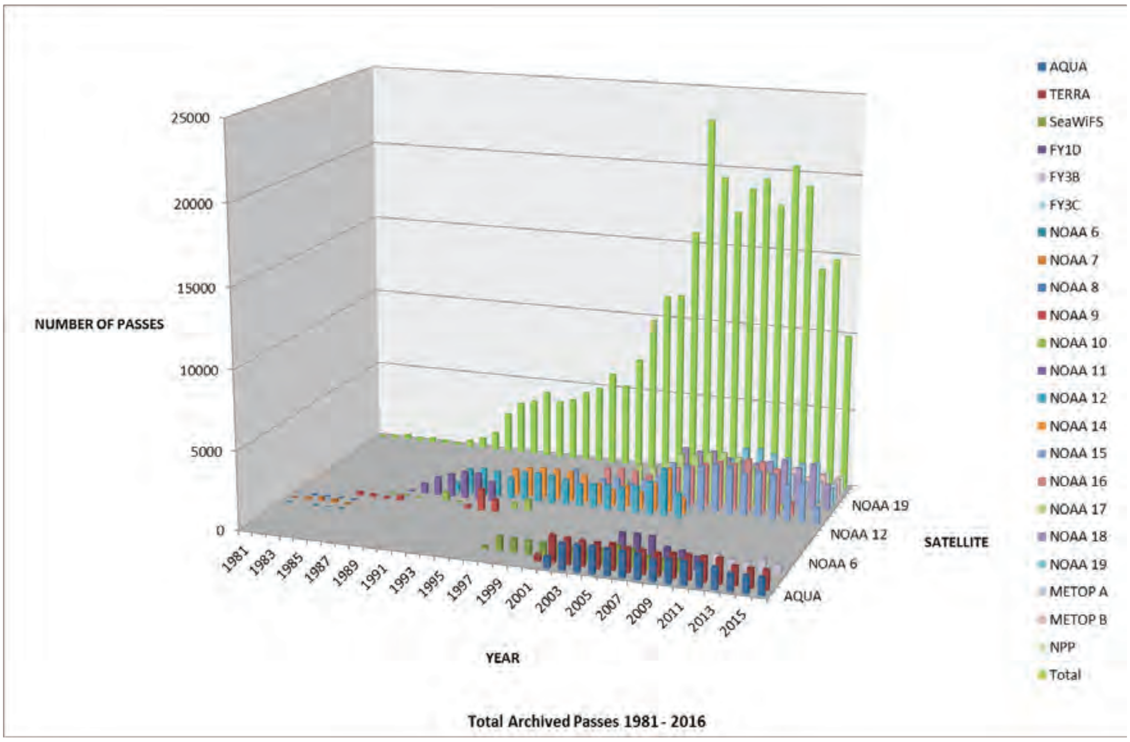


Figure 1:
Summary of archived passes recorded by year and by satellite from 1981-2016.

	AQUA	TERRA	FY3B	FY3C	METOP A	METOP B	NPP	SeaWiFS	FY1D	NOAA 6	NOAA 7	NOAA 8	NOAA 9	NOAA 10	NOAA 11	NOAA 12	NOAA 14	NOAA 15	NOAA 16	NOAA 17	NOAA 18	NOAA 19	Total
1981										5	22												27
1982											115	1											116
1983										12	244	12											268
1984										7	179	4											190
1985										7	33	4	212										256
1986													151										151
1987													97	18									115
1988													280	25	53								358
1989														21	601								622
1990															1103								1103
1991														506	1399	575							2480
1992														47	1693	1571							3311
1993													183		1656	1720							3559
1994													1362		1227	1641							4230
1995													770			1326	1615						3711
1996														354		1780	1776						3910
1997								142						694		1797	1876						4509
1998								859								1763	1828	432					4882
1999								822								1589	1839	1663					5912
2000								843								1427	1681	905	341				5197
2001		390						811								1548	1271	1292	1733				7045
2002	734	1710						780								1579	976	1455	1789	709			9732
2003	1651	1645						696								1521	1351	1200	1728	1827			11388
2004	1665	1602						680								1727	1058	1481	1524	1797			11534
2005	1705	1577						863	553							2101	1706	1904	1743	2212	1339		15703
2006	1635	1639						1239	1683							3030	2761	2823	2240	2883	2989		22922
2007	1615	1512						1092	1678							1571	952	2777	2442	2869	2839		19347
2008	1553	1495						787	1673									2844	2711	3165	2985		17213
2009	1327	1411						687	1132									3055	2951	3254	2622	2306	18745
2010	1454	1516						793	1040									3061	2895	3054	2567	3058	19438
2011	1485	1537							751									2692	3282	2527	2453	3128	17855
2012	1465	1571	775		1118	316	924		255									2923	3223	2278	2677	2880	20405
2013	1349	1569	557		1383	1503	1243											2781	2845	316	2883	2752	19181
2014	1085	1232	536		1021	1044	987											2282	866		2484	2473	14010
2015	1101	1179	845	82	1161	1300	1106											2463			2790	2642	14669
2016	1096	1203	545	0	1102	1123	999											1059			1612	1112	9851

Table 1:
Total number of archived passes recorded by year and by satellite for 1981-2016.

Total Archived Passes for 2016

		NOAA 15	NOAA 18	NOAA 19	FY3B	FY3C	METOP A	METOP B	TERRA	AQUA	NPP	TOTAL
JAN	C	67	90	103								260
	M	129	120	37	74	0	105	111	117	108	103	904
												1164
FEB	C	14	16	19								49
	M	103	116	85	31	0	109	106	87	76	93	806
												855
MAR	C	0	0	0								0
	M	100	131	96	39	0	112	107	110	93	95	883
												883
APR	C	0	0	0								0
	M	89	133	90	40	0	101	100	108	93	115	869
												869
MAY	C	0	0	0								0
	M	83	133	94	34	0	95	98	113	93	88	831
												831
JUN	C	0	0	0								0
	M	79	136	91	61	0	96	102	114	107	81	867
												867
JUL	C	0	0	0								0
	M	91	132	92	37	0	101	100	118	101	97	869
												869
AUG	C	0	0	0								0
	M	68	143	91	51	0	83	87	114	110	94	841
												841
SEP	C	0	0	0								0
	M	83	130	105	55	0	102	94	98	112	81	860
												860
OCT	C	0	0	0								0
	M	57	133	112	52	0	96	104	107	116	80	857
												857
NOV	C	0	0	0								0
	M	59	100	80	32	0	70	81	63	46	34	565
												565
DEC	C	0	0	0								0
	M	37	99	17	39	0	32	33	54	41	38	390
												390
		1059	1612	1112	545	0	1102	1123	1203	1096	999	9851
	Curtin	81	106	122								309
	Murdoch	978	1506	990	545	0	1102	1123	1203	1096	999	9542

Table 2:
Summary of number of passes archived each month by satellite and by receiving dish during 2016.

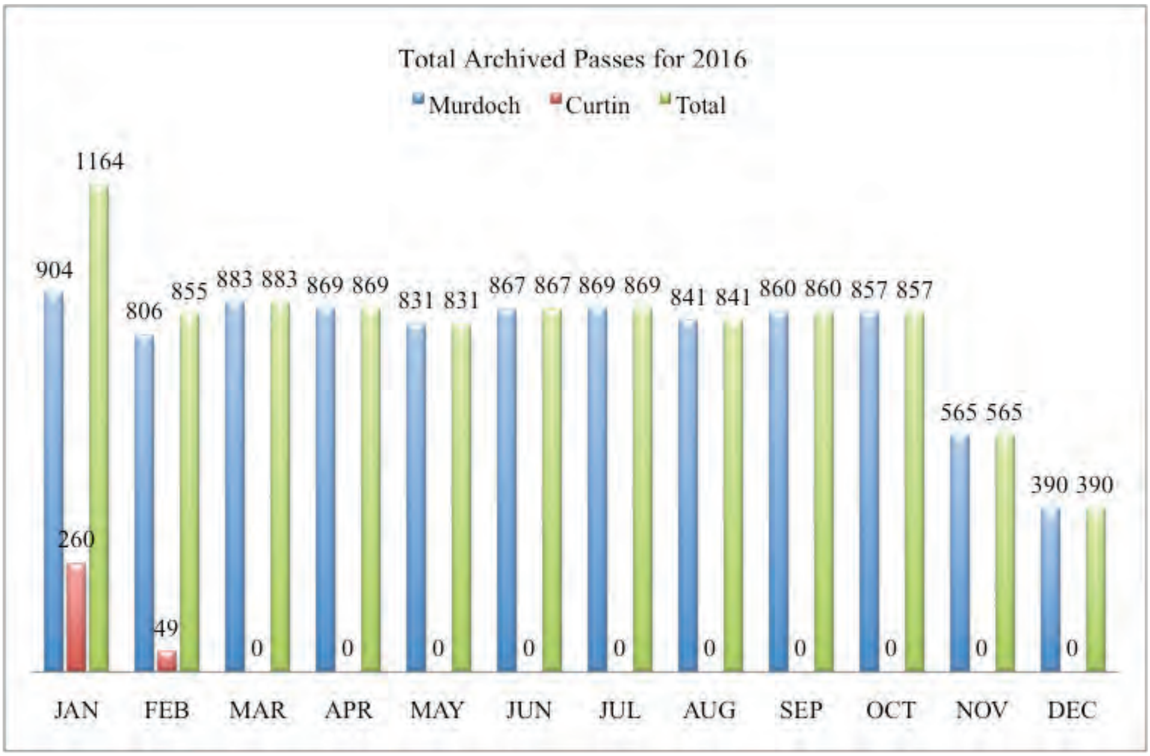


Figure 2:
Total number of archived passes for both Curtin and Murdoch dishes in 2016.

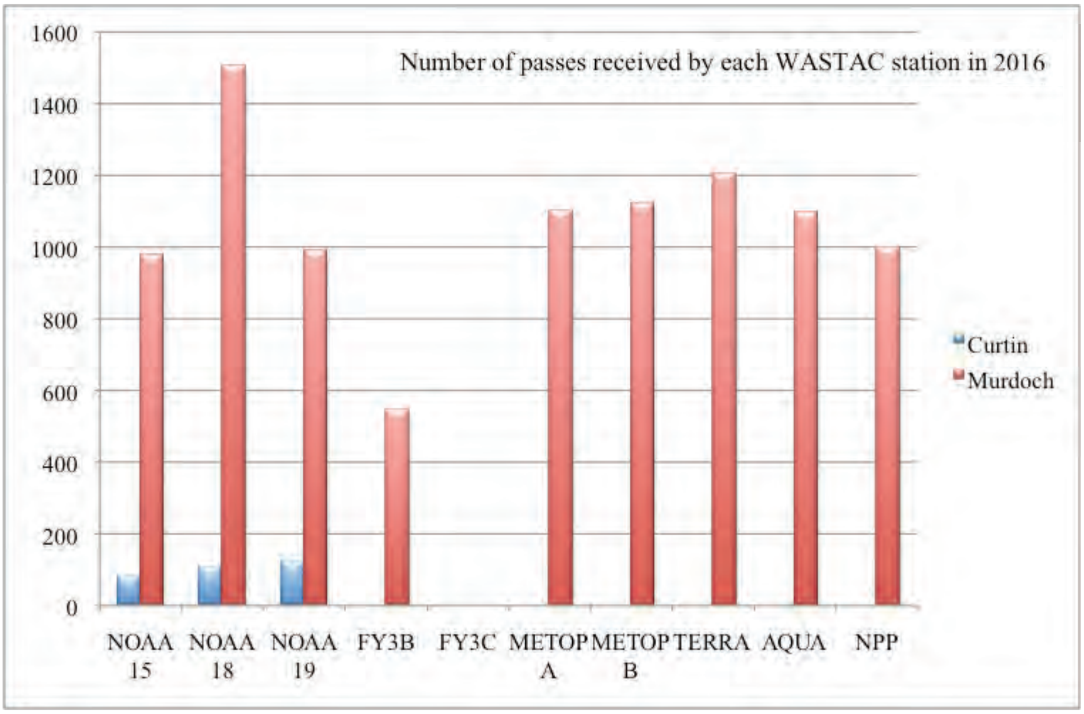


Figure 3:
Total number of passes archived for each satellite per WASTAC receiving dish in 2016.

Vale Curtin Dishes

Satellite Data Reception 1981-2016

From the first NOAA passes archived in August 1981 to the final NOAA passes received in February 2016, the satellite receiver dishes located at Curtin University captured over 150,000 passes from a suite of satellite borne sensors. The establishment of WASTAC led to an upgrade in 1987 of the original manually-operated receiving facility to the fully automated L-band receiver that was switched off in February 2016 due to critical equipment failure.

Nearly a dozen satellite borne sensors have been turned on and off during the life span of the L-band receiver, including a suite of NOAA-AVHRR satellites and SeaWiFS, a sensor focused on ocean data and the Mission to Planet MODIS satellites.

Notable events:

1981 – First manually operated receiving facility established in May at Curtin (then known as Western Australian Institute of Technology – WAIT) and first passes archived in August from NOAA-6 and NOAA-7.

1982 – Utilising AVHRR satellite imagery received via the Curtin dish, CSIRO and Curtin staff discovered that simple image processing could easily distinguish water droplet clouds and volcanic ash clouds. These image processing techniques, used to identify volcanic ash clouds and generate warnings to aviation, are still in use today.

1983 – First full passes with every pixel of every line received.

1987 – Start of WASTAC received data with the upgrade to automatic reception facilities at Curtin in July with first passes archived from the upgraded facility in September.

1995 – First daily manual fire hot spot detection using data received through the WASTAC facility.

1996 – First fully digital transfer of WASTAC data and products developed related to sea surface temperature map products as navigation aids for fish stocks for the seafood industry.

1996 – The WASTAC receiver data assisted in the rescue of a stricken yachtsman in the Southern Ocean.

1997 – First online dissemination of fire hot spot information using WASTAC data.

1997 – First encrypted SeaWiFS pass received by WASTAC L-band facility.

1998 – First passes received from NOAA-15, which is the longest continually operating satellite sensor delivering data to WASTAC reception facilities.

2003 – FireWatch Classic (precursor to My FireWatch and FireWatch Pro) – the start of online emergency management services providing automated fire hotspot information.

2010 – Final SeaWiFS passes received by WASTAC L-band facility; 11,094 passes archived from SeaWiFS sensors over its operational life span (1997-2010).

2016 – Curtin dish taken offline permanently in February due to critical equipment failure.

Figure 4:
The first satellite data receiving dish being installed at Curtin University, c. 1981. The dish was the initiative of Curtin and CSIRO and fabricated in the Mechanical Engineering Workshops at Curtin. The downlink system was used from 1981 to 1987, when the WASTAC joint venture installed a dish on an adjoining building at Curtin University.

Figure 5:
The WASTAC L-Band receiver, the second satellite data receiving dish installed at Curtin University in 1987 as a result of the WASTAC joint venture. Photo c. 2009

Figure 6:
The WASTAC L-Band receiver at Curtin University. Photo c. 2016

Future of WASTAC

Strategic Workshop, Melbourne August 31-September 1, 2016

Purpose

In 2013, Geoscience Australia tabled a paper for the Board that led to the Siting Study conducted in 2016. Alongside the proposal to conduct a Siting Study was the observation that "in considering options for capital expenditure, WASTAC must have a view to the longer term future of WASTAC."

WASTAC members undertook a strategic planning workshop on 31 August – 1 September 2016 to examine its position moving forward. The workshop recognized a need for WASTAC to reflect on past achievements and examine its mission going forward, given that the policy and operating environment had significantly changed since WASTAC's inception in 1989.

Members were provided with a discussion paper around the future direction of WASTAC. The paper included an options analysis for consideration on the purpose and governance of a future WASTAC entity.

The Workshop also considered the summary findings of the Siting Study by the Shoal Group on the location of a new ground receiving station in Western Australia (WA), which is discussed in depth p14 (see Shoal Siting Study [wastac.wa.gov.au]).

Strategic summary

A key outcome (which was confirmed at the November 2016 Board meeting) was to wind up WASTAC by the end of 2018, if possible. WASTAC will fund a new capability in regional WA and transfer the operation of that capability to either the Bureau of Meteorology or Geoscience Australia. The new capability will be integrated into a national ground station network with the network coordinated by a national group called 'ANGSTT' – Australian National Ground Segment Technical Team, chaired initially through Geoscience Australia. ANGSTT will focus on ground station technical requirements for both future and operational earth observation science (EOS) missions at a national level. The WASTAC Board has also agreed to fund several smaller projects that will facilitate a nationally coordinated ground station network.

A second outcome was the recognition that WASTAC has played a critical role in engaging Western Australia with the broader national discussion on Earth Observation from Space and that it was important for Western Australia to maintain engagement at a national level. To facilitate this engagement the Board and Standing Committee are investing the concept of a 'WASTAC 2.0' that emphasizes EOS coordination, education and research for Western Australia. The focus would center on Western Australian coordination with national linkages, based on principles of public good, open data and open science.

Summary of agreed outcomes:

- Establishment of new dish in North Western Australia
- Decommissioning of existing Perth-metro dishes (L-Band & X-Band)
- Funding to support WA led coordination, education and research activities in earth observation sciences
- Development of national website with schedules from all sites/tiers
- Development of national scheduling system for Tier 3
- Development of Tier 3 stitching for NOAA/MODIS/VIIRS

Shoal Siting Study

WASTAC commissioned an independent study to develop options for the long-term siting of ground station facilities in WA so that WASTAC is able to continue to meet user needs as part of a national ground station network, and as a basis for future investment.

WASTAC acknowledges there are challenges in the increase in demand for spectrum and spectrum use, which involves greater costs around licensing and increasing noise.

It has been identified through the National Earth Observations from Space Infrastructure Plan (NEOS-IP) that the future of operational ground station capabilities lies in consolidation of facilities in carefully chosen locations. Those locations are likely to be distant from development, yet accessible and close to optical fibre communications.

In late 2016, The Shoal Group delivered 'Current and Future Ground Segment Options for Western Australian Satellite Technology and Applications Consortium' report to WASTAC. The report is available on the WASTAC webpage [www.wastac.wa.gov.au].

The report examined the policy drivers supporting improvements to a national strategic EOS supply chain network and the development of siting options for the expansion of ground station reception facilities in Western Australia. Eight potential sites were initially investigated with WASTAC requesting three of those examined at greater detail. The recommended site preference resulted in co-recommendation of the Bureau facility at Learmonth Airport (LEA) and Yarragadee Geodetic Observatory (YGO) for site preference, followed by the CSIRO Australian Academic and Research Network fibre repeater at Mullewa (Mullewa).

Site selection considered the following: co-location potential with existing related facilities; secure and long-term availability of tenure; spectrum; suitable power and fibre communications; site accessibility and travel time from Perth or regional airport; availability of technical expertise; radio quietness and favourable horizon mask and climate.

Landgate, Satellite Remote Sensing Services, Floreat

Creating long term statistics for determining aquaculture sites

Mike Steber, Satellite Systems, Landgate
Brett Harrison, Department of Fisheries

The Department of Fisheries (Fisheries) has been undertaking modelling and site assessments around Western Australian waters for suitability for aquaculture sites. Aquaculture in Western Australia (WA) includes commercial farming for species such as barramundi, yellowtail kingfish and shellfish such as abalone and edible oysters. Fisheries examine a suite of criteria to support the initial desktop analysis and suitability modelling, including depth of water, proximity to ports and transport access. Long-term averages of sea surface temperature (SST) and chlorophyll as detected from satellite imagery were determined important information to feed into the site selection analysis.

In early 2016, Landgate was engaged to assist Fisheries in examining long-term averages (in the order of five to 10 years) and minimum and maximum values for particular areas in WA for both SST and chlorophyll-a using satellite data (Figure 7). Fisheries was interested in averages on a month-by-month basis for SST and chlorophyll to determine both the suitability of site for aquaculture as well as species for a particular location.

Using the WASTAC archive of Terra and Aqua satellite data, Landgate wrote a Python script to extract 10 years (2006-2015) worth of data, remove cloudy pixels and then calculate the required statistics (Figure 8). The Terra and Aqua MODIS data were best suited for this type of analysis as WASTAC had complete coverage for these areas around Western Australia and there was already processed data going back at least 10 years. Both satellites offer one kilometre (1 km) resolution over oceans.

These statistics were grouped by both month and the satellite from which the image was derived, which formed the first version of the data. The resulting images were then evaluated for errors within a GIS software package. Errors detected included 'noisy' and cloud-edge affected images, which skewed the image and can impact analysis. These errors were systematically removed until a set of smooth images were produced. The final summary statistics provided to Fisheries were used to feed into a detailed model to support informed decision making for aquaculture site assessments in WA.

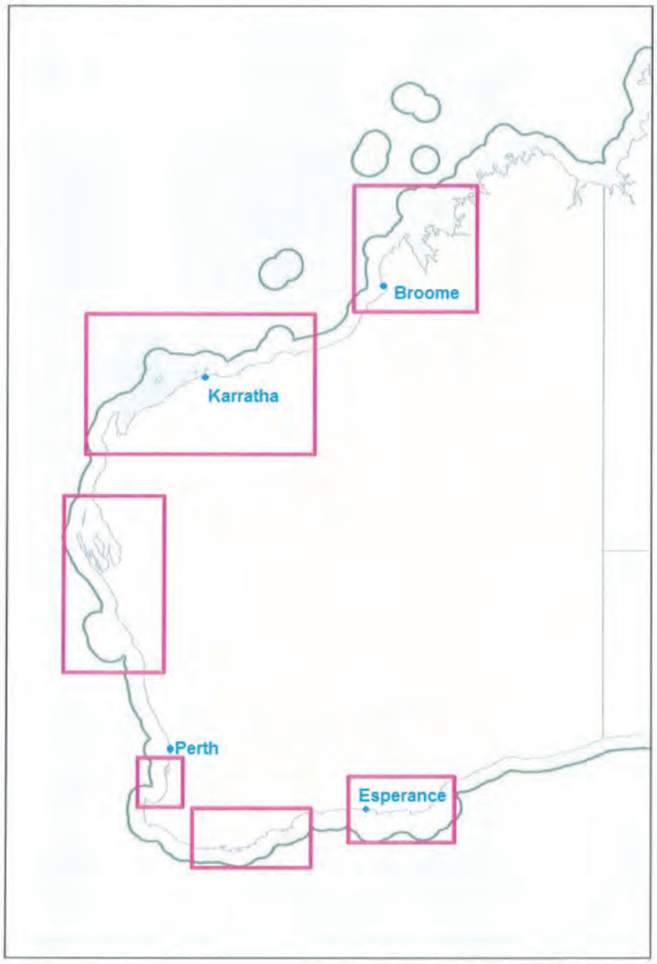


Figure 7:
Department of Fisheries areas of interest for aquaculture sites in Western Australia.

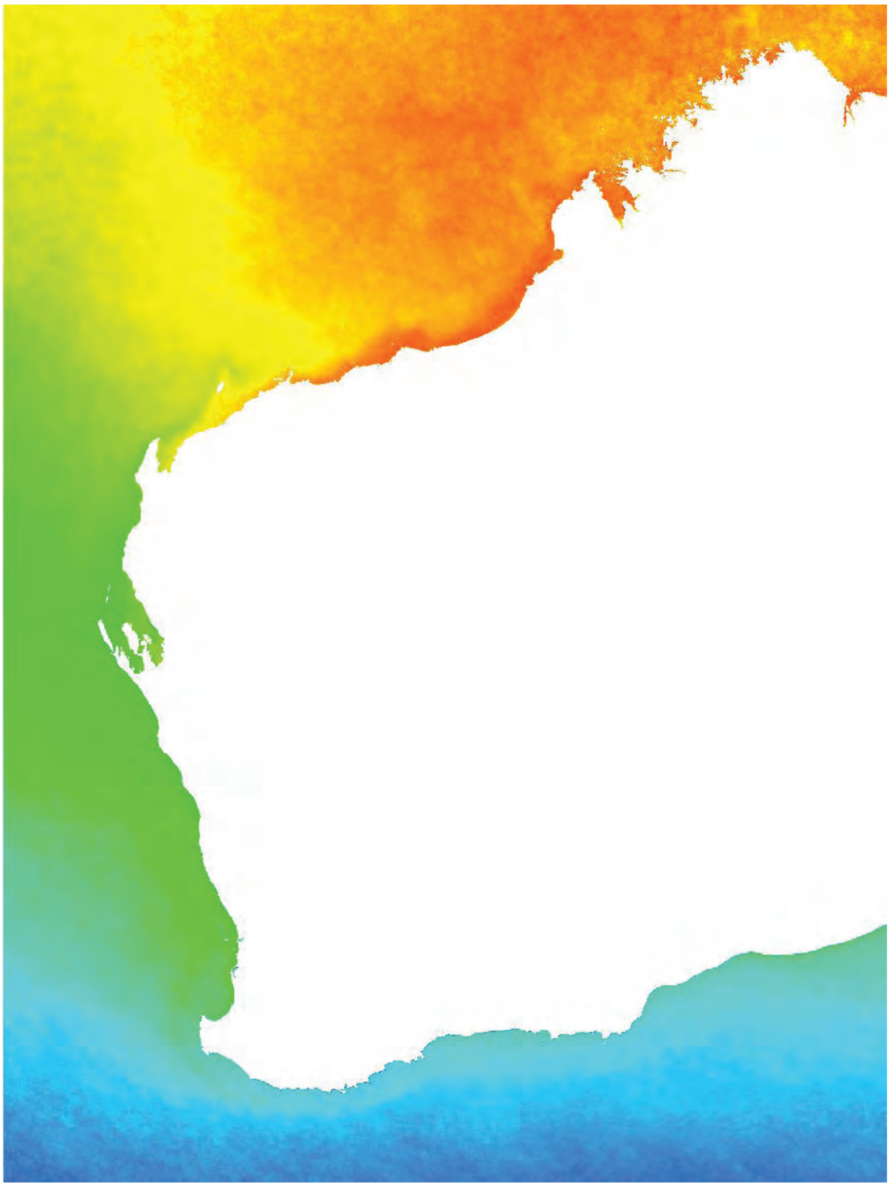


Figure 8:
10 year mean value SST image (2006-2015) for Aqua MODIS night time for December.

Australian Fire Season 2016

Improvements in Fire Hotspot Detection

Carolyn McMillan, Emergency Management, Landgate

Fire Monitoring

Satellite Remote Sensing Services (SRSS), Landgate map the location of active fires Australia wide.

Satellite data from the WASTAC receiving station at Murdoch University (dual L- and X-band) plus data from other satellite receiving stations at Alice Springs, Darwin, Crib Point, Goddard, Townsville, and Hobart are downloaded at SRSS. The thermal channels from the MODIS (Aqua and Terra), AVHRR (NOAA 19) and VIIRS (Suomi NPP) instruments are processed to detect active fires (fire hotspots) using both the NASA algorithms and algorithms derived by SRSS for the local conditions.

All the fire hotspot data, including the imagery used to map the fire hotspots is updated on a suite of emergency management websites (i.e. MyFireWatch - myfirewatch.landgate.wa.gov.au) within one (1) hour of the pass being received at SRSS. The FireWatch websites are accessed by a variety of users, particularly during bushfire events, such as the Waroona-Yarloop bushfire in Western Australia in January 2016 (Figure 9).

Gibb River Fire Detection

The fire hotspot information was used to monitor a large bushfire that burnt more than 13,000 km^2 in the Gibb River area of North West Western Australia in September and October 2016. The first hotspots were detected on 21 September and the last hotspots were detected on 30 October. The MODIS fire hotpots imagery and the improved resolution from the 375 m VIIRS sensor assisted determining a more accurate assessment of the location of active fire fronts (Figure 10).

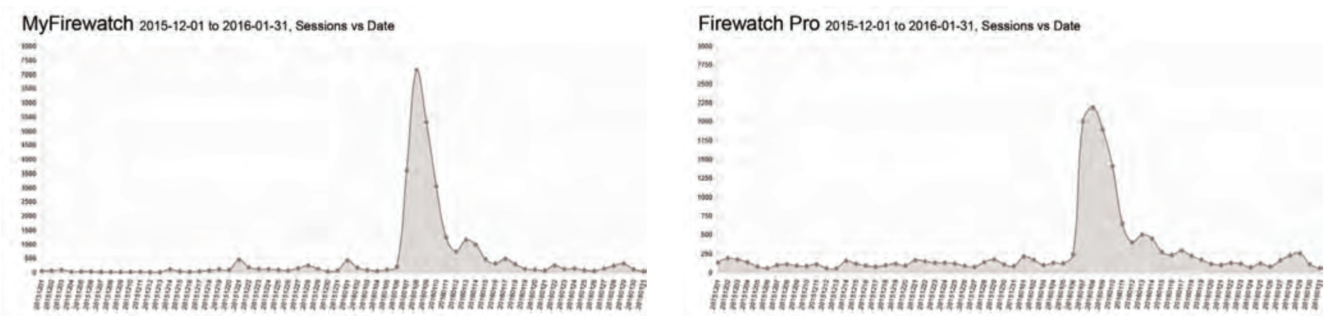


Figure 9:
MyFireWatch (left graph) and FireWatch Pro (right graph) usage during the Waroona Yarloop Bushfire in January 2016. The bushfire was detected from satellite hotspots on 6 January 2016, with a peak number of sessions accessing MyFireWatch (7,160) and FireWatch Pro (2,187) on 8 January 2016.

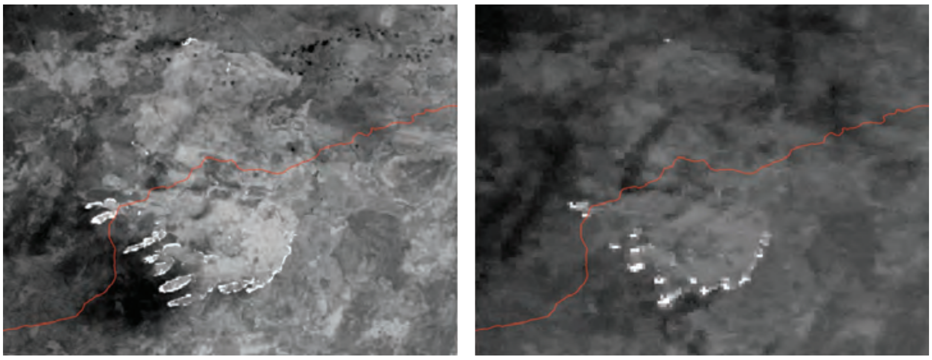


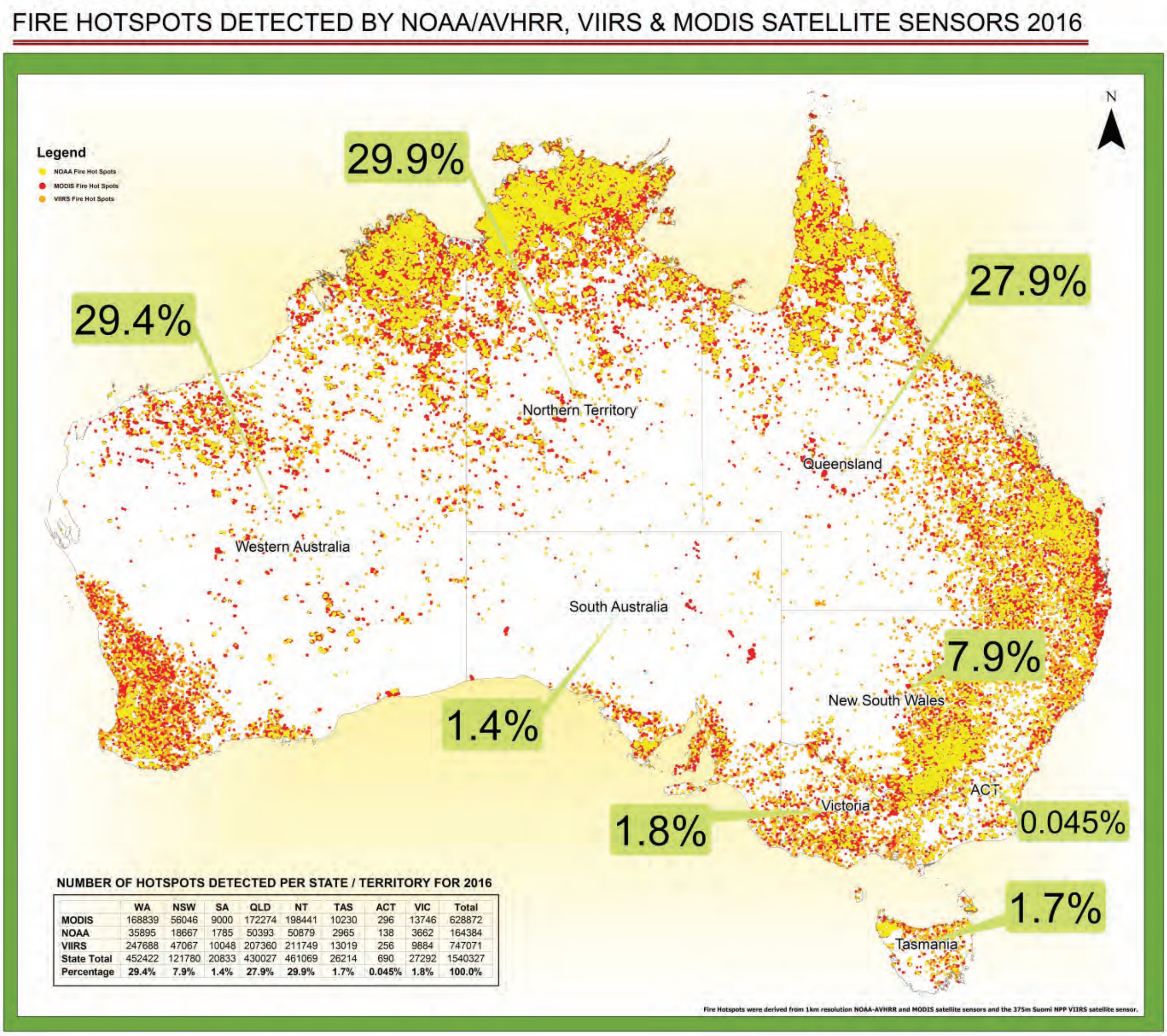
Figure 10:
Satellite imagery of the Gibb River area fire, captured on 5 October 2016. Fire hotspots are visible as bright areas. Left image: VIIRS sensor (Suomi NPP satellite); Right image: MODIS sensor (Band 20; Terra satellite).

All the fire information is collated in a GIS software package for analysis and interpretation along with other data such as fire burnt areas. The archive of fire hotspots data extends from 1998 for NOAA/AVHRR, 2002 for MODIS and 2012 for VIIRS.

The fire hotspot data is used by a variety of land managers, pastoralists and government organisations such as Department of Fire and Emergency Services and Department of Parks and Wildlife to plan and assess controlled burning activities, emergency management response, active firefighting and fire prediction modelling.

Australian Fire Hotspots 2016

An analysis of the 2016 fire hotspots for Australia is detailed in the image below (Figure 11). The Northern Territory had the greatest number of fire hotspots recorded during 2016 (461,069; 29.9%) with Western Australia accounting for a close second spot (452,422; 29.4%) and Queensland third (430,027; 27.9%). The Northern Territory had the highest number of fire hotspots detected from the MODIS and NOAA/AVHRR sensors (198,441 and 50,879, respectively) and Western Australia had the greatest number of hotspot detections via the VIIRS sensor (247,688).



NUMBER OF HOTSPOTS DETECTED PER STATE / TERRITORY FOR 2016

	WA	NSW	SA	QLD	NT	TAS	ACT	VIC	Total
MODIS	168839	56046	9000	172274	198441	10230	296	13746	628872
NOAA	35895	18667	1785	50393	50879	2965	138	3662	164384
VIIRS	247688	47067	10048	207360	211749	13019	256	9884	747071
State Total	452422	121780	20833	430027	461069	26214	690	27292	1540327
Percentage	29.4%	7.9%	1.4%	27.9%	29.9%	1.7%	0.045%	1.8%	100.0%

Figure 11:
Fire hotspots detected by AVHRR/NOAA, VIIRS and MODIS satellite sensors for 2016 across Australia.

Pastures from Space® Plus (PfS+)

Simon Abbott, Agriculture & Natural Resource Management, Landgate

The re-developed Pastures from Space® Plus (PfS+) web service, based on MODIS data, was released at Western Australia's Wagin Woolarama in March 2016. This initiated a steady increase in new PfS+ subscriptions. Feedback from customers has shown the historical data from MODIS going back to 2004 is one of the most highly valued features of the PfS+ service. These data enable comparison of the progress of the season with the historical growth patterns in a particular paddock (Figure 12). As well as requiring pasture growth rate numbers, many land managers want a visual representation of their paddocks and the 250 metre (m) pixels from MODIS are not ideal for this. In response to customer requests, Landgate added Landsat 8 imagery (30 m pixels) to the PfS+ service (Figure 13). This has increased the perceived value of PfS+, which has resulted in increased subscriptions.

More general feedback from the grazing industry is that grazing has been left behind in the development of smart farming and the introduction of technological tools to the industry. Now amongst the top 20% of producers who produce 80% of the product, there is increased interest in producing optimum kg of meat per kg of grass consumed. The basis of this is to know how much feed is in the paddock and how quickly it is growing. With the development of online grazing management tools, the input of pasture growth rate data from PfS+ is being sought by these providers as a partnership.

The Property Valuation Service at Landgate has expressed keen interest in using historical MODIS NDVI data to assist in valuing rural properties. Historically, the Valuers have used soil maps from various sources in combination with field inspection to arrive at an estimate of the productive potential and thus the value of rural properties. Instead of inferring productive potential from disparately mapped soil types, the historical NDVI data from MODIS provides a representation of the actual agronomic productivity over time. This investigative work is being conducted under the Landgate Innovation program.

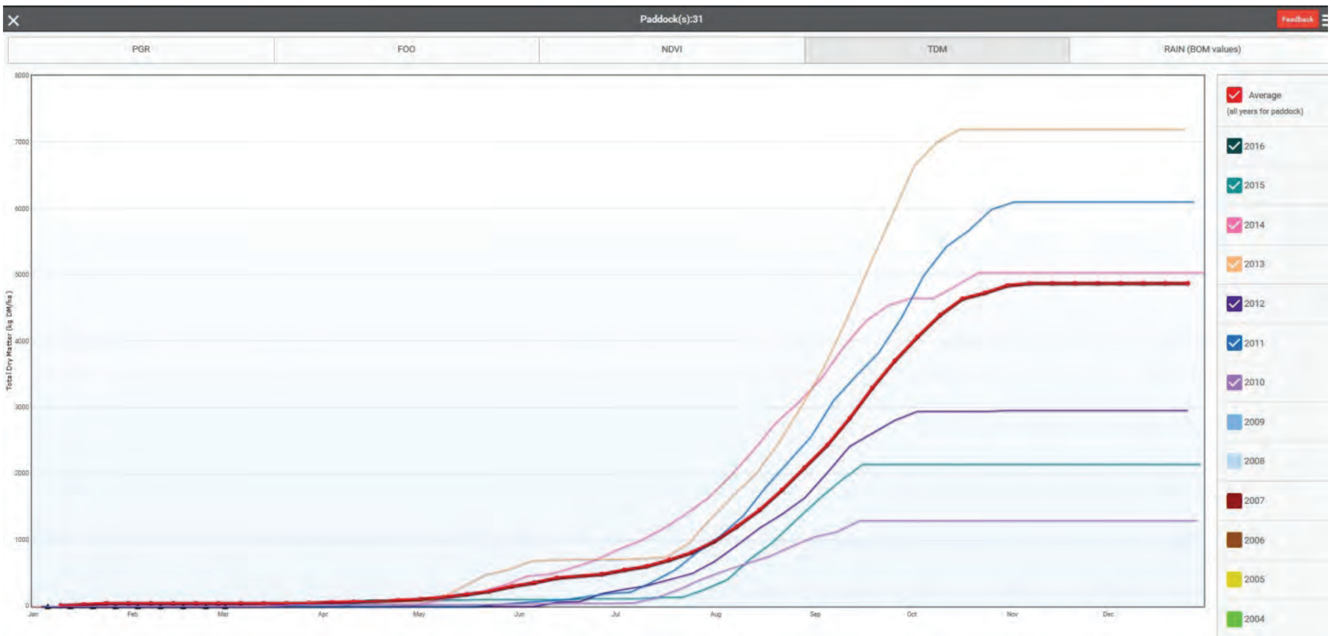


Figure 12:
Annual total dry matter (TDM) summarised for 2004-2016 for a sample paddock. Historical dry matter production from MODIS data enables land managers to see how current pasture production tracks against previous years. This information is added value for land managers to assist with the decision making.

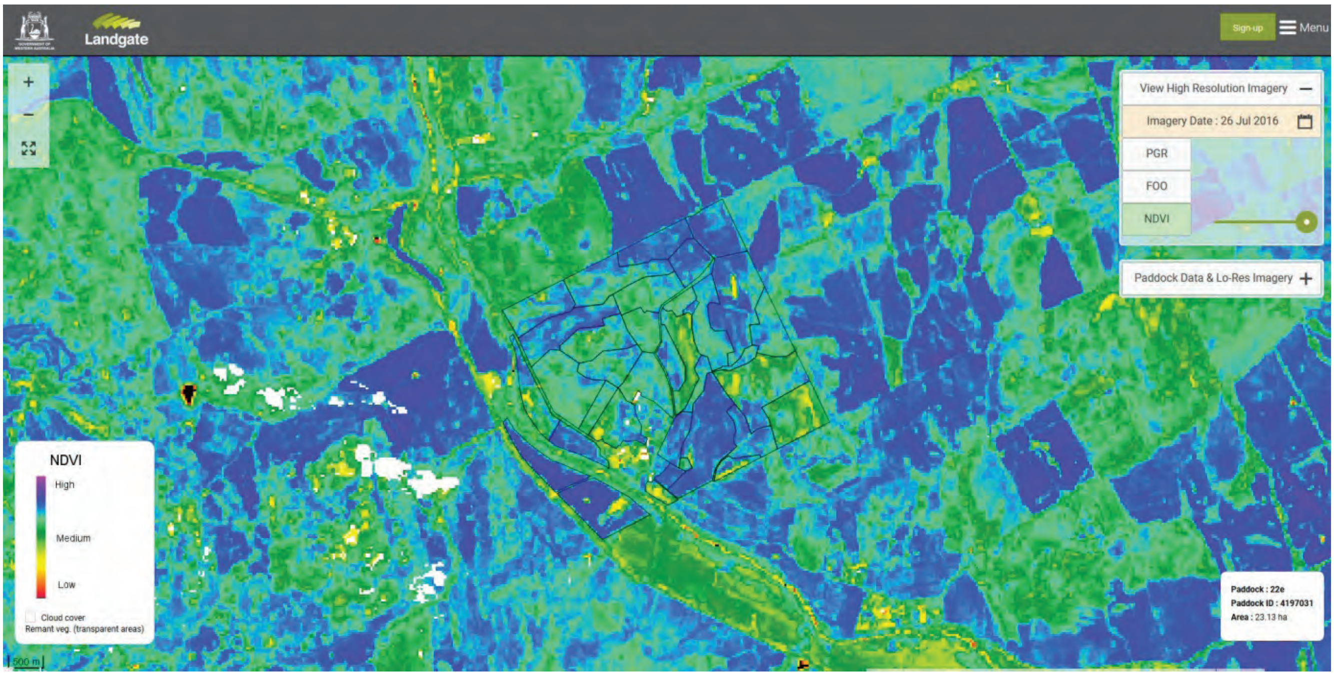


Figure 13:
Landsat 8 NDVI image (26 July 2016) showing variation within paddocks that is not visible in the MODIS imagery. Higher resolution Landsat imagery has been added to the PfS+ service.

Bureau of Meteorology, Melbourne

Tropical Cyclone Monitoring

Mike Willmott and the Western Australian regional Forecasting Centre

1. Overview

The Bureau of Meteorology is responsible for Tropical Cyclone warnings to the Australian public. To assist in the effective mitigation against the loss of life and damage to property, the Bureau operates Tropical Cyclone Warning Centres (TCWC) in Brisbane, Darwin and Perth. The Perth Tropical Cyclone Warning Centre operates out of the Perth Regional Forecasting Centre. Each TCWC has an area of responsibility for Tropical Cyclone Warning and these areas can be found in Figure 14.

For the Period 1 January 2016 to 31 December 2016, three Tropical Cyclones occurred within the Perth TCWC's area of jurisdiction (Table 3). One image was received for Tropical Cyclone Stan (27 - 31 Jan 2016; Figure 15). Due to antenna problems there were no further images received after 7 February. The image of Tropical Cyclone Stan shows the loss of data at the start and the end of the orbit as well as the corruption of the data throughout the orbit. The most significant loss of signal, unfortunately, occurred over the top of the eye of the cyclone. Compare this image with that taken from the Darwin Reception System (Figure 16).

The Bureau is looking forward to the installation of a new replacement antenna in Western Australia, as the data is extremely useful to the Bureau for analysis and forecast of severe weather events.

The Bureau also receives satellite data from other reception facilities and the internet to support its forecasting activities. Himawari-8 data with its increased spatial and temporal resolution was unprecedented in its usefulness for analysis and forecasting of all major weather events during this period. Feng Yun 2 was also useful for capturing these tropical systems over the Indian Ocean when they were at the west most extent of the Himawari-8 coverage.

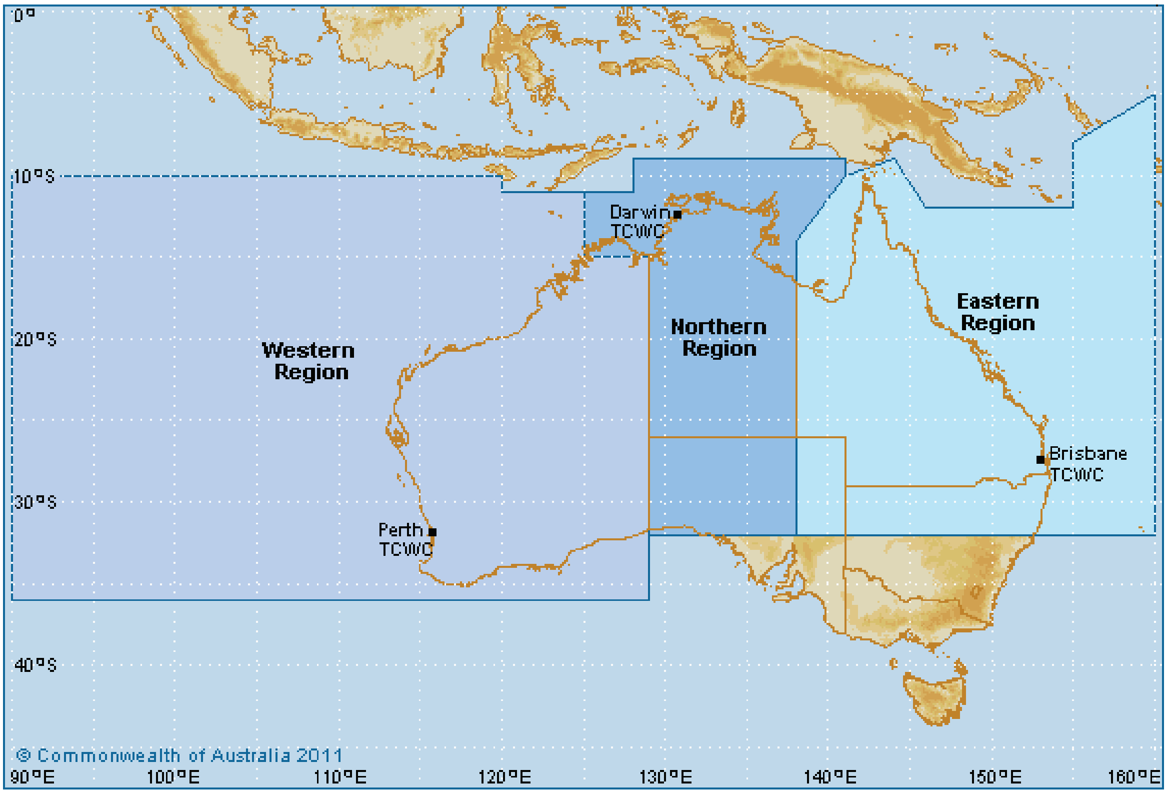


Figure 14:
The three Tropical Cyclone Warning Centres and their areas of responsibility.

2. Tropical Cyclones for the Period 1 January 2016 to 31 December 2016

As stated above, there were three tropical cyclones within the reporting period in 2016 within Perth's TCWC area of responsibility.

Tropical Cyclone	Period (2016)	Max Intensity	Impact on Coast or Other Aus. Territory	Means of Detection
Stan	27 to 31 January	2	Moderate	Satellite
Uriah	11 to 14 February	2	Low	Satellite
Yvette	19 to 25 December	1	Low	Satellite

Table 3:
List of Tropical Cyclones within the Western Region for the Period: January 2016 to December 2016. Due to critical equipment failure of the antenna, there were no images received after 7 February.

2.1 Severe Tropical Cyclone STAN (27-31 January 2016)

Summary

Tropical Cyclone Stan was the first tropical cyclone of the 2015/16 season in Australia. Stan was first identified as a tropical low in an active monsoon trough approximately 660 kilometres (km) northwest of Broome during 27 January. On the following day, the tropical low moved to the south and gradually developed. On 29 January, the system started to track towards the southeast and intensified to tropical cyclone strength, and was subsequently named Tropical Cyclone Stan at 8:00am AWST 29 January when it was about 320 km north northwest of Port Hedland (Figure 17). Stan continued to intensify during the day and moved slowly in a general southeast direction towards the east Pilbara coast, reaching category 2 intensity at 8:00pm AWST, when it was located about 280 km north of Port Hedland. Stan maintained category 2 intensity on 30 January. Category 2 winds (storm force) with wind gusts of 133 km/h were recorded at Rowley Shoals around 9:30am AWST when Stan was about 100 km to the south of the island.

Bedout Island recorded category 1 winds (gale force) from 9:30pm AWST on the 30 January until about 8:30am AWST on 31 January as Stan approached the east Pilbara coast. Stan crossed the coast between Port Hedland and Wallal Downs, about 30 km east of Pardoo, at 2:00am AWST 31 January as a category 2 cyclone. As the cyclone crossed the coast near the time of high tide, the associated storm tide is likely to have resulted in inundation of low-lying coastal areas to the east of the crossing point, but no data is available. It then continued to move further inland towards the southeast and Shay Gap then recorded a wind gust of 94 km/h at 7:16am AWST as Stan passed by.

Stan weakened to a category 1 cyclone at 8:00am AWST 31 January and further weakened to below cyclone intensity at 11:00am AWST. Ex-Tropical Cyclone Stan moved through eastern inland parts of the Pilbara District during 31 January and into the South Interior District during 1 February. During this time damaging winds and heavy rainfall were likely to have occurred near the centre. Ex-Tropical Cyclone Stan moved into South Australia late on 1 February.

There was no major damage to homes or other infrastructure due to the community being well prepared.

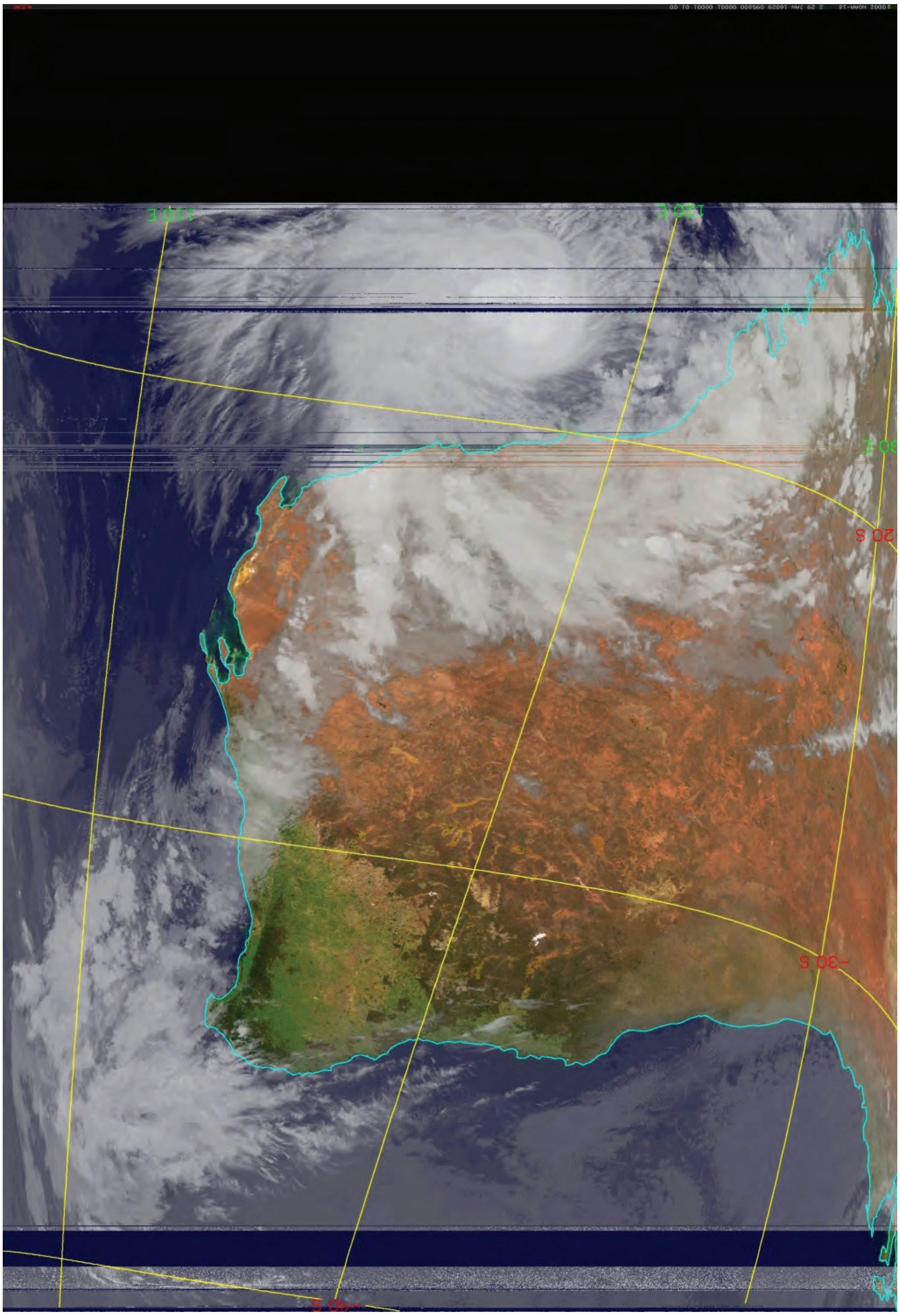


Figure 15:
Tropical Cyclone Stan showing the corruption of data at the most significant part of the image caused by the failing WASTAC Antenna. Note also, that the tropical cyclone is almost at the limit of the orbit (NOAA-18 29-1-2016, 09:58 UTC).

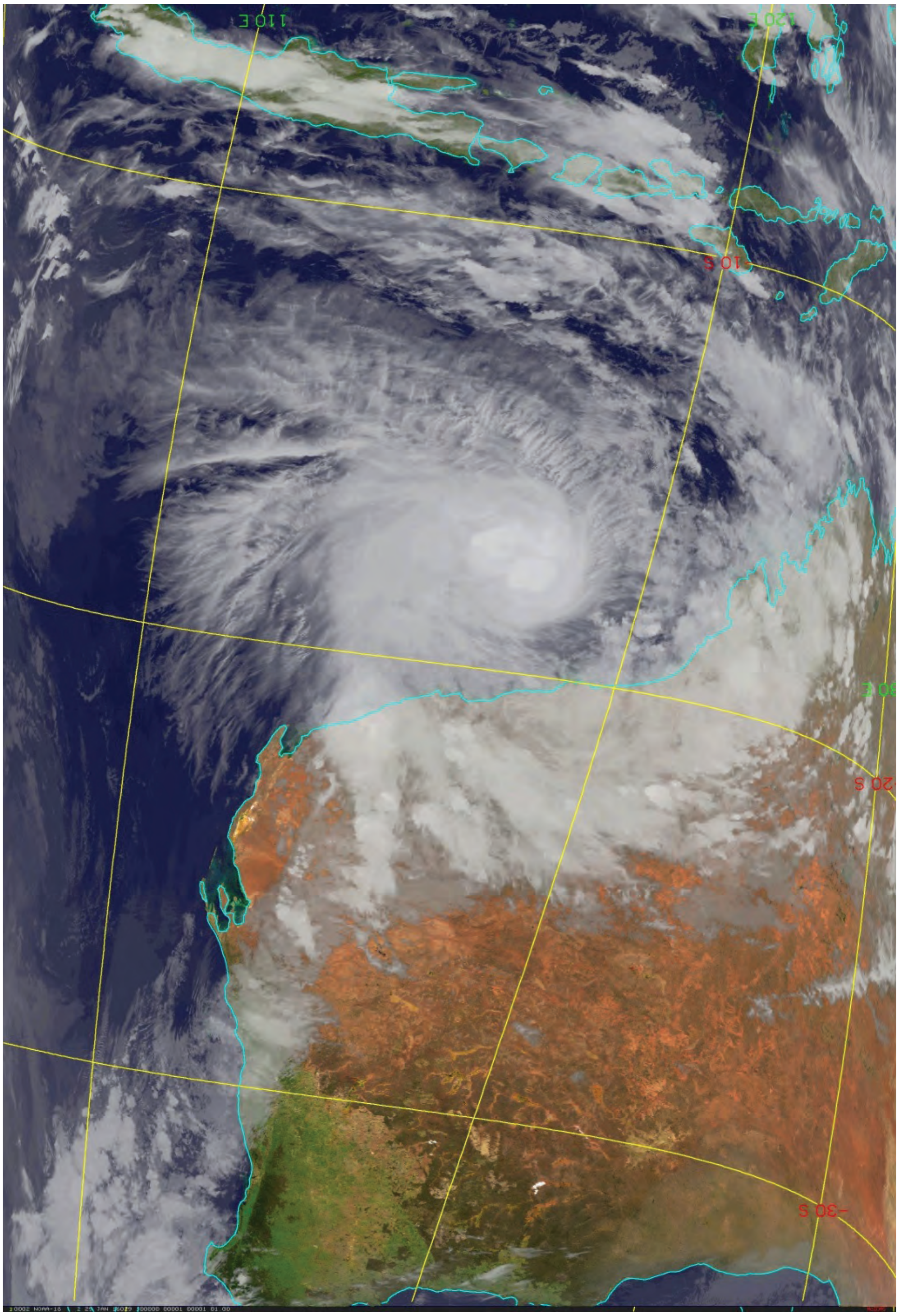


Figure 16:
The same orbit for Tropical Cyclone Stan as captured from the Darwin Reception station (NOAA-18 29-1-2016,10:00 UTC).

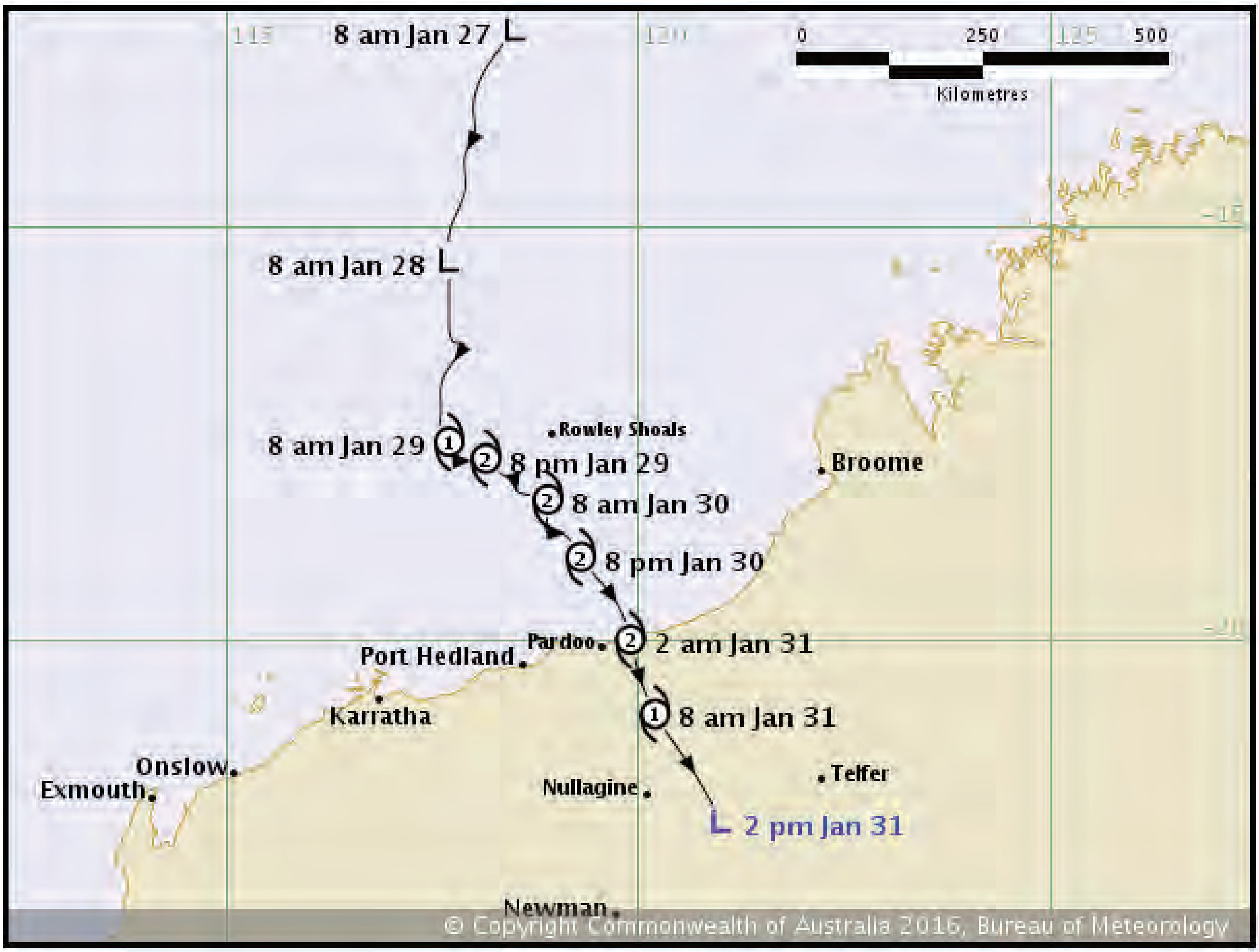


Figure 17:
Tropical Cyclone Stan track map, 27-31 January 2016.

Curtin University, Perth

Monitoring Water Quality of northern Western Australia using Satellite Remote Sensing

Passang Dorji and Dr. Peter Fearns, Remote Sensing and Satellite Research Group

In the last decade, the quality of coastal waters of northern Western Australia (Figure 18) has been impacted by the increased activities in development of offshore oil and gas infrastructure. Regular extensive *in situ* monitoring of water quality in the region has been challenging due to the requirement of huge resources needed to monitor the large spatial extent.

The total suspended sediment (TSS) concentration, which serves as a proxy for water quality, has been successfully mapped at high spatio-temporal resolution in the coastal waters via satellite remote sensing. However, the accuracy and utility of such TSS measurements is directly related to the accuracy of the TSS algorithm and satellite sensors used in mapping TSS concentration. Most previous TSS algorithms have been developed for specific regions and have been based on empirical approaches and for particular satellite sensors. Such TSS algorithms lack general applicability, and the use of a single satellite sensor with specific radiometric, spectral, temporal and spatial characteristics also limit the general application of remote sensing to study highly dynamic TSS variation across differing coastal regimes. Therefore, as part of the Western Australian Marine Science Institution (WAMSI; http://www.wamsi.org.au) supported postgraduate research project, the study was conducted with focus on the development of a multi-sensor TSS model for highly turbid coastal waters of northern Western Australia, which is physically based on the principle of radiative transfer, but locally tuned using *in situ* optical properties of regional coastal waters of northern Western Australia.

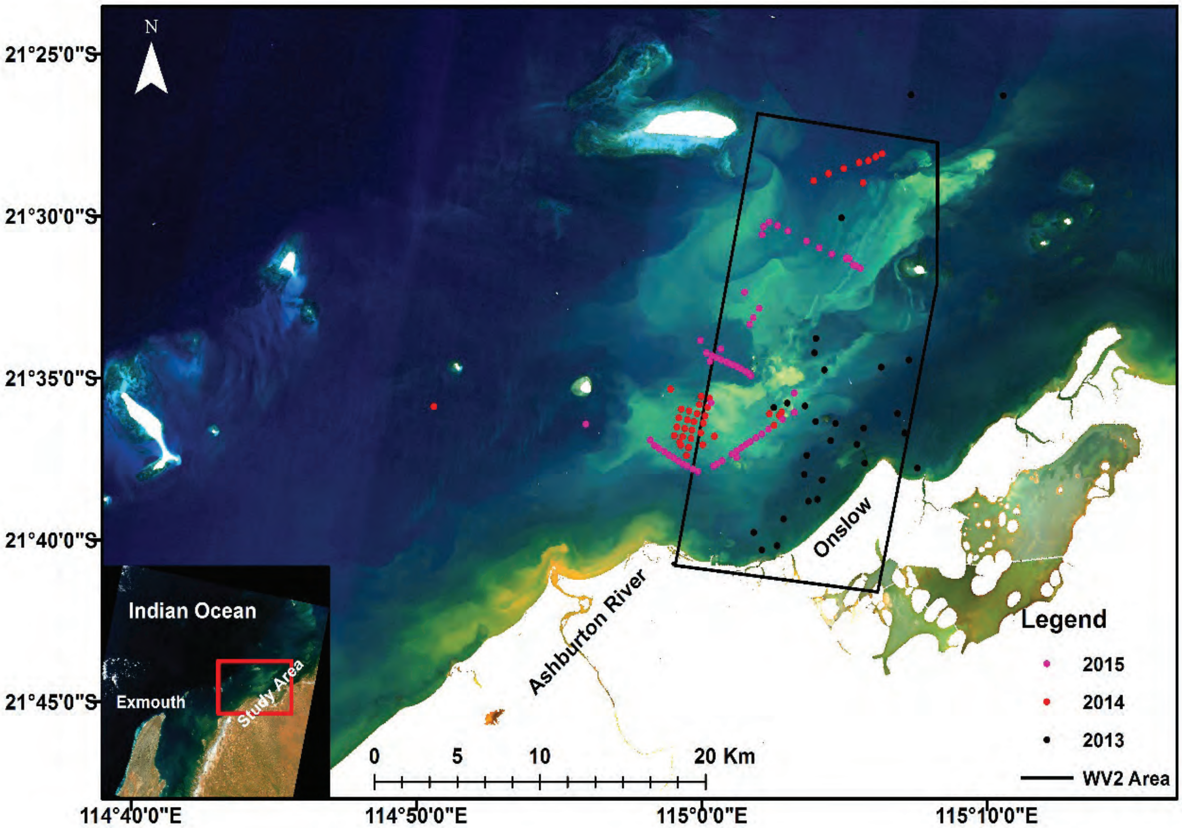


Figure 18:
True colour Landsat-8 OLI image showing the location of study sites in the waters off the coast of Onslow, Western Australia. Image is reproduced from Dorji & Fearns (2017). The black polygon represents the area where WorldView 2 data were captured on 13 June 2014. The coloured dots represent the location of *in situ* data used in formulation of the TSS algorithm presented in Figure 19.

In the study, a generic multi-sensor red band semi-analytic sediment model (SASM) was developed for regional waters of northern Western Australia (Figure 19). The SASM was used in mapping TSS concentration of the region using different sensors; high spatial resolution WorldView-2 (WV2) at 2 m and Landsat-8 Operational Land Imager (OLI) at 30 m, medium spatial resolution MODerate resolution Imaging Spectroradiometer (MODIS)-Aqua at 250 m and low spatial resolution Advanced Himawari Imager (AHI) on-board Himawari-8 at 500 m.

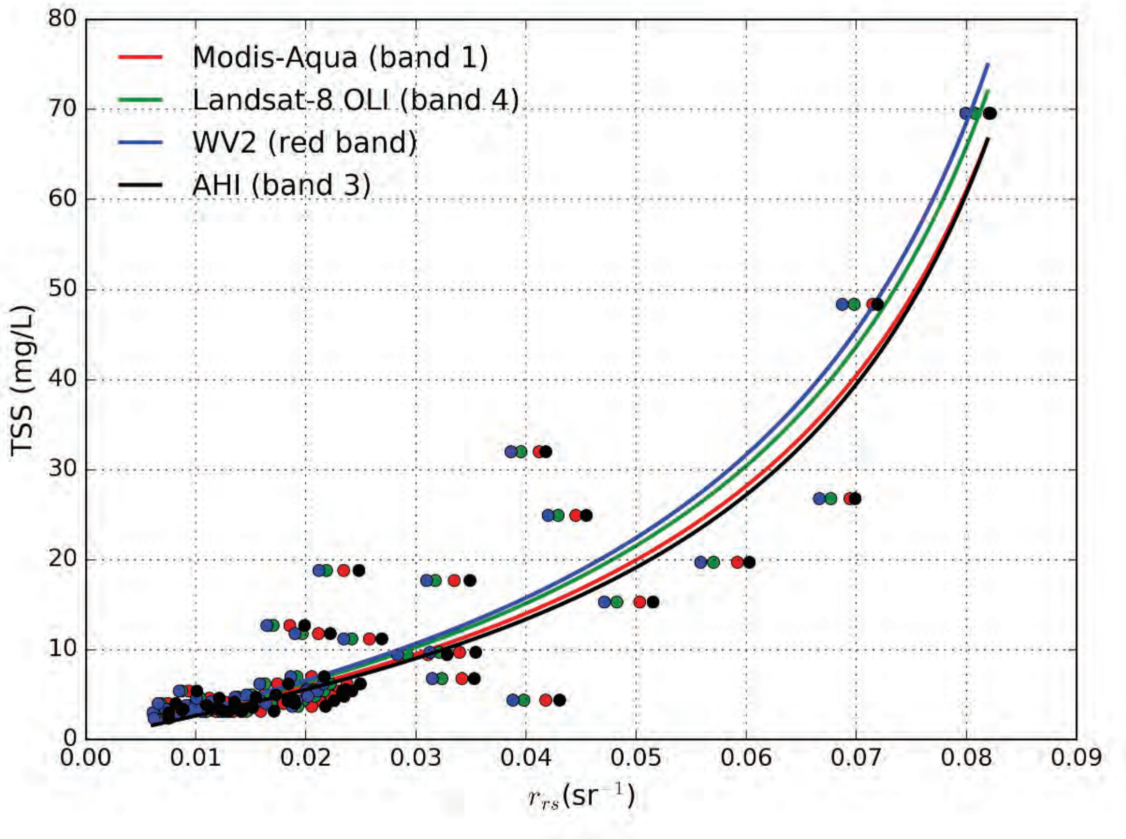


Figure 19:
The SASM (TSS model) developed for MODIS-Aqua (red), Landsat-8 OLI (green), WorldView 2 (blue) and Himawari-8 AHI (black). The details of the derivation of the SASM curve is presented in Dorji, Fearns, and Broomhall (2016)

As shown in Figure 20, it was found that the satellite sensors with spatial resolution of at least 250 m were adequate in spatially discerning sediment plumes from the background waters. Further, it was observed the temporal resolution of one (1) image/day from MODIS-Aqua was sufficient to segregate TSS variation as a result of dredging and natural processes. However, diurnal TSS variation caused by the tidal currents in the regions were only discernible from the high temporal resolution geostationary satellite—Himawari-8. The Himawari-8 results (Figure 21) showed that it can be a valuable resource in monitoring the TSS dynamics of coastal regions in Western Australia at high temporal resolution, which can effectively fill the temporal gaps of other satellite sensors.

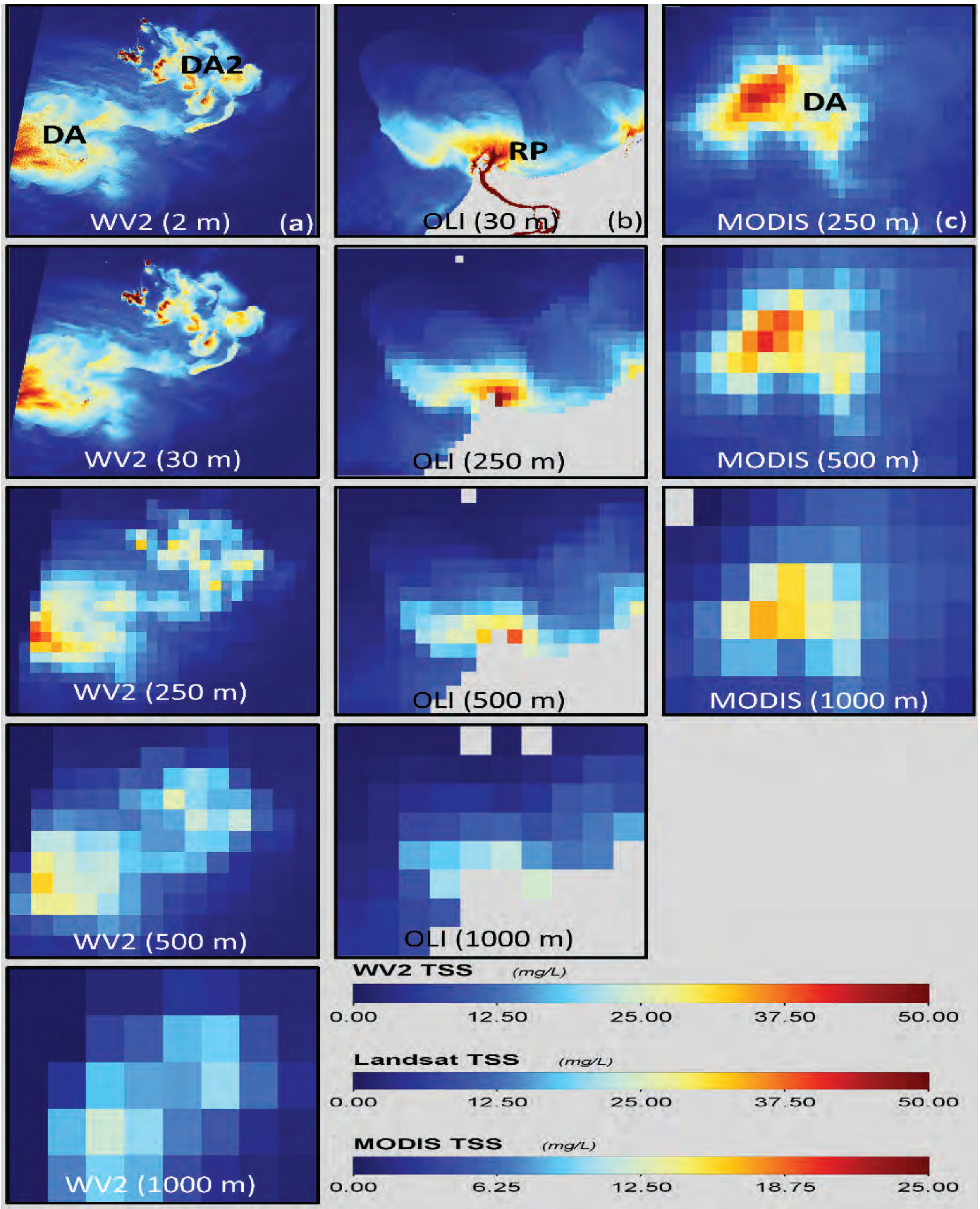


Figure 20:
Spatially degraded images (reproduced from Dorji & Fearns (2017)) of the very turbid regions as seen from (a) WorldView 2, (d) Landsat-8 OLI and (c) MODIS-Aqua satellite at different spatial resolutions. DA and DA2 represent the dredge areas and RP represents the River Plume from the Ashburton River in Figure 18.

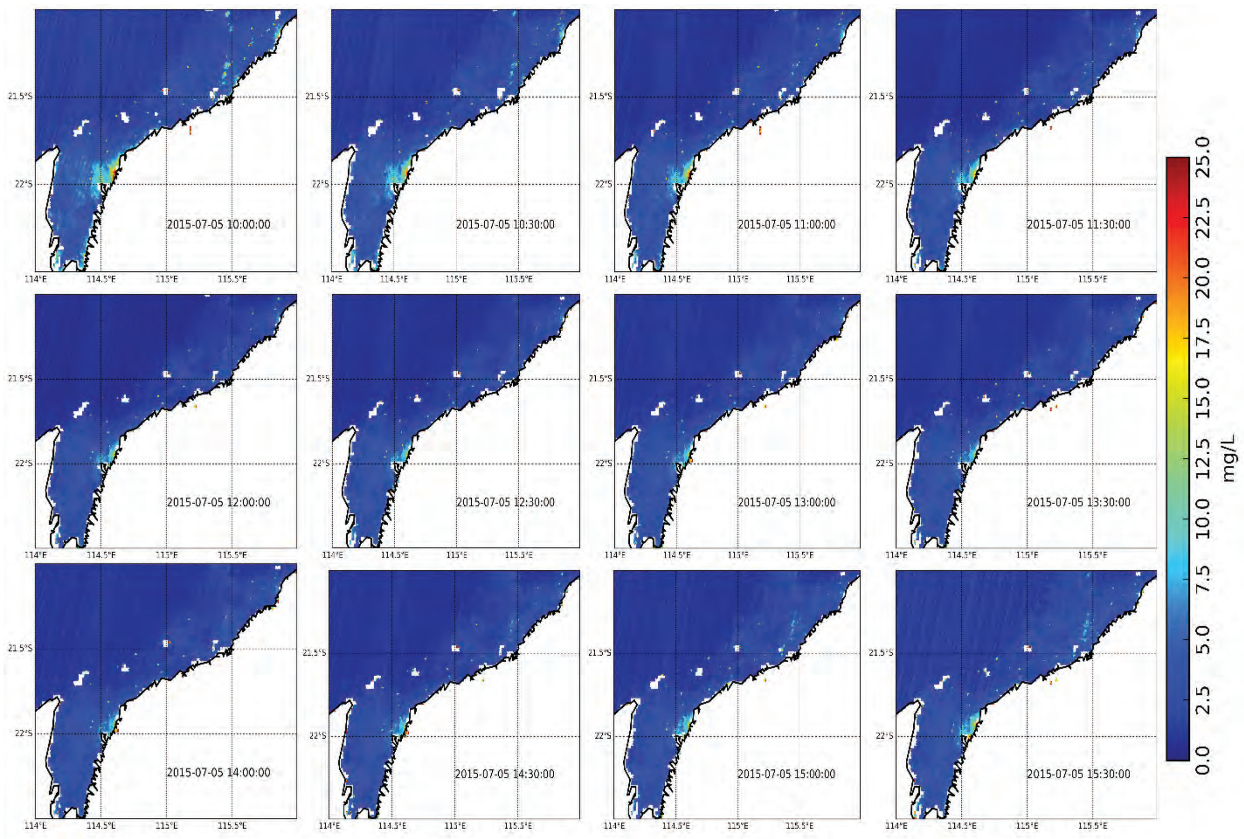


Figure 21:
High temporal repeat (every 30 min) TSS concentration maps derived using AHI on 5 July 2015 from 10:00 – 15:30 hrs. Image reproduced from Dorji & Fearns (2017).

The implications of using readily available TSS algorithms and different satellite sensors were also quantified using rigorous statistical tests and simulated optical datasets. It was found that few previously published TSS algorithms from the last decade were robust enough to be used in mapping TSS concentration of optically unknown water types, with Mean Absolute Relative Errors (MARE) ranging from 69.96% to 481.82% (Dorji & Fearns, 2016). Also, the application of an untested TSS algorithm, without first testing and selecting an appropriate TSS algorithm, was shown to potentially result in errors in excess of three orders of magnitude. In highly turbid waters, the discrepancies between peak TSS levels obtained from satellite sensors with different spatial resolutions was demonstrated, with TSS concentration as high as 160 mg/L observed from WV2 at 2 m spatial resolution and only 23.6 mg/L from MODIS-Aqua at 250 m (Figure 22a-c). The implications of such discrepancies in TSS estimation via satellite remote sensing are extremely important to environmental resource managers for effective implementation of monitoring policies.

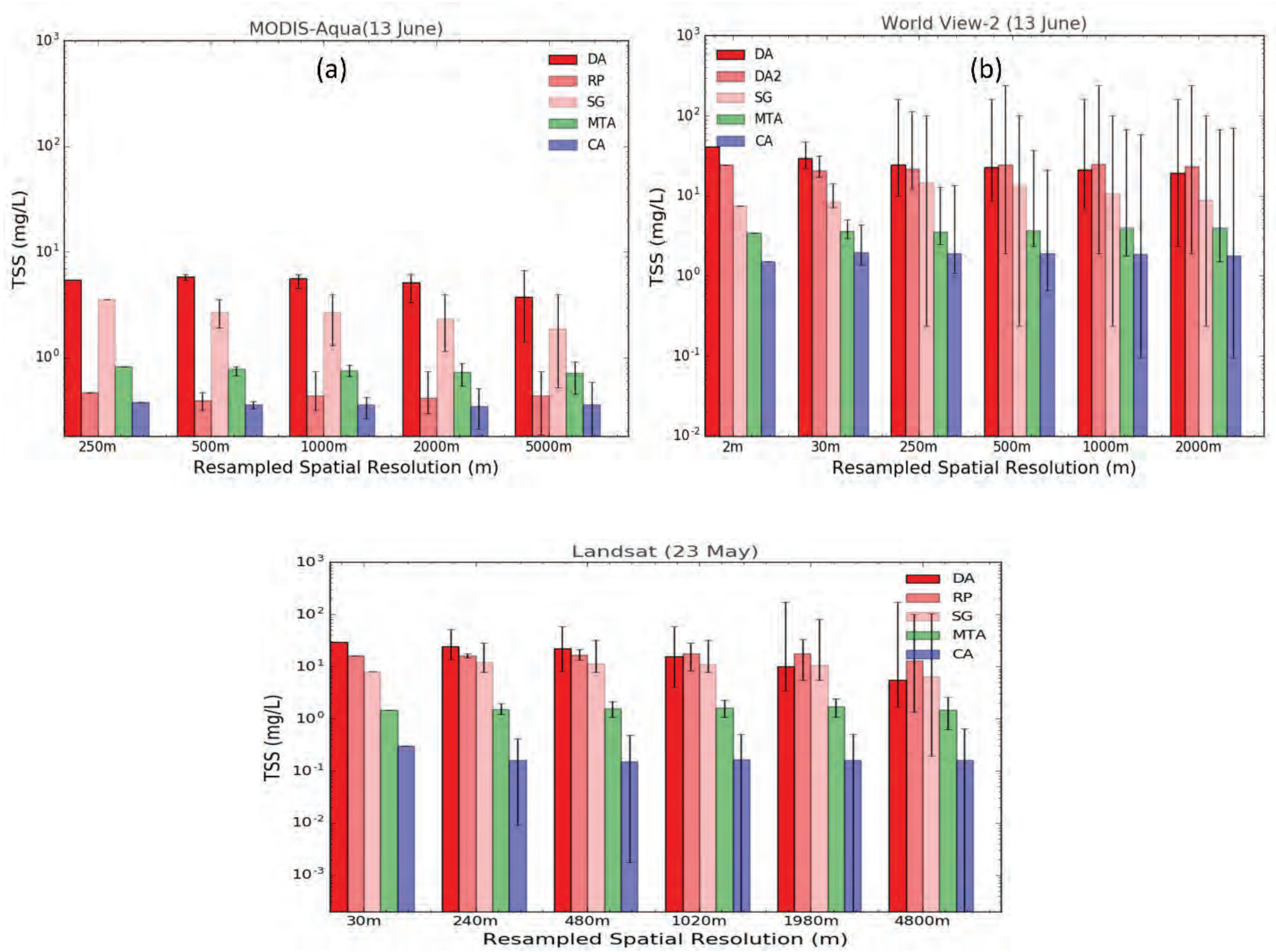


Figure 22:

TSS concentration derived from (a) MODIS-Aqua, (b) WorldView 2 and (c) Landsat-8 OLI at their native and spatially degraded spatial resolutions, averaged over the areas: dredge plume (DA and DA2), Spoil Group (SG), River Plume (SP), Moderate Turbid Area (MTA) and Clean Area. The error bars indicate the extreme TSS concentration in each spatial grid.

References:

Dorji, P., & Fearns, P. (2016). A Quantitative Comparison of Total Suspended Sediment Algorithms: A Case Study of the Last Decade for MODIS and Landsat-Based Sensors. ***Remote Sensing, 8***(10), 810.

Dorji, P., & Fearns, P. (2017). Impact of the spatial resolution of satellite remote sensing sensors in the quantification of total suspended sediment concentration: A case study in turbid waters of Northern Western Australia. ***PLoS One, 12***(4), e0175042.

Dorji, P., Fearns, P., & Broomhall, M. (2016). A Semi-Analytic Model for Estimating Total Suspended Sediment Concentration in Turbid Coastal Waters of Northern Western Australia Using MODIS-Aqua 250 m Data. ***Remote Sensing, 8***(7), 556.

Dorji, P., & Peter, F. (2017). ***Mapping Total Suspended Sediment in Near Real Time: A Preliminary Assessment of the AHI sensor on board the geostationary Himawari-8 satellite for Coastal Waters of Western Australia***. Curtin University. Submitted to the Remote Sensing of Environment

Improving Hyperspectral Image Consistency for Vegetation

Classification over the Port Hedland Coastal Region

Shawn Henson Bos and Dr. Peter Fearns, Remote Sensing and Satellite Research Group

An airborne-based hyperspectral survey was conducted over the Port Hedland coastal region of Western Australia in September 2010 using an AISA EAGLE hyperspectral sensor. Each image pixel represents a spatial area of one (1) m^2 with spectra recorded over 246 bands, over a range 0.40 – 0.98 µm.

The purpose of the airborne hyperspectral survey was to examine the extent to which vegetation could be mapped with confidence. However, due to spectral inconsistencies over the scene, an empirical mathematical process was developed to construct an improved data set prior to classification.

Prior to classification, pixels exhibiting spectra reminiscent of vegetation were retained using a specially developed vegetative mask. The masked data were then classified, using the k-means unsupervised classification method, resulting in a thematic map containing 15 classes. The separability of the classes was assessed using separability statistics, in particular making use of the JM (Jeffries-Matusita) distance. A total of eight (8) sound classes were found to be spectrally separable, resulting in a map exhibiting a high degree of spatial consistency with well-defined gross structures.

The left image of Figure 23 shows a small region of the complete aerial survey. Visually, the green regions are apparent and are dominated by mangrove forests. The thematic map (the right image of Figure 23) shows three dominant classes, which are spectrally highly separable. These classes correspond to regions of vegetation and form structures not always directly apparent to the eye.

A field survey identified the major classes as dense mangrove forests (the blue class); although due to the spectral similarity of mangroves, many species are spectrally inseparable using the techniques in this research. The orange coloured class coincided to medium density *Avicennia marina* (possibly the dominant mangrove species in the region) in addition to dust-covered *Avicennia marina* and brown grass.

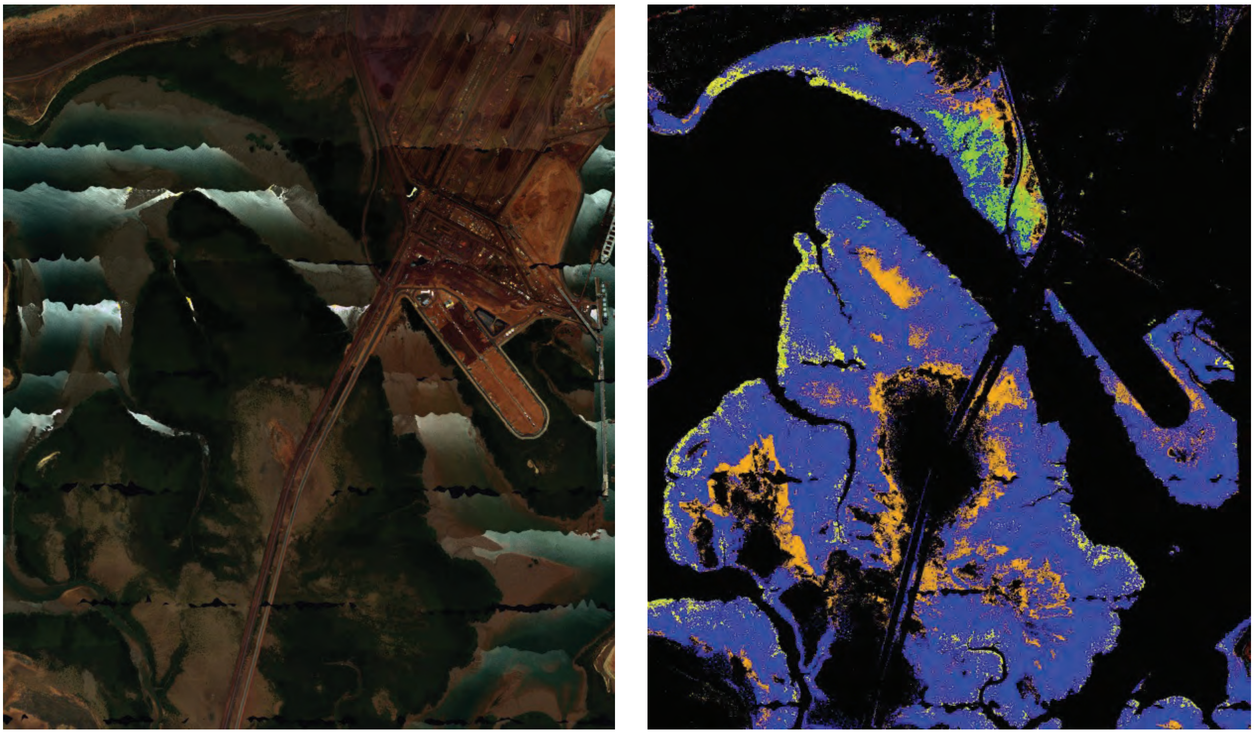


Figure 23:
The left image shows a region of the Port Hedland aerial survey. The right image is the thematic map; the classification result where 3 dominant classes are apparent.

The thematic map was compared to a commercially funded product derived from photo-interpretation and in–situ identification, and both showed similar spatial structures, suggesting the hyperspectral data were suitable for mapping the vegetative distribution in a timely manner with sound results representing the gross spatial structures.

Monitoring Turbidity in the Kimberley

Dr. Peter Fearns and Helen Chedzey, Remote Sensing and Satellite Research Group

The WAMSI $30 million Kimberley Marine Research Program (KMRP; http://www.wamsi.org.au/kimberley-marine-research-program) is a multi-disciplinary program to support the management of the marine environments of the Kimberley region in Western Australia. One of the key environmental impact parameters identified in a review of the remote sensing for environmental monitoring of the Kimberley was water column turbidity, particularly in terms of its effect on the benthic light field. Within the KMRP, Curtin University in collaboration with CSIRO have been using MODIS data to study the spatio-temporal patterns of total suspended solids (TSS), as well as the impact of the TSS on the light reaching the benthos.

MODIS data were used to produce daily TSS estimates for the entire Kimberley region. These daily data were then analysed to determine monthly, seasonal and annual averages. The 10 years from 2003 to 2012 was also used to define baseline TSS conditions, against which anomalies from the baseline were calculated. Analysis of the spatio-temporal patterns for the entire Kimberley coastline showed 6 regions, (1) Broome and surrounds, (2) King Sound, (3) Collier Bay and surrounds, (4) Kalumburu, (5) the region north of Berkeley River, and (6) the region extending beyond the Western Australian border to capture the Joseph Bonaparte Gulf, each characterized by consistent patterns within the region, but distinct differences between regions.

Figure 24 shows an example of annual TSS deviations for the King Sound region. There are clearly significant differences in the long term TSS levels at an annual scale.

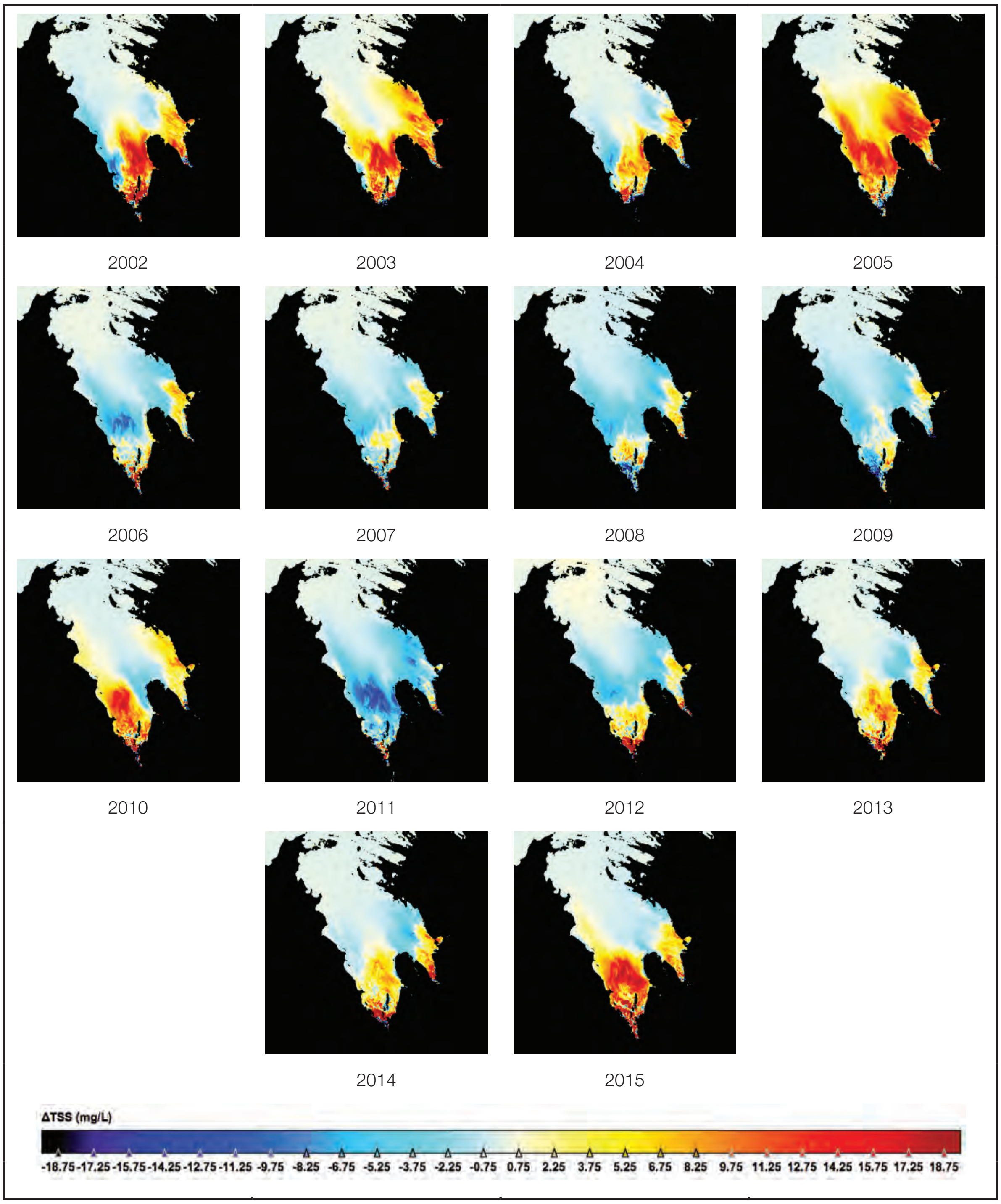


Figure 24:
Yearly MODIS Aqua TSS anomaly images between 2002 (half year) and 2015 for King Sound in northwestern Western Australia. Each yearly average is compared to an averaged TSS background determined from 10 years of monthly data averaged between January 2003 and December 2012.

This page is left blank intentionally

CPA

Santo Casilli Accounting and Auditing Services is a CPA Practice

Santo Casilli
Accounting and Auditing Services
Certified Practising Accountant

Liability limited by a scheme approved under Professional Standards Legislation

Suite 8 - 336 Churchill Avenue Subiaco WA 6008
Postal Address: PO Box 617 Subiaco WA 6904

Mobile: 0409 104 929 - **Phone:** (08) 9388 3678 - **Fax:** (08) 9388 3860 -
Email: scasilli@westnet.com.au

AUDITOR'S INDEPENDENCE DECLARATION

Auditor's independence declaration to the Members of the Board of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band.

In relation to my audit of the special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band for the period ended 31 December 2016, to the best of my knowledge and belief, there have been no contraventions of the auditor independence requirements of Australian Professional Accounting Bodies.

Date: 30 March 2017

Santo Casilli Accounting and Auditing Services is a CPA Practice

Santo Casilli
Accounting and Auditing Services
Certified Practising Accountant

Liability limited by a scheme approved under Professional Standards Legislation

Suite 8 - 336 Churchill Avenue Subiaco WA 6008
Postal Address: PO Box 617 Subiaco WA 6904

Mobile: 0409 104 929 - **Phone:** (08) 9388 3678 - **Fax:** (08) 9388 3860 -
Email: scasilli@westnet.com.au

INDEPENDENT AUDITOR'S REPORT

The Members of the Board

Opinion

We have audited the special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band, which comprises the balance sheet as at 31 December 2016, the income statement and the statement of cash flows for the year then ended, notes to the financial report and including a summary of significant accounting policies and other explanatory information. Our audit opinion is provided in order to satisfy the reporting requirements of the Board and its Joint venture participants.

In our opinion, the accompanying special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band for the year ended 31 December 2016 is prepared, in all material respects, in accordance with the financial reporting provisions as outlined in Note 1 of the financial statements.

Basis for Opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Report* section of our report. We are independent of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band in accordance with the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) that are relevant to our audit of the financial report in Australia, and we have fulfilled our other ethical responsibilities in accordance with the Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Emphasis of Matter - Basis of Accounting and Restriction on Distribution and Use

We draw attention to Note 1 to the special purpose financial report, which describes the basis of accounting. The financial report is prepared to assist the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band to meet its reporting obligations between the Board and its Joint Venture participants. As a result, the financial report may not be suitable for another purpose. Our report is intended solely for the Board and its joint venture participants and should not be distributed to or used by other parties. Our opinion is not modified in respect of this matter.

Responsibilities of Management and Those Charged with Governance for the Financial Report

Curtin University management, on behalf of the Board, is responsible for the preparation of the special purpose financial report and for establishing such internal control as Curtin University management determines is necessary to enable the preparation of a special purpose financial report that is free from material misstatement, whether due to fraud or error.

In preparing the special purpose financial report, Curtin University management with the Board is responsible for assessing the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band's ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the Board either intends to cease operations of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band, or has no realistic alternative but to do so.

The members of the Board are responsible for overseeing the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Report.

Our objectives are to obtain reasonable assurance about whether the special purpose financial report, as a whole, is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of this financial report.

As part of an audit in accordance with Australian Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band's internal control.

- Evaluate the appropriateness of accounting policies used as described in Note 1 to the financial statements and the reasonableness of accounting estimates and related disclosures made by Curtin University management, if any.

- Conclude on the appropriateness of Western Australian Satellite Technology and Application Consortium (WASTAC) L Band's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Western Australian Satellite Technology and Application Consortium (WASTAC) L Band to cease to continue as a going concern.

Electronic publication of the audited financial report

It is our understanding that the Western Australian Satellite Technology and Application Consortium L Band intends to electronically present the audited financial report and auditor's report on its internet website. Responsibility for the electronic presentation of the financial report on the Western Australian Satellite Technology and Application Consortium website is that of those charged with governance of the Western Australian Satellite Technology and Application Consortium. The security and controls over information on the website should be addressed by the Western Australian Satellite Technology and Application Consortium to maintain the integrity of the data presented. The examination of the controls over the electronic presentation of audited financial report on the Western Australian Satellite Technology and Application Consortium website is beyond the scope of the audit of the financial report.

We have communicated with Western Australian Satellite Technology and Application Consortium (WASTAC) L Band Board regarding, among other matters, the planned scope and timing of the audit and, via our management letter, significant audit findings, including any significant deficiencies in internal control that we may have identified during our audit.

Santo Casilli FCPA

Date: 30 March 2017

Perth

Estimated expenditure for the year

January 2016 – December 2016

		2016 $	2015 $
1.	Data Tapes	-	-
2.	System maintenance/repairs	5,000	5,000
3.	Telecommunications license of facility	5,000	5,000
4.	Consultants	5,000	5,000
5.	Sundry consumables	1,500	1,500
6.	Travelling – Airfares	3,000	3,000
7.	Provision for major equipment (NW WA Dish)	375,000	12,000
8.	Annual Report	6,000	6,000
9.	Melbourne Workshop expenses	3,015	-
	TOTAL:	**$403,515**	**$37,500**

Estimated income/revenue for the year

January 2016 – December 2016

1.	Contributions received ($10,000 each)	40,000	40,000
2.	Interest	16,000	15,000
	TOTAL INCOME:	**$56,000**	**$55,000**

WESTERN AUSTRALIAN SATELLITE
TECHNOLOGY and APPLICATION CONSORTIUM
L-BAND
INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2016

	2016	2015
	$	$
REVENUE		
Contributions Received	40,000	40,000
Interest Received	13,093	14,035
Other Income	4,772	-
TOTAL REVENUE	**57,865**	**54,035**
EXPENDITURE		
Outsourced work	-	15,000
Depreciation expenses	458	6,672
Travel & Transport	547	-
Venue Hire	2,150	-
Hospitality	167	-
Microwave licence	2,791	244
Other operating expenditure	76	2,520
TOTAL EXPENDITURE	**6,189**	**24,436**
NET OPERATING RESULT FOR THE YEAR	**51,676**	**29,599**

WESTERN AUSTRALIAN SATELLITE
TECHNOLOGY and APPLICATION CONSORTIUM
L-BAND
BALANCE SHEET AS AT 31 DECEMBER 2016

	Note	2016	2015
		$	$
CURRENT ASSETS			
Cash at Bank		540,745	485,914
Account Receivable		-	10,000
Prepayments		-	-
Accrued Revenue		-	-
TOTAL CURRENT ASSETS		**540,745**	**495,914**
NON – CURRENT ASSETS			
Property, plant and equipment	2	-	458
TOTAL NON – CURRENT ASSETS		-	458
TOTAL ASSETS		**540,745**	**496,372**
CURRENT LIABILITIES			
Income received in advance		-	10,000
Accrued Expenses		2,697	-
TOTAL CURRENT LIABILITIES		2,697	10,000
TOTAL LIABILITIES		**2,697**	**10,000**
NET ASSETS		**538,048**	**486,372**
EQUITY			
Retained Funds	4	**538,048**	**486,372**
TOTAL EQUITY		**538,048**	**486,372**

WESTERN AUSTRALIAN SATELLITE
TECHNOLOGY and APPLICATION CONSORTIUM
L-BAND
CASH FLOW STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2016

	Note	2016	2015
CASH FLOWS FROM OPERATING ACTIVITIES		**$**	**$**
Receipts			
Contributions Received:			
Landgate		10,000	10,000
CSIRO		-	20,000
Bureau of Meteorology		10,000	10,000
Curtin University		20,000	-
Interest received		13,093	14,035
Other Receipts		4,772	-
Total Receipts		**57,865**	**54,035**
Payments			
Payments to suppliers		(3,034)	(17,764)
Total Payments		(3,034)	(17,764)
Net cash provided by operating activities	3	**54,831**	**36,271**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payments for property, plant and equipment		-	-
Net cash used in investing activities		-	-
Net increase/(decrease) in cash		**54,831**	**36,271**
Cash at the beginning of the year		485,914	449,643
Cash at the end of the year		**540,745**	**485,914**

Notes:

1 Summary of Significant Accounting Policies

The principal accounting policies adopted in the preparation of the financial report are set out below. These policies have been consistently applied unless otherwise stated.

Basis of Preparation

The Western Australian Satellite Technology and Application Consortium (WASTAC) L Band financial report is a special purpose financial report which has been prepared on an accrual basis.

(a) Valuation of Property, Plant and Equipment

All property, plant and equipment is shown at cost, less subsequent depreciation and impairment losses. Cost includes expenditure that is directly attributable to the acquisition of the items. Subsequent costs are included in the asset carrying amount or recognised as a separate asset, as appropriate, only when it is probable that future economic benefits associated with the item will flow to the entity and the cost of the item can be measured reliably.

Any gains and losses on disposals are determined by comparing the disposal proceeds with the carrying amount and are included in the Income Statement.

(b) Depreciation of non-current assets

All property, plant and equipment having a limited useful life are depreciated over their estimated useful lives, in a manner which reflects the consumption of their future economic benefits.

Depreciation is calculated on a straight-line basis from the time the asset becomes available for use. Estimated useful lives are as follows:

- Computing equipment 3 years
- Other equipment 8 years

Assets' residual values and useful lives are reviewed, and adjusted if appropriate, at each balance sheet date.

A class of asset's carrying amount is written down immediately to its recoverable amount if the class of asset's carrying amount is greater than its estimated recoverable amount (see note 1(c)).

(c) Impairment of property, plant and equipment

At each reporting date, WASTAC reviews the carrying amounts of each class of asset within property, plant and equipment to determine whether there is any indication that those asset classes have suffered an impairment loss. If any such indication exists, the recoverable amount of the class of asset is estimated in order to determine the extent of the impairment loss. Where the asset does not generate cash flows that are independent from other assets, WASTAC estimates the recoverable amount of the cash-generating unit to which the asset belongs.

Recoverable amount is the higher of fair value less costs to sell and value in use. In assessing value in use, the depreciated replacement cost is used where the future economic benefits of WASTAC's assets are not primarily dependent on the assets ability to generate net cash inflows.

If the recoverable amount of a class of asset is estimated to be less than its carrying amount, the carrying amount is reduced to recoverable amount. An impairment loss is recognised as an expense to the Income Statement immediately.

(d) Income Tax

The Board considers that its operations are exempt from income tax under the provisions of section 50-25 of the Income Tax Assessment Act (1997) as amended.

(e) Goods and Services Tax (GST)

Revenues, expenses and assets are recognised net of the amount of GST, except where the amount of GST is not recoverable from the Australian Taxation Office. In these circumstances the GST is recognised as part of the cost of acquisition of the asset or as part of an item of the expense.

(f) Income Recognition

The Board recognises income as it is received. All income is stated net of the amount of goods and services tax (GST). Interest is recognised on the effective interest rate method.

2 Property, Plant and Equipment

	2016	2015
Computer Equipment		
At cost	35,196	35,196
Accumulated depreciation	(35,196)	(35,196)
	-	-
Other Equipment		
At cost	202,441	202,441
Accumulated depreciation	(202,441)	(201,983)
	-	458
Total Property, Plant and Equipment	**-**	**458**

Reconciliations

Reconciliations of the carrying amounts of property, plant and equipment at the beginning and end of the current financial year are set out below:

	Computer Equipment	Other Equipment	Total
Carrying amount at start of year	-	458	458
Additions/(Disposals)	-	-	-
Depreciation expense	-	(458)	(458)
Carrying amount at end of year	**-**	**0**	**0**

3 Notes to the Cash Flow Statement

Reconciliation of operating result from ordinary activities to net cash inflow from operating activities

	2016	2015
Net operating result	51,676	29,599
Depreciation expense	458	6,672
Movement in Current Assets & Liability	2,697	-
Net cash provided/(used) by operating activities	**54,831**	**36,271**

4 Retained Earnings

Balance at beginning of the year	486,372	456,773
Operating surplus/(deficit) for the year	51,676	29,599
Balance at end of the year	**538,048**	**486,372**

This page is left blank intentionally

Santo Casilli Accounting and Auditing Services is a CPA Practice

Santo Casilli
Accounting and Auditing Services
Certified Practising Accountant
Liability limited by a scheme approved under Professional Standards Legislation

Suite 8 - 336 Churchill Avenue Subiaco WA 6008
Postal Address: PO Box 617 Subiaco WA 6904

Mobile: 0409 104 929 - **Phone:** (08) 9388 3678 - **Fax:** (08) 9388 3860 -
Email: scasilli@westnet.com.au

AUDITOR'S INDEPENDENCE DECLARATION

Auditor's independence declaration to the Members of the Board of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band.

In relation to my audit of the special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band for the period ended 31 December 2016, to the best of my knowledge and belief, there have been no contraventions of the auditor independence requirements of Australian Professional Accounting Bodies.

Santo Casilli FCPA

Date: 30 March 2017

Santo Casilli Accounting and Auditing Services is a CPA Practice

Santo Casilli
Accounting and Auditing Services

Certified Practising Accountant

Liability limited by a scheme approved under Professional Standards Legislation

Suite 8 - 336 Churchill Avenue Subiaco WA 6008
Postal Address: PO Box 617 Subiaco WA 6904

Mobile: 0409 104 929 - **Phone:** (08) 9388 3678 - **Fax:** (08) 9388 3860 -
Email: scasilli@westnet.com.au

INDEPENDENT AUDITOR'S REPORT

The Members of the Board

Opinion

We have audited the special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band, which comprises the balance sheet as at 31 December 2016, the income statement and the statement of cash flows for the year then ended, notes to the financial report and including a summary of significant accounting policies and other explanatory information. Our audit opinion is provided in order to satisfy the reporting requirements of the Board and its Joint venture participants.

In our opinion, the accompanying special purpose financial report of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band for the year ended 31 December 2016 is prepared, in all material respects, in accordance with the financial reporting provisions as outlined in Note 1 of the financial statements.

Basis for Opinion

We conducted our audit in accordance with Australian Auditing Standards. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Report* section of our report. We are independent of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band in accordance with the ethical requirements of the Accounting Professional and Ethical Standards Board's APES 110 *Code of Ethics for Professional Accountants* (the Code) that are relevant to our audit of the financial report in Australia, and we have fulfilled our other ethical responsibilities in accordance with the Code. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Emphasis of Matter - Basis of Accounting and Restriction on Distribution and Use

We draw attention to Note 1 to the special purpose financial report, which describes the basis of accounting. The financial report is prepared to assist the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band to meet its reporting obligations between the Board and its Joint Venture participants. As a result, the financial report may not be suitable for another purpose. Our report is intended solely for the Board and its joint venture participants and should not be distributed to or used by other parties. Our opinion is not modified in respect of this matter.

Responsibilities of Management and Those Charged with Governance for the Financial Report

Curtin University management, on behalf of the Board, is responsible for the preparation of the special purpose financial report and for establishing such internal control as Curtin University management determines is necessary to enable the preparation of a special purpose financial report that is free from material misstatement, whether due to fraud or error.

In preparing the special purpose financial report, Curtin University management with the Board is responsible for assessing the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band's ability to continue as a going concern, disclosing, as applicable, matters relating to going concern and using the going concern basis of accounting unless the Board either intends to cease operations of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band, or has no realistic alternative but to do so.

The members of the Board are responsible for overseeing the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band's financial reporting process.

Auditor's Responsibilities for the Audit of the Financial Report.

Our objectives are to obtain reasonable assurance about whether the special purpose financial report, as a whole, is free from material misstatement, whether due to fraud or error, and to issue an auditor's report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with Australian Auditing Standards will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of this financial report.

As part of an audit in accordance with Australian Auditing Standards, we exercise professional judgement and maintain professional scepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial report, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band's internal control.

- Evaluate the appropriateness of accounting policies used as described in Note 1 to the financial statements and the reasonableness of accounting estimates and related disclosures made by Curtin University management, if any.

- Conclude on the appropriateness of Western Australian Satellite Technology and Application Consortium (WASTAC) X Band's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditor's report to the related disclosures in the financial report or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditor's report. However, future events or conditions may cause the Western Australian Satellite Technology and Application Consortium (WASTAC) X Band to cease to continue as a going concern.

Electronic publication of the audited financial report

It is our understanding that the Western Australian Satellite Technology and Application Consortium X Band intends to electronically present the audited financial report and auditor's report on its internet website. Responsibility for the electronic presentation of the financial report on the Western Australian Satellite Technology and Application Consortium website is that of those charged with governance of the Western Australian Satellite Technology and Application Consortium. The
security and controls over information on the website should be addressed by the Western Australian Satellite Technology and Application Consortium to maintain the integrity of the data presented. The examination of the controls over the electronic presentation of audited financial report on the Western Australian Satellite Technology and Application Consortium website is beyond the scope of the audit of the financial report.

We have communicated with Western Australian Satellite Technology and Application Consortium (WASTAC) X Band Board regarding, among other matters, the planned scope and timing of the audit and, via our management letter, significant audit findings, including any significant deficiencies in internal control that we may have identified during our audit.

Santo Casilli FCPA

Date: 30 March 2017

Perth

Estimated expenditure for the year

January 2016 – December 2016

		2016 $	2015 $
1.	Data Tapes	-	-
2.	System maintenance/repairs	84,000	84,000
3.	Consultants, product development	141,000	120,000
4.	Sundry consumables	2,000	2,000
5.	Travelling – Airfares	4,000	4,000
6.	Provision for major equipment	25,000	25,000
7.	Melbourne Workshop expenses	4,165	-
8.	ACMA Licensing for Murdoch	50,000	-
	TOTAL:	**$310,165**	**$235,000**

Estimated income/revenue for the year

January 2016 – December 2016

1.	Annual Contributions ($20,000 each)	80,000	80,000
2.	Interest	25,000	25,000
	TOTAL INCOME:	**$105,000**	**$105,000**

WESTERN AUSTRALIAN SATELLITE
TECHNOLOGY and APPLICATION CONSORTIUM
X-BAND
INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2016

	2016	2015
	$	$
REVENUE		
Contributions received	80,000	80,000
Interest received	17,597	19,181
TOTAL REVENUE	**97,597**	**99,181**
EXPENDITURE		
Outsourced Work (Consultancy)	299	-
Freight Expenses	83	672
Other Software & licence <$5,000	14,263	4,777
Venue Hire	2,969	-
Travel & Transport	756	-
Outsourced work (Software Support)	127,370	-
Depreciation	31,928	31,915
TOTAL EXPENDITURE	**177,668**	**37,364**
NET OPERATING RESULT FOR THE YEAR	**(80,071)**	**61,817**

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY and APPLICATION CONSORTIUM
X-BAND
BALANCE SHEET AS AT 31 DECEMBER 2016

	Note	2016	2015
		$	$
CURRENT ASSETS			
Cash at Bank		600,885	665,953
TOTAL CURRENT ASSETS		**600,885**	**665,953**
NON – CURRENT ASSETS			
Property, plant and equipment		142,854	174,782
TOTAL NON – CURRENT ASSETS	2	142,854	174,782
TOTAL ASSETS		**743,739**	**840,735**
CURRENT LIABILITIES			
Income received in advance		-	20,000
Accrued Expenses		3,075	-
TOTAL CURRENT LIABILITIES		3,075	20,000
TOTAL LIABILITIES		**3,075**	**20,000**
NET ASSETS		**740,664**	**820,735**
EQUITY			
Retained Funds	4	740,664	820,735
TOTAL EQUITY		**740,664**	**820,735**

WESTERN AUSTRALIAN SATELLITE
TECHNOLOGY and APPLICATION CONSORTIUM
X-BAND
CASH FLOW STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2016

	Note	2016	2015
CASH FLOWS FROM OPERATING ACTIVITIES		**$**	**$**
Receipts			
Contributions received			
Landgate		20,000	20,000
CSIRO		-	40,000
Bureau of Meteorology		20,000	20,000
Geoscience Australia		20,000	20,000
Interest received		17,597	19,181
Total Receipts		**77,597**	**119,181**
Payments			
Payments to Suppliers		(142,665)	(5,449)
Total Payments		(142,665)	(5,449)
Net cash provided/ (used) by operating activities	3	**(65,068)**	**113,732**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payments for property, plant and equipment		-	(86,509)
Net cash used in investing activities		**-**	**(86,509)**
Net increase/(decrease) in cash		**(65,068)**	**27,223**
Cash at the beginning of the year		665,953	638,730
Cash at the end of the year		**600,885**	**665,953**

Notes:

1 Summary of Significant Accounting Policies

The principal accounting policies adopted in the preparation of the financial report are set out below. These policies have been consistently applied unless otherwise stated.

Basis of Preparation

The Western Australian Satellite Technology and Application Consortium (WASTAC) X Band financial report is a special purpose financial report which has been prepared on an accrual basis.

(a) Valuation of Property, Plant and Equipment

All property, plant and equipment is shown at cost, less subsequent depreciation and impairment losses. Cost includes expenditure that is directly attributable to the acquisition of the items. Subsequent costs are included in the asset carrying amount or recognised as a separate asset, as appropriate, only when it is probable that future economic benefits associated with the item will flow to the entity and the cost of the item can be measured reliably.

Any gains and losses on disposals are determined by comparing the disposal proceeds with the carrying amount and are included in the Income Statement.

(b) Depreciation of non-current assets

All property, plant and equipment having a limited useful life are depreciated over their estimated useful lives, in a manner which reflects the consumption of their future economic benefits.

Depreciation is calculated on a straight-line basis from the time the asset becomes available for use. Estimated useful lives are as follows:

- Computing equipment 3 years
- Computer software 10 years
- Other equipment 8 years

Assets' residual values and useful lives are reviewed, and adjusted if appropriate, at each balance sheet date.

A class of asset's carrying amount is written down immediately to its recoverable amount if the class of asset's carrying amount is greater than its estimated recoverable amount (see note 1(c)).

(c) Impairment of property, plant and equipment

At each reporting date, WASTAC reviews the carrying amounts of each class of asset within property, plant and equipment to determine whether there is any indication that those asset classes have suffered an impairment loss. If any such indication exists, the recoverable amount of the class of asset is estimated in order to determine the extent of the impairment loss. Where the asset does not generate cash flows that are independent from other assets, WASTAC estimates the recoverable amount of the cash-generating unit to which the asset belongs.

Recoverable amount is the higher of fair value less costs to sell and value in use. In assessing value in use, the depreciated replacement cost is used where the future economic benefits of WASTAC's assets are not primarily dependent on the assets ability to generate net cash inflows.

If the recoverable amount of a class of asset is estimated to be less than its carrying amount, the carrying amount is reduced to recoverable amount. An impairment loss is recognised as an expense to the Income Statement immediately.

(d) Income Tax

The Board considers that its operations are exempt from income tax under the provisions of section 50-25 of the Income Tax Assessment Act (1997) as amended.

(e) Goods and Services Tax (GST)

Revenues, expenses and assets are recognised net of the amount of GST, except where the amount of GST is not recoverable from the Australian Taxation Office. In these circumstances the GST is recognised as part of the cost of acquisition of the asset or as part of an item of the expense.

(f) Income Recognition

The Board recognises income as it is received. All income is stated net of the amount of goods and services tax (GST). Interest is recognised on the effective interest rate method.

2 Property, Plant and Equipment

	2016	2015
Computer Equipment		
At cost	119,937	119,937
Accumulated depreciation	(48,312)	(39,661)
	71,625	80,276
Other Equipment		
At cost	852,919	852,918
Accumulated depreciation	(781,690)	(758,412)
	71,229	94,506
Total Property, Plant and Equipment	**142,854**	**174,782**

Reconciliations

Reconciliations of the carrying amounts of property, plant and equipment at the beginning and end of the current financial year are set out below:

	Computer Equipment	Other Equipment	Total
Carrying amount at start of year	80,276	94,506	174,782
Additions/(Disposals)	-	-	-
Depreciation expense	(8,650)	(23,278)	(31,928)
Carrying amount at end of year	**71,626**	**71,228**	**142,854**

3 Notes to the Cash Flow Statement

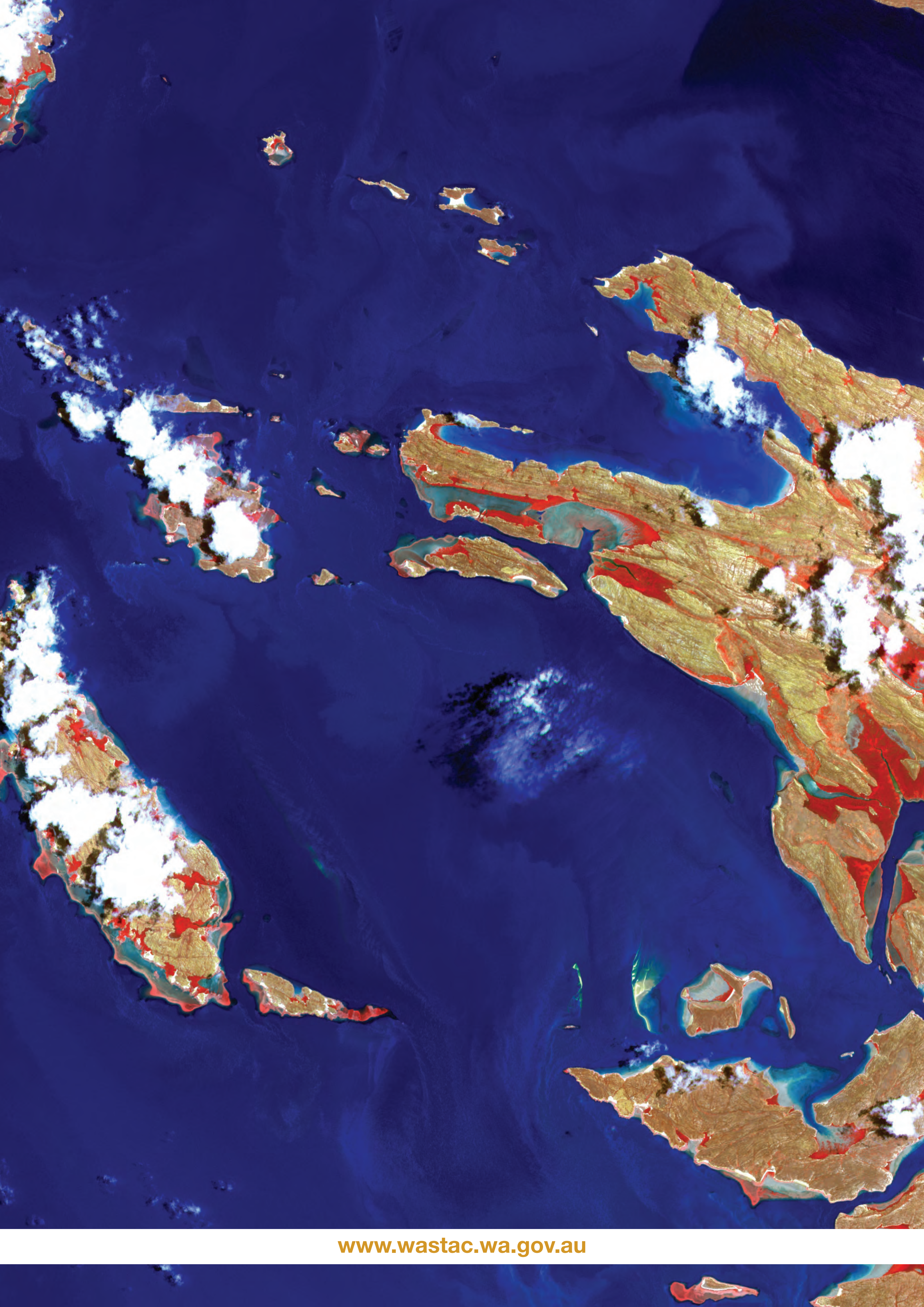
Reconciliation of operating result from ordinary activities to net cash inflow from operating activities

	2016	2015
Net operating result	(80,071)	61,817
Depreciation expense	31,928	31,915
Movement in Current Assets & Liability	(16,925)	20,000
Net cash provided/(used) by operating activities	**(65,068)**	**113,732**

4 Retained Earnings

Balance at beginning of the year	820,735	758,918
Operating surplus/(deficit) for the year	(80,071)	61,817
Balance at end of the year	**740,664**	**820,735**

This page is left blank intentionally



www.wastac.wa.gov.au