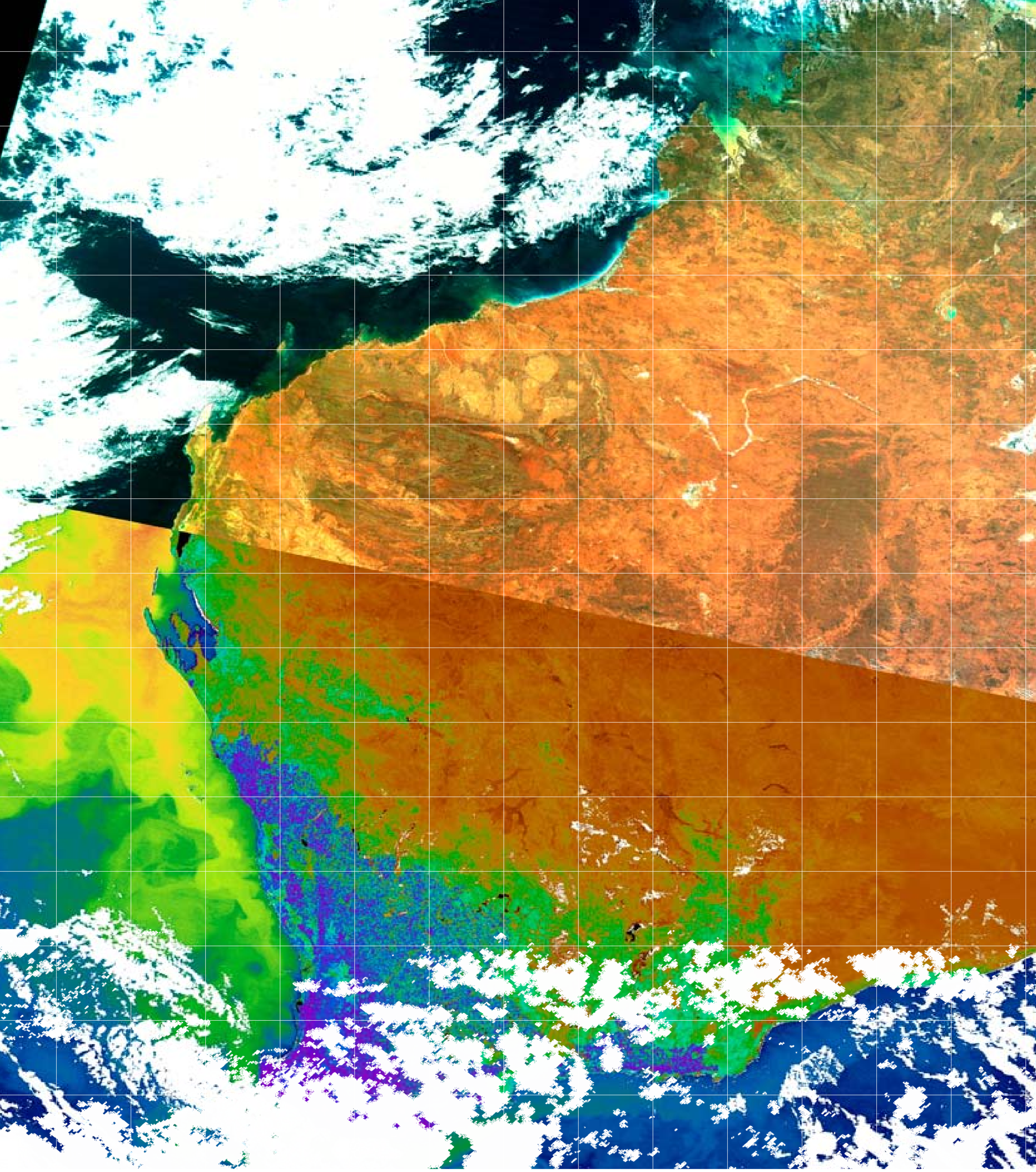

WASTAC Annual Report 2005

Western Australian Satellite Technology and Applications Consortium

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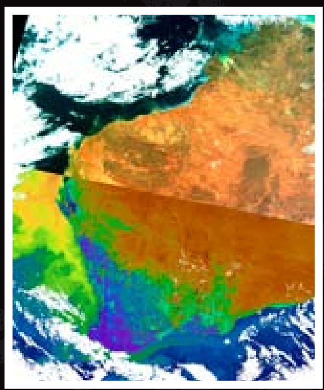
COVER IMAGE

Terra MODIS image acquired on June 27, 2005 by WASTAC and processed by Satellite Remote Sensing Services. The upper part of the image shows the scene in natural colours similar to the way the human eye would see it. The lower part shows two information products which have been derived from the same satellite data utilising parts of the electromagnetic spectrum invisible to the human eye. Over the ocean the "Sea Surface Temperature" product is shown. Yellow to red colours represent areas of warm water whereas green to blue colours are showing areas of lower water temperature. Over land the so called "Normalised Difference Vegetation Index" is shown. It is a measure of vegetation greenness where brown to yellow colours indicate very sparse to sparse vegetation and green to blue and purple show areas of dense to very dense vegetation.



EDITORS

R. Stovold DLI, SRSS
A.F. Pearce

ACKNOWLEDGEMENTS:

CONTENTS

01 WASTAC Chairman's Report 2006

Welcome to our 2005 annual report. You may just enjoy the pictures or like me dig deeper to try and understand why such an activity exists in this remote corner of the world.

My perspective is that governments increasingly seek to manage the inter-related pressures of economic growth, an expanding world population and global climate change. The global impacts of these pressures on Western Australia are evident from changing rainfall patterns and increased cyclonic activity to housing shortage and rampant house prices. To resolve these inter-related pressures we have to think globally but act locally. To me WASTAC provides an example of this paradigm in action with the tacit or implicit support of the USA, Commonwealth and State Government Agencies.

NASA made the data and science of their polar earth observing satellites, aptly named Mission to Planet Earth, freely available to the global community. From such good fortune and the ever increasing demand for local information with which to manage these global pressures, members of WASTAC have grasped the opportunity. For one WASTAC member, this has contributed to the satellite data processed doubling on average every 2.6 years (Figure 1). The products resulting from this data have on average doubled every 5.8 years (Figure 2). These products from global thinking are helping regional communities address local issues such as fire, flood, drought, loss of biodiversity and declining terms of trade.

I congratulate all the people mentioned within this report who have helped transform global thinking into action by regional businesses and communities.

Richard Smith
Chairman

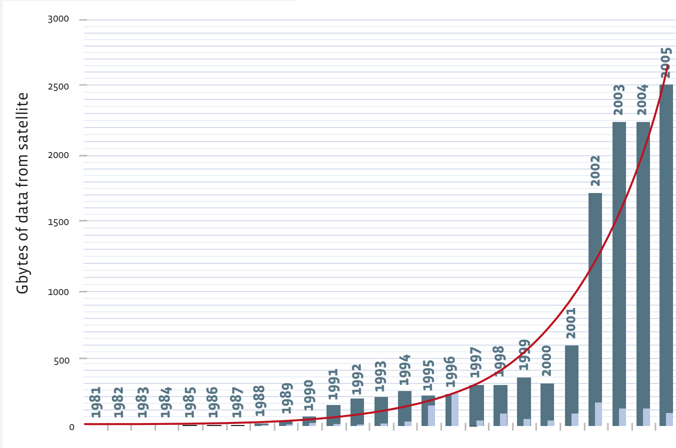


Figure 1: Trend in amount of satellite data processed by Satellite Remote Sensing Services, Department of Land Information

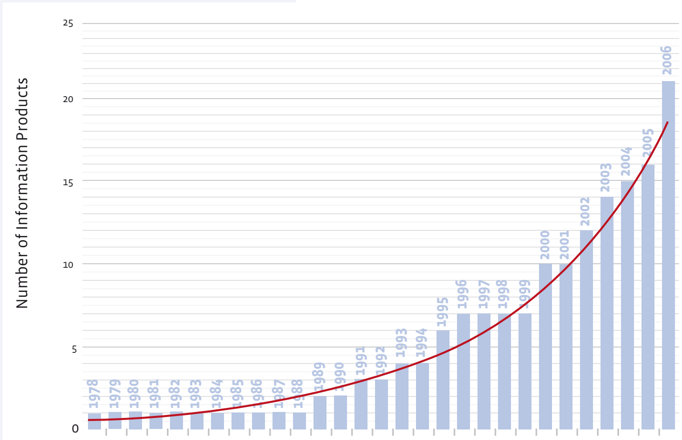


Figure 2: Number of satellite based products available from Satellite Remote Sensing

02 WASTAC Board Members

WASTAC BOARD FOR 2005

Dr Richard Smith
(Chairman)
Department of Land Information

Dr Stefan Maier
Department of Land Information

Assoc. Prof. Merv Lynch
Curtin University of Technology

Dr Doug Myers
Curtin University of Technology

Dr Greg Ayres
CSIRO, Atmospheric Research

Dr Alex Held
CSIRO, Earth Observation Centre

Dr David Griersmith
Bureau of Meteorology

Mr Alan Scott
Bureau of Meteorology

Mr Adam Lewis
Geoscience Australia

Professor Tom Lyons
Murdoch University

Exec. Dean Yianni Attikiouzel
Murdoch University

WASTAC STANDING COMMITTEE AND PROXY TO THE BOARD

Dr Richard Smith
(Chairman)
Department of Land Information

Dr Stefan Maier
Department of Land Information

Assoc. Prof. Merv. Lynch
Curtin University of Technology

Dr Doug Myers
Curtin University of Technology

Mr Alan Scott
Bureau of Meteorology

Mr Don Ward
Bureau of Meteorology

Mr Alan Pearce
CSIRO, Marine Research

Dr Peter Fearns
CSIRO, Marine Research

Professor Tom Lyons
Murdoch University

Dr Halina Kobryn
Murdoch University

WASTAC SECRETARY:

Mr Richard Stovold
(Secretary to the WASTAC Board and Standing Committee)

WASTAC TECHNICAL COMMITTEE:

Mr Don Ward
(Chairman)

Assoc Prof Merv Lynch

Dr Doug Myers

Mr Ronald Craig

03 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, NOAA (TOVS and AVHRR), SeaWiFS and FY1D 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
- promote educational uses of WASTAC data
- ensure maximum use of Aqua, Terra, NOAA, SeaWiFS and FY1D data in the management of renewable resources.

FUTURE STRATEGIES:

- Upgrade reception capabilities for METOP (including AVHRR) and NPP (including VIIRS).
- Advance MODIS processing from Level 1b to Level 2 (below-atmosphere NADIR reflection) through the introduction of atmospheric and view angle (BRDF) corrections.
- Advance the processing of AIRS data from Aqua.
- Improved management of the archive through collaboration with IVEC (Interactive Virtual Environment Computing Facility).
- Network access to other Earth Observation Satellite receiving stations in Australia.

FUTURE SATELLITE OPPORTUNITIES:

- National Polar Orbiting Environmental Satellite System (NPOESS)
- Landsat Continuity Data Mission

04 The WASTAC story

Alan Pearce, Brendon McAtee and Robert Shaw (DLI)

It was over 25 years ago that CSIRO and the Western Australian Institute of Technology (WAIT; now Curtin University of Technology) signed an historic agreement to establish a NOAA satellite receiving station on the WAIT campus. It took another 2 years for the installation of the first receiving dish on the roof of the Electrical Engineering building.

Since then, the satellite data from that facility and its successors have been increasingly used for agricultural, marine and atmospheric applications such as fire and flood monitoring, weather forecasting, vegetation indices and sea-surface temperatures for the fishing industry. WASTAC has well deserved its enviable record in the acquisition, archiving and distribution of locally-received satellite remote sensing products, and there is now an archive of approaching 100,000 passes from NOAA-AVHRR, SeaWiFS and MODIS.

Three phases can be identified in the development of WASTAC, and this note highlights the major milestones along the way.

1) PRE-WASTAC BEGINNINGS: THE PIONEERS (1979 – 1986)

1979: Initial agreement between CSIRO (Dr. Frank Honey) and WAIT (Dr. Bill Carroll) to establish a NOAA satellite receiving station.

May 1981: First manually-operated receiving facility established at WAIT as a joint CSIRO/WAIT project.

August 1981: First NOAA-6 and NOAA-7 passes archived (partial pixels on every second line), using 9-track 6250 bpi magnetic tapes.

June 1983: First full passes with every pixel of every line received.

1985: Early discussions between CSIRO, WA State Government agencies, Bureau of Meteorology and Curtin University on establishing an upgraded reception facility to provide operational remote sensing data on a regular basis. This led directly to the establishment of WASTAC, under the chairmanship of Henry Houghton (DOLA).

2) ESTABLISHMENT AND GROWTH OF WASTAC: NEW DEED, NEW DISH, NEW PARTNERS (1987 – 2000)

July 1987: Upgraded automatic L-band reception facilities at WAIT officially commissioned by the Hon. Barry Jones (Federal Minister for Science) and the Hon. Keith Wilson (State Minister for Housing and Lands).

September 1987: First satellite pass using the new WASTAC reception facilities. While the antenna and controller were retained at Curtin University, the data were relayed in real-time via analogue microwave link for ingest into a Dual computer system at the Bureau of Meteorology offices in Wellington Street (Perth); data archiving and distribution were undertaken by DOLA at Jardine House in the city.

January 1989: First WASTAC deed signed by the Bureau of Meteorology, CSIRO, Curtin University (ex-WAIT) and the Department of Land Administration (DOLA), with the stated objectives:

(a) to acquire, operate and maintain the facility;

(b) to maintain an archive of remotely sensed data acquired by the facility from satellites of the National Oceanic and Atmospheric Administration (hereinafter called "NOAA");

(c) to provide remotely sensed data for the day-to-day operational requirements of the Bureau;

(d) to provide facilities and remotely sensed data for the parties here to conduct research and development projects from time to time;

(e) to provide in accordance with the provisions of this Deed remotely sensed data to members of the Consortium for their own requirements or purposes or for supply by them to those to whom they may be responsible or for sale by them to their respective customers or clients as the case may be on terms and conditions determined by the Board.

December 1989: First formal WASTAC Annual Report published.

January 1993: The Leeuwin Centre for Earth Sensing Technologies opened, providing accommodation for the remote sensing sections of DOLA, CSIRO, Curtin University, TAFE and some commercial clients.

March 1995: WASTAC deed renewed for second 5-year period. This included a re-structure of the WASTAC Board of Management to meet twice a year separately from the ongoing Standing Committee.

December 1995: Henry Houghton retired as inaugural Chairman of WASTAC and was replaced by Richard Smith (DOLA).

WASTAC Board for 1991: (L–R) Mr Don Ward, Bureau of Meteorology; Dr Richard Smith, CSIRO; Dr Doug Myers, Curtin University of Technology; Mr Henry Houghton (Chairman), Department of Land Administration; Mr Alan Pearce, CSIRO; Mr Richard Stovold (Secretary), Department of Land Administration; Assoc. Prof. Merv Lynch, Curtin University of Technology; Mr L Broadbridge (absent), Bureau of Meteorology

September 1996: Upgrade to the ingest facility with HP workstations replacing the IBM PS/2 system, and a high speed microwave link established for transferring satellite data directly to the Leeuwin Centre.

December 1996: The WASTAC receiver assisted in the rescue of a stricken yachtsman in the Southern Ocean.

1997: WASTAC Strategic Plan prepared, with the 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".

March 1997: WASTAC "quicklook" facility for AVHRR passes established on the World Wide Web.

October 1997: First SeaWiFS pass received by WASTAC.

April 2001: Implementation of CAPS software into the WASTAC/DOLA processing stream.

3) X-BAND EXPANSION: A NEW GENERATION OF SATELLITES (2001 – THE PRESENT)

August 2001: Expanded WASTAC-X consortium formed by the Bureau of Meteorology, CSIRO, Curtin University, DOLA (now Department of Land Information, DLI), Geosciences Australia and Murdoch University.

September 2001: New X-band facility (with a 3.6 m radomed autotracking antenna) installed at Murdoch University to receive MODIS data; the facility was officially commissioned in November.

The first NOAA receiving dish at Curtin University, c.1982

September 2001: First MODIS/Terra pass received and archived.

September 2001: WASTAC website established: www.wastac.wa.gov.au.

November 2001: The digital microwave link was upgraded from 2 to 4 Mbits/sec.

July 2002: First MODIS/Aqua pass received and archived.

November 2002: Three MODIS development working groups established for atmosphere, land and ocean.

June 2004: WASTAC-X deed signed by the 6 Consortium partners.

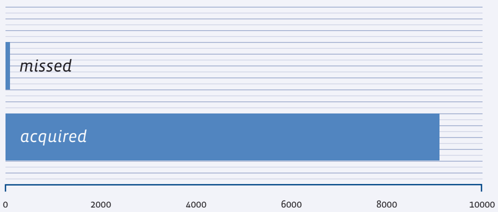
August 2005: L-band upgrade to the Murdoch antenna, allowing reception of NOAA/AVHRR, SeaWiFS and FY-1D.

The success of WASTAC over the past 2 decades may be summed up in simple terms: "competence and cooperation" — the high level of competence of the individuals comprising the WASTAC Standing Committee and Board, and the encouraging degree of co-operation between the participating organisations. These hallmarks will ensure that WASTAC can continue to meet the challenges of new satellite sensors and new marine, terrestrial and atmospheric applications into the future.

05 Operational Status

Don Ward, Regional Computing Manager, Bureau of Meteorology Perth (www.bom.gov.au)

WASTAC facilities include both L Band and X Band reception. The X Band facility at Murdoch University was commissioned on the 21 November 2001.



NOAA Passes in 2005

WASTAC L

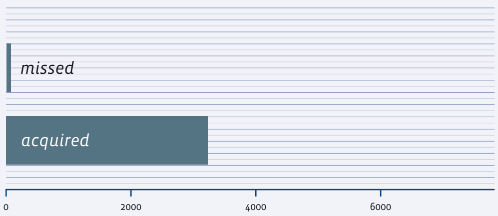
WASTAC L band facilities consist of a 2.4m antenna and antenna controller at Curtin University of Technology and ingest and display computers with hard disk storage and tape archive facilities located at the Bureau of Meteorology premises at 1100 Hay Street, West Perth. A low speed uni-directional microwave link connects the antenna to the ingest computers. A high speed microwave communications system was installed in June 1996, allowing the transmission of raw and processed satellite data between the Leeuwin Centre, Curtin University, and the WA Regional Office of the Bureau of Meteorology.

Colour and grey scale quicklook pictures are produced at the Department of Land Information's (DLI) Satellite Remote Sensing Services (SRSS) at the Leeuwin Centre for Earth Sensing Technologies at Floreat in near realtime for archiving, indexing and distribution. The raw data archive is produced on 20Gb DLT tape and a duplicate copy is currently produced for a national NOAA data archive program that is coordinated by the CSIRO Office of Space Science and Applications (COSSA) in Canberra.

The AVHRR ingest and display system, developed and installed by the Bureau of Meteorology in September 1996 consists of two HP UNIX workstations, one provided by WASTAC and the other by the Bureau. The software was upgraded late in 1999.

The ingest program runs on both workstations providing display, processing and backup facilities. The TOVS data, a subset of AVHRR is automatically sent to the Bureau of Meteorology in Melbourne so that atmospheric temperature retrievals can be included in the global numerical weather prediction models. Sea surface temperatures (SST) are produced by the Bureau and DLI. DLI also produces vegetation maps and monitors fire scars in near realtime. NOAA and SeaWiFS archive information are posted to DLI's World Wide Web page.

Equipment failures during the year caused the loss of 5 days of data but the dedicated efforts of DLI and Bureau staff resulted in a total of 8652 passes being recorded during the year.



MODIS Passes in 2005

WASTAC X

The WASTAC X band facilities at the Environmental Science building at Murdoch University were supplied and installed by SeaSpace Corp in September 2001 and consist of a 3.6m diameter antenna mounted in a fibreglass dome and a Sun Sparc 400 antenna control computer. The separately acquired ingest and display computers with hard disk storage and tape archive facilities as well as a dual CPU LINUX processing computer are located at SRSS at the Leeuwin Centre. The X band reception facility is directly connected to the high speed PARNET wide area network at the Murdoch node. This allows data transfer to DLI and via the internet to other members of WASTAC.

The X band computer has been upgraded by SeaSpace to incorporate ingest for new X band satellites and a L band ingest facility has been added to provide backup and help resolve pass conflicts.

Quicklook pictures are produced at SRSS in around one hour for archiving, indexing and distribution.

Equipment failures during the year resulted in the loss of 2 days of data but a total of 3283 X band MODIS passes were recorded for the year.

A total of 5755 Aqua passes have been recorded since its launch early in 2002.

ARCHIVE STORAGE

DLI is currently holding the archive on 8mm exabyte and DAT tapes. 20Gb DLT tape was introduced as the archive media late in 2000 for the L band data and since its commencement in 2001, X band data have been archived to 35 Gb DLT.

Orders for digital data can be provided via the internet www.wastac.wa.gov.au on 8mm data tape, DAT tape, DLT tape, DVD/CD-ROM.

RECENT DEVELOPMENTS AND FUTURE DIRECTIONS

A project is underway that will upgrade the existing L band station at Curtin to match similar Bureau facilities.

WASTAC DATA ARCHIVE

The WASTAC archive of NOAA, MODIS and SeaWiFS satellite passes, managed and maintained by the Department of Land Information (DLI) Satellite Remote Sensing Services (SRSS) group, is held at the Leeuwin Centre in Floreat,Western Australia.

DLI actively manages the daily archive and management systems which have been installed to ensure rapid and reliable delivery of WASTAC satellite data for research and wider community use.

A total of 8652 NOAA passes were archived at Curtin in 2005. Passes include data from the NOAA 12, NOAA 14, NOAA 15, ,NOAA 16 ,NOAA 17 and NOAA 18 satellites. All passes were stored on DLT tapes.

The archiving of SeaWiFS data continued during 2005 with 863 passes being archived.

During 2005 1577 Terra and 1705 Aqua passes have been archived.

We continue to maintain the near real time quick-look archive of MODIS and NOAA-AVHRR data on the world wide web. The digital archive holds data from the present time back to 1983. A similar archive of SeaWiFS quick-look data is also held on the world wide web.

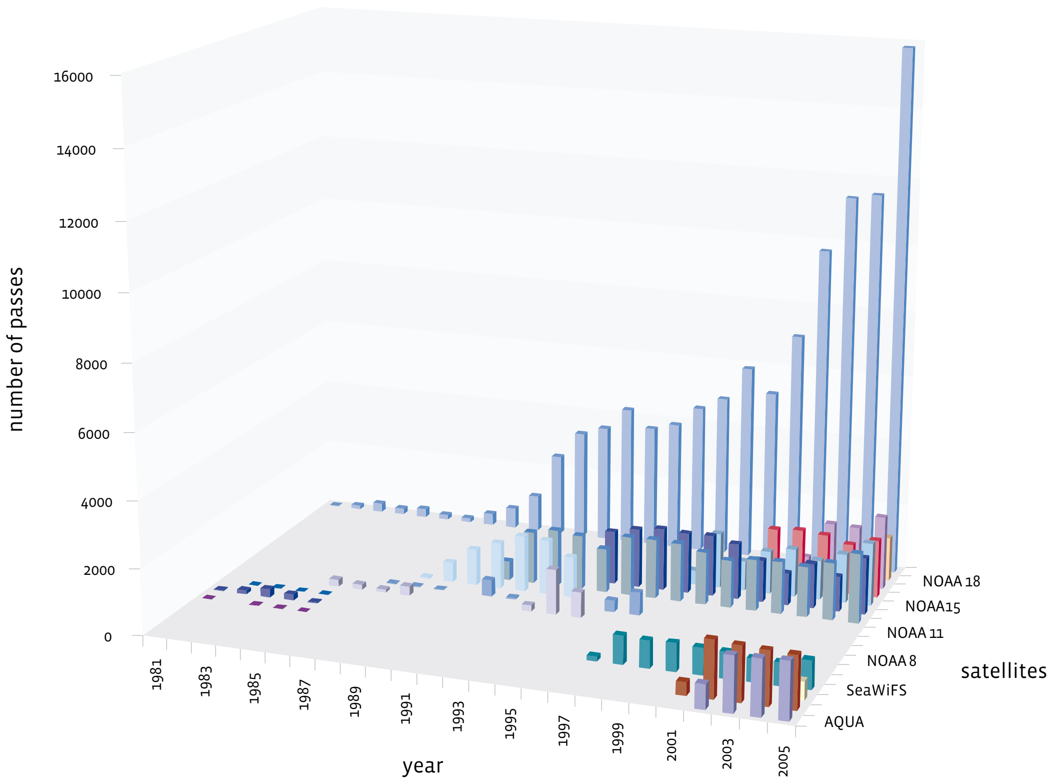
Web addresses to view this archive of MODIS, NOAA and SeaWiFS data online are:

http://www.rss.dola.wa.gov.au/noaaql/NOAAql.html
http://www.rss.dola.wa.gov.au/modisql/MODISql.html

A project is underway that will upgrade the existing L band station at Curtin to match similar Bureau facilities...

TOTAL NUMBER OF PASSES HELD IN THE WASTAC ARCHIVE

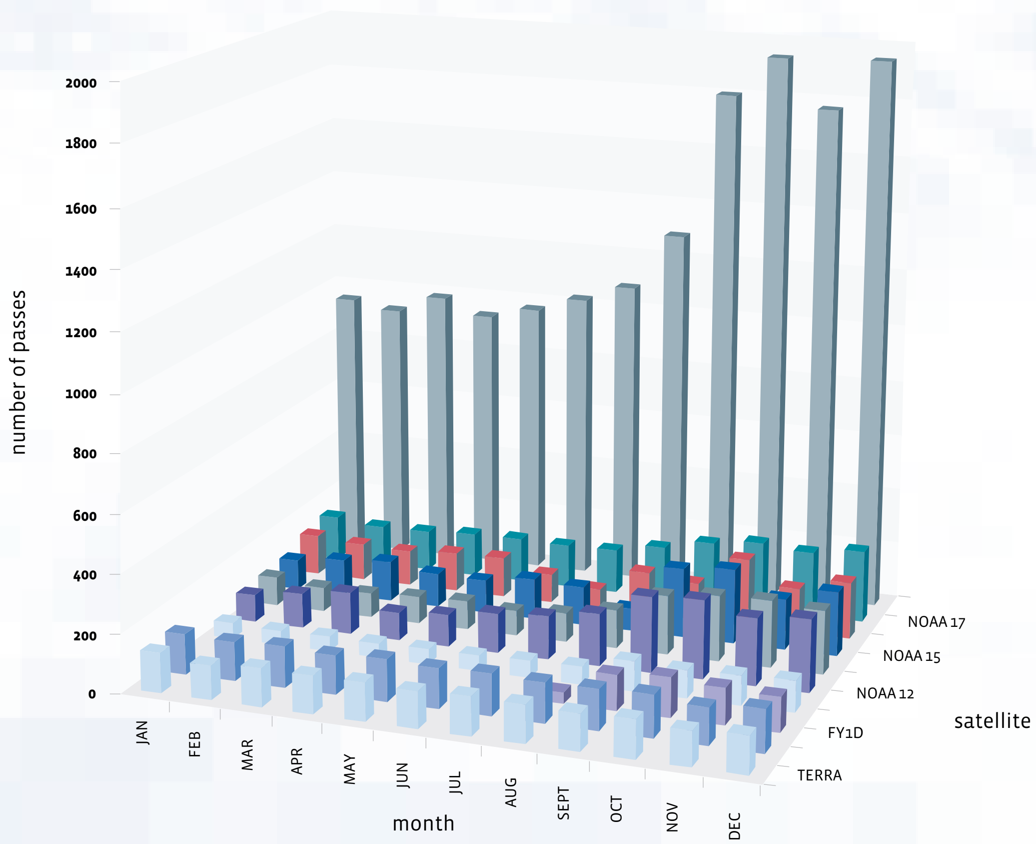
	AQUA	TERRA	SeaWiFS	FY1D	NOAA 6	NOAA 7	NOAA 8	NOAA 9	NOAA 10	NOAA 11	NOAA 12	NOAA 14	NOAA 15	NOAA 16	NOAA 17	NOAA 18	Total
1981					5	22											27
1982						115	1										116
1983					12	244	12										268
1984					7	179	4										190
1985					7	33	4	212									256
1986								151									151
1987								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



WASTAC SATELLITE DATA 2005

	TERRA	AQUA	FY1D	SeaWiFS	NOAA 12	NOAA 14	NOAA 15	NOAA 16	NOAA 17	NOAA 18	TOTAL
JAN	140	142		56	97	102	108	143	160		948
FEB	120	137		50	123	86	129	132	143		922
MAR	135	145		53	149	87	145	126	145		985
APR	133	137		51	99	96	121	140	154		931
MAY	134	148		54	114	102	118	143	158		971
JUN	128	141		55	140	89	144	102	153	71	1023
JUL	136	146		60	154	103	137	69	156	122	1083
AUG	133	140	39	64	185	136	80	152	187	167	1285
SEPT	128	142	124	106	267	210	247	134	224	217	1799
OCT	134	148	140	98	278	232	266	242	245	256	1939
NOV	121	130	128	104	238	238	181	158	231	237	1770
DEC	131	149	122	110	257	225	228	202	256	269	1949

WASTAC Satellite Data Archive 2005



06 Operational Applications 2005

A variety of operational marine, terrestrial and atmospheric products have been developed using locally-received satellite data from the AVHRR, SeaWiFS and MODIS sensors. The principal agencies involved are the Bureau of Meteorology and the Satellite Remote Sensing Services group in the WA Department of Land Information (DLI).

BUREAU OF METEOROLOGY, MELBOURNE

Compiled by Ian Grant, Mike Willmott, David Griersmith, Anthony Rea, Graham Warren

SEA SURFACE TEMPERATURES (DERIVED FROM NOAA DATA)

The Bureau of Meteorology calculates satellite derived sea surface temperatures (SSTs) for the Australian region by combining data from the WASTAC Perth station with similar NOAA AVHRR data from its Casey, Crib Point (Melbourne) and Darwin stations. The algorithms currently in use are the Non-Linear SST (NLSST) algorithms derived by NOAA/NESDIS (see for example http://coastwatch.noaa.gov/poes_sst_algorithms.html). The Bureau AVHRR data is navigated, calibrated, cloud cleared in real time and the processed orbit is available within an hour after the completion of the ingest. The resulting SSTs for a particular orbit are then sent to Melbourne for inclusion into the Bureau's national data set. The data is then quality controlled against SST data collected from ships and drifting buoys prior to being mosaiced into a national map. These data are mainly used in support of internal and defence operations (e.g. assimilation into Bureau numerical weather prediction models) but are also available to external users as metadata and browse images of daily mosaics (since November 1998) via the world wide web at http://www.bom.gov.au/nmoc/archives/SST/. The SST grid data are archived as part of Australia's National Climate Record.

Navigation to an accuracy of around 1 km or better is achieved with the Common AVHRR Processing System (CAPS), using the Clift navigation model and orbital information from CSIRO Marine Research (Hobart).

Verification of the computed SST fields is carried out automatically after each individual orbit is processed. SST temperatures are compared to ship and buoy sea-temperature observations which are co-located in both space and time. Observations within 3 hours of the nominal AVHRR image time are accepted. The results of the comparisons are produced in both graphical and tabular formats and are accessible via the Bureau internal web. Statistics for this verification system have been kept since July 1999. Typical RMS errors (usually around 1K) for the satellite-observed minus ship/buoy observed SSTs are shown in Figure 1, with a typical bias (for September 2004 to March 2005) of -0.14 (NOAA-17), 0.03 (NOAA-15) and -0.16 (NOAA-12) degrees.

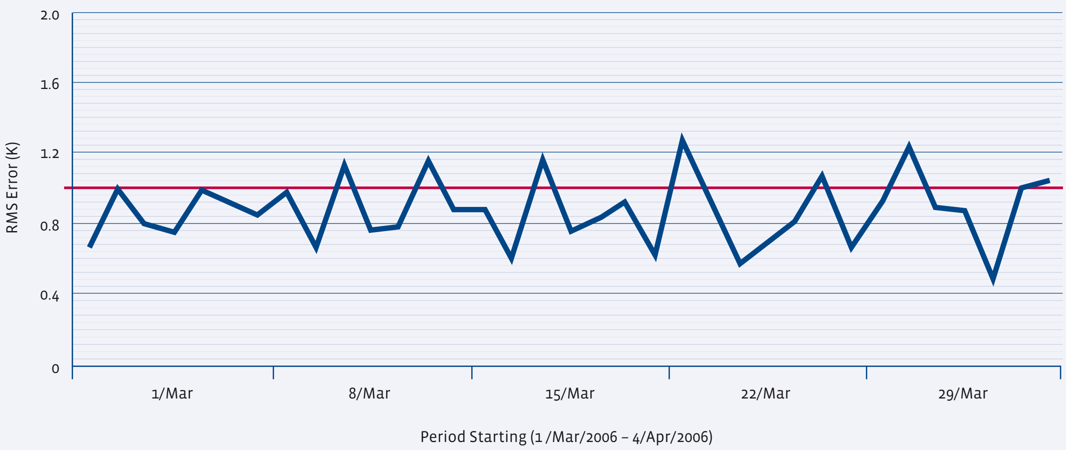


Figure 1: Average RMS error computed by taking the sum of the squares of the SST errors (satellite versus ground truth), dividing by the number of observations, subtracting the square of the bias and taking the square root. The red line on the graph represents an RMS error of 1.0 degree Kelvin.

These SST data are used by the Bureau/CSIRO/Navy collaborative BLUElink project as input to the SST analysis system which BLUElink is developing for ocean nowcasting and forecasting applications. While this system uses global SST data from a variety of satellite sensors, the AVHRR data from WASTAC and the other Australian sites are particularly valuable because of their timeliness and fine resolution.

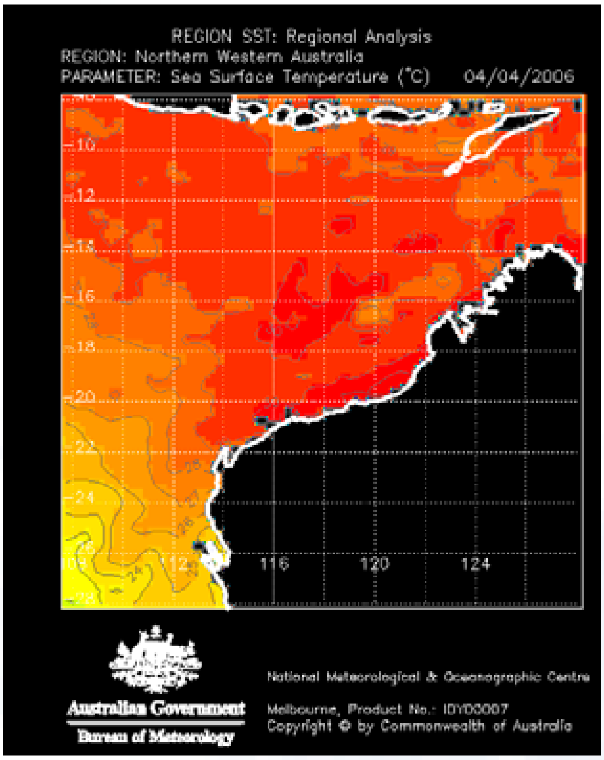


Figure 2: Daily regional contour map of satellite-derived SSTs in degrees Celsius, on a 0.25 degree grid. This product is available to the public via a registered subscription service.

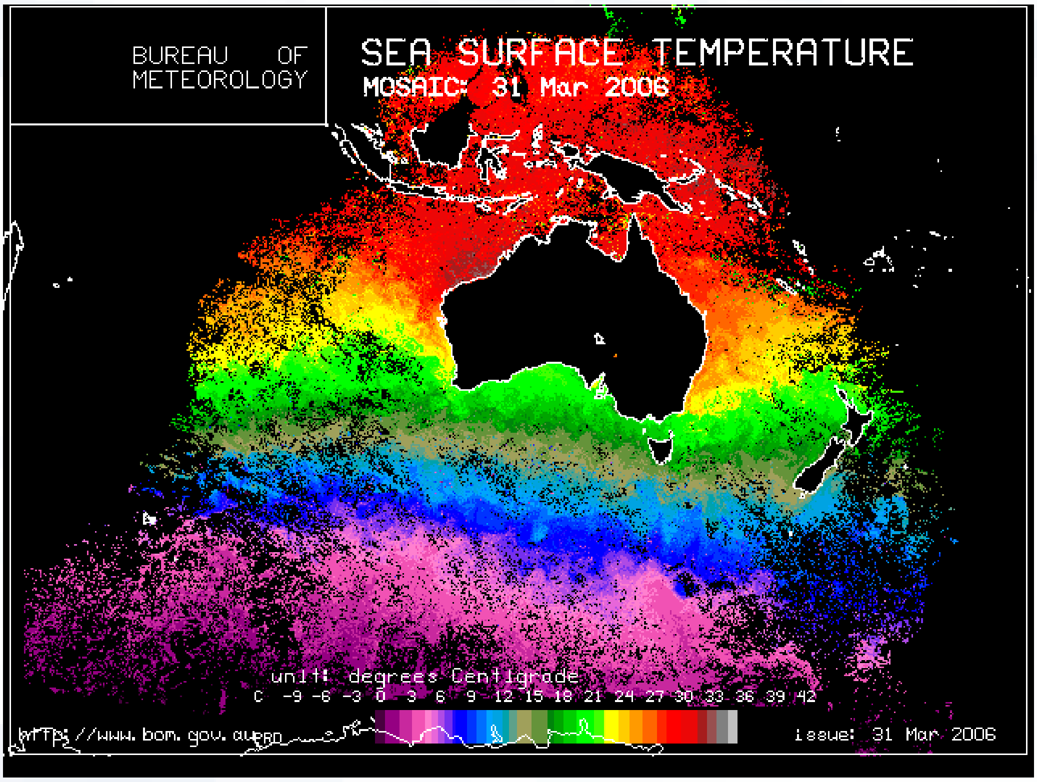


Figure 3: SST product available free to the public via a browse service on the Bureau's web site (www.bom.gov.au). The image shows SSTs at 1:5 resolution.

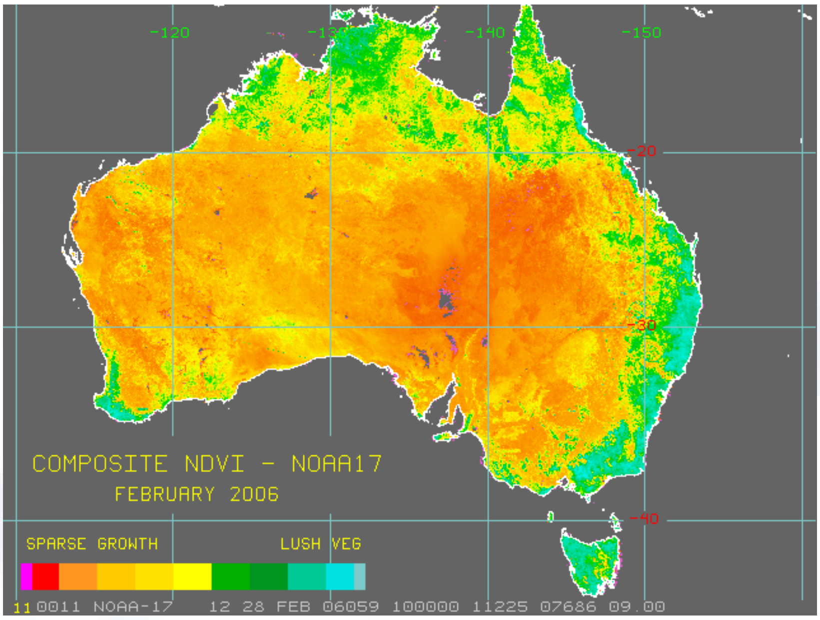


Figure 4: An example of the Bureau's Monthly Maximum Value Composite NDVI product.

NORMALISED DIFFERENCE VEGETATION INDICES (NDVI)

The Bureau currently produces NDVI products using AVHRR data based on Melbourne and Perth WASTAC data. Data are used to monitor monthly changes in vegetation and other drought/climate related matters, such as flood monitoring and burned areas;.

Differential reflectance measurements from channels 1 and 2 of the AVHRR instrument on board the NOAA-17 satellite provide a means of monitoring the density and vigour of green vegetation growth using the spectral reflectivity of solar radiation.

Typically two sequential daytime orbits covering most of Australia are available for processing in near real time each day. Monthly Maximum Value Composite (MVC) NDVI maps in Mercator projection are produced by taking the highest value for each pixel for the month from all the daily composites created from the individual orbits. This minimises data gaps in any particular composite due to cloud interference or missing data and overcomes some of the systemic errors that reduce the index value. See figure 4 for an example of the Bureau's NDVI product.

Precise navigation corrections are being automatically performed using the Common AVHRR Processing Software (CAPS) package developed by CSIRO Atmospheric Research.

GRASSLAND CURING INDEX (GCI)

The Bureau provides an experimental Grassland Curing Index (GCI) product derived from NOAA AVHRR data. The product was developed at CSIRO Atmospheric Research based on field data collected in Victoria in collaboration with the Victorian Country Fire Authority (CFA). The result is a high-quality product which is of great use to a range of customers including regional fire services and various power generation and distribution companies. The product is currently available for Victoria and for South Australia. An example of the Victorian product is given in figure 5.

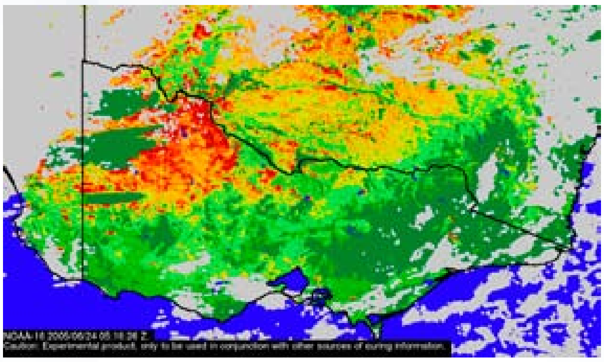


Figure 5: An example of the Bureau's Grassland Curing Index (GCI) product.

The Victorian GCI imagery is produced as part of a cooperative agreement involving the Bureau of Meteorology, the CFA and the CSIRO. CSIRO has provided the software, the Bureau runs it via its Central Computing Facility and relevant operational staff, and the CFA provides validation data and other support. The Bushfire CRC is supporting collaboration between the Bureau, CSIRO and several state fire agencies to develop a GCI product that is validated across Australia.

The product is generated once per day from an afternoon pass of the NOAA-17 satellite, between 04 and 06 UTC (around 3-5pm EDST). In cases where a single NOAA pass does not completely cover the target area (a 'split pass') the product is not generated. Due to the orbital characteristics of the satellite this will happen once every 9 days for each region.

WEATHER MODELLING / FORECASTING

The NOAA satellites carry the ATOVS suite of instruments which measures vertical profiles of atmospheric temperature and humidity, namely the AMSU-A, AMSU-B and HIRS instruments. The Bureau's present operational global assimilation system utilises a One-Dimensional Variational (1D-VAR) retrieval of AMSU-A and HIRS radiances, utilising level 1D radiances as available from NESDIS. An extended version of this global system allows the full forward calculation of ATOVS radiance first guess values in the 1D-VAR retrieval scheme still using level 1D ATOVS radiances. The use of 1C radiances will be examined where each instrument in the ATOVS package will be treated as a separate observation. Processing of locally-derived data can deliver both 1C and 1D radiances which are desirable in support of early cut-off regional assimilation. The Bureau is currently processing HRPT data received at WASTAC, Darwin and Crib Point (south of Melbourne) to level 1D using the ATOVS and AVHRR Processing Package (AAPP) from EUMETSAT. Figure 6 shows an example of AMSU-B radiances from the level 1D output from the Bureau's AAPP system.

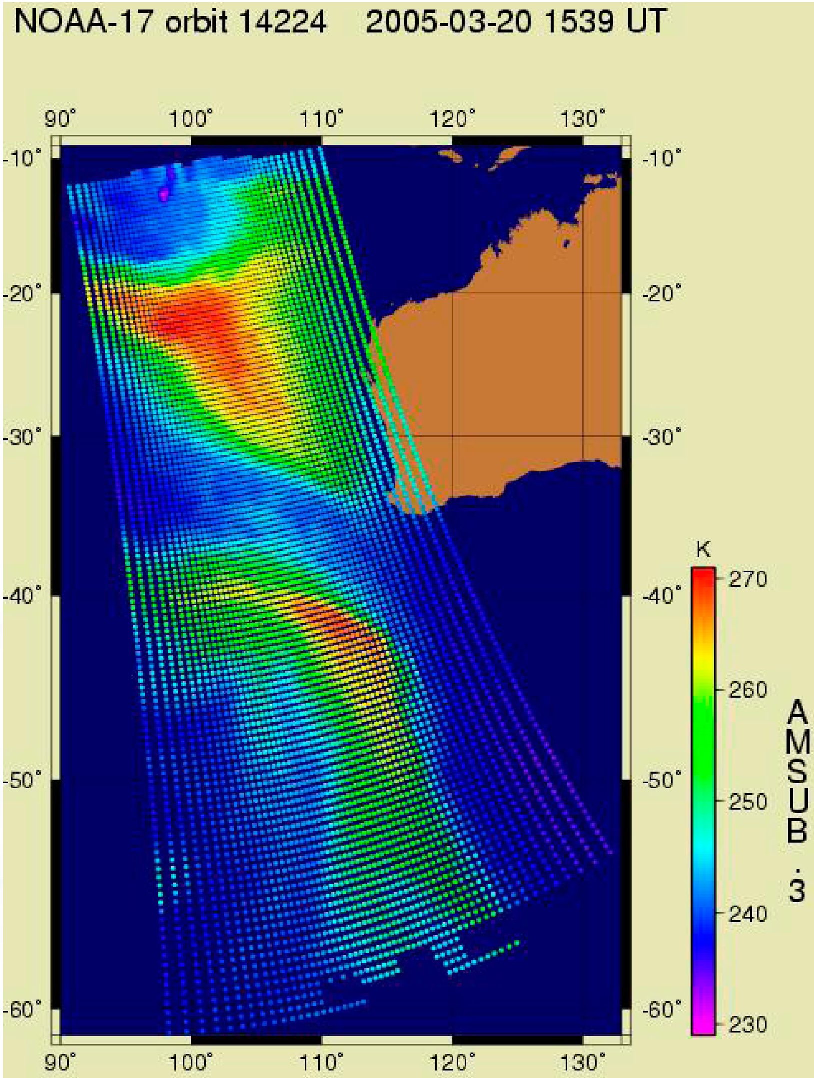


Figure 6: Microwave brightness temperatures from channel 3 of the AMSU-B instrument on NOAA-17 on 20 March 2005 at 1539 UTC, processed and regridded by the AAPP package.

The online 1D-VAR ATOVS radiance retrieval scheme, implemented operationally within the global system (GASP), has also been integrated with the Bureau's Limited area Assimilation and Prediction System (LAPS), as part of the effort to unify the data assimilation component of the local and global forecasting systems. The 1D-VAR retrievals are used over the sea and at pressures less than 100 hPa over land. Work is underway to test the 1D-VAR system in an extended version of LAPS with an increased number of vertical levels and the model top raised to 0.1 hPa, following similar extensions to GASP. This eliminates the need for NESDIS retrievals and will facilitate the use of locally received and processed ATOVS radiances whose timeliness will improve the amount of data available to the operational LAPS system.

The Bureau of Meteorology and other national meteorological agencies in the Asia-Pacific region are planning the Regional ATOVS Retransmission Service (RARS) for the mutual exchange of near-real time ATOVS products. Initial tests were conducted in 2005, and pre-operational routine exchange will commence in 2006. Through RARS, WASTAC will serve as a node in a regional NOAA reception network that will give the Bureau's numerical weather prediction systems access to timely ATOVS products from across the region.

VOLCANIC ASH

Work is continuing on the use of AVHRR (and GOES-9) satellite data for the discrimination of volcanic ash clouds from water/ice clouds and reduction in the incidence of false alarms. The Bureau's Volcanic Ash Advisory Centre (VAAC) in Darwin provides advice on volcanic ash clouds within its area of responsibility for the aviation industry. The advisory messages are based on advice from aircraft, vulcanological authorities, NOAA and GOES-9 satellite imagery and a volcanic ash trajectory forecast model. Even though the Volcanic Ash Advisory Centre is located in Darwin, the AVHRR data from Perth is used for full coverage of Darwin's area of responsibility. By way of example, in 2002 Darwin issued a total of 224 advices covering the area south of 10°N between longitudes 100° E and 160° E. The Bureau is planning to use MODIS data from WASTAC in further R&D efforts to monitor ash clouds.

The Volcanic Ash Advisories (VAAs) issued are based on an initial report or detection of a volcanic eruption or ash cloud, an analysis of satellite data to identify and track the ash cloud, and a short term forecast of the ash movement based on upper level winds and a numerical dispersion model. In the event of a volcanic eruption the provision of timely warnings is critical if the risk of an aircraft encounter with the ash is to be minimised.

FOG / LOW CLOUD

The fog/low cloud program developed by Bureau of Meteorology Research Centre is aimed at improving our understanding and forecasting capability for fog. These forecasts are critical to efficient and safe aircraft operations. The low cloud software mosaics AVHRR infrared imagery onto a latitude-longitude grid, using near real-time NOAA-15 and -17 satellite data received at WASTAC and Melbourne. Products are available within 10 minutes of the satellite pass being received, and are geometrically calibrated to within one pixel (1 km).

Daytime low cloud detection is produced using NOAA-15 data. Daytime detections are obtained by taking advantage of the high reflectivity of water clouds in the 3.7-micron channel compared to lower reflectivity and higher emissivity of the ground. If the 3.7-micron channel is warmer than the 11-micron channel by approximately 14K, then cloud is flagged. Subsequent checks eliminate cloud that is too cold or (where the ground is visible) too high off the ground.

Nighttime low cloud detection is performed using channels 3 and 4 from NOAA-15 and -17 data. Emittance of low altitude water clouds (with small droplets) at nighttime approximates blackbody emittance in NOAA channel 4, but not in channel 3, therefore $T3 < T4$. Clouds composed of large droplets and/or ice crystals are not detected.

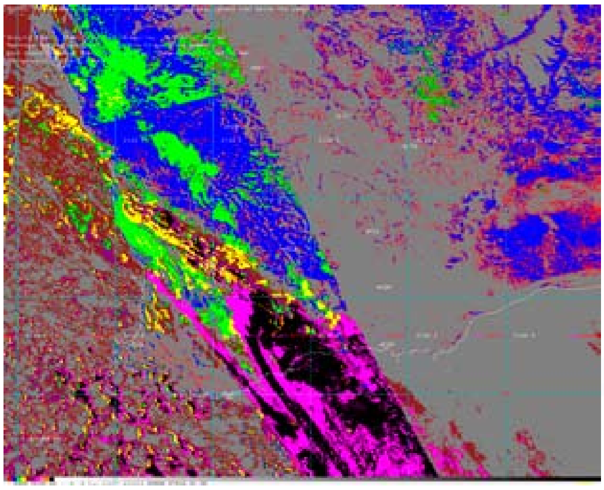


Figure 7: Cloud mask of the southern portion of Western Australia, 2 July 2005. Colours on the cloud mask mean: gray – no cloud detected; red – rejected fog / low cloud; blue – very low cloud / fog; green – low cloud; yellow – low cloud but tops clearly distinct from ground (ex ch3-ch4); brown – dull cloud, low and/or thin (ex neighbouring pixel check); purple – bright cloud, mid and/or thick (ex neighbouring "surface" check); magenta/pink – cirrus and cloud edges; orange – cold cloud, ice or large water droplets; black – cold cloud, probably ice.

Recent improvements to the software include improved cloud height assignment with the use of topography and a land-sea mask, use of temperature rather than brightness values (for greater thermal resolution) and better quality control. For example, nominally low cloud pixels (from ch3 - ch4 test) are rejected, and shown in red on the cloud mask. The cloud mask was also improved to better detect low cloud pixels. See Figure 7 for an example of a cloud mask.

CYCLONE MONITORING

The Bureau's Western Australian Regional Forecasting Centre in Perth provides warnings of tropical cyclones whenever the need arises from its Tropical Cyclone Warning Centre (TCWC). The AVHRR data is used to assist in the monitoring of fine detail of tropical cyclones and supplements the positioning of these large systems by radar, MTSAT-1R imagery and NWP analysis. It is also a critical back-up to MTSAT-1R imagery. As an example, Figure 8 shows tropical cyclone Glenda approaching the Pilbara region of Western Australia on 30 March 2005 at 0133 UTC.

FIRE WEATHER FORECASTING

The Bureau issues Fire Weather forecasts and warnings as part of its public weather forecast and warning service. In support of this service the Bureau has developed fire detection algorithms for use with AVHRR data. The data received from WASTAC provides coverage for Western and South Australia. See Figure 9 for a hotspot image of fires near Perth in early 2005.

MODIS AND AIRS DATA

The Bureau is using IMAPP (International MODIS and AIRS Processing Package) software from University of Wisconsin for developmental processing of AIRS sounder data and MODIS high resolution imagery. The Bureau plans to establish operational systems which would use the WASTAC X-band antenna MODIS data in real time. The Bureau will use the operational products produced in support of its forecasting requirements. These products will include fog/low cloud detection and cyclone intensity monitoring.

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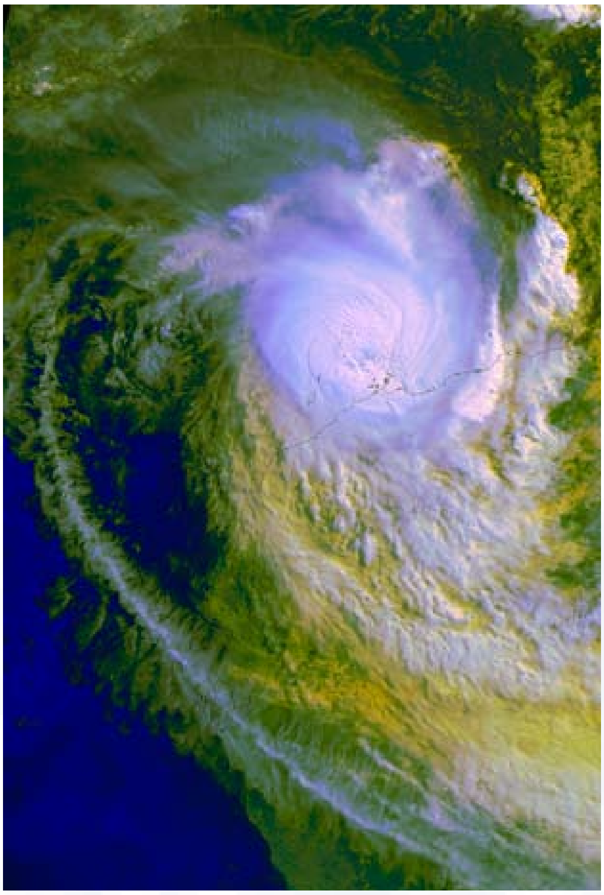

Figure 8: Tropical Cyclone Glenda bears down on the Pilbara region of Western Australia. Image taken from NOAA-14, 30 March 2006 0133 UTC using channels 1, 4 and 5.

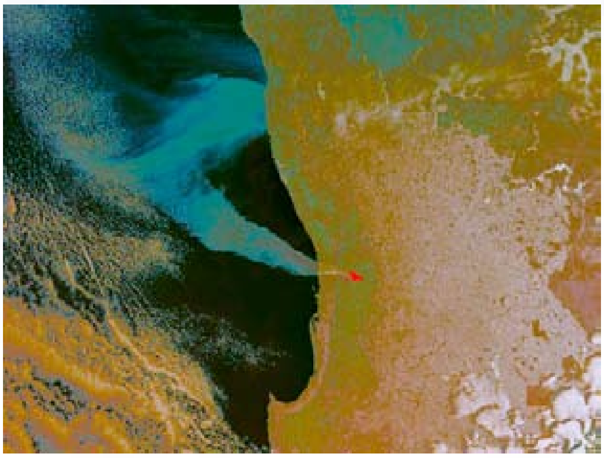

Figure 9: Fires near Perth taken from NOAA-15 on 18 January 2005 at 2200 UTC. This false colour image has been derived using channels 3, 4 and 5. The hot spots can be seen as the red pixels

DEPARTMENT OF LAND INFORMATION

Satellite Remote Sensing Services

VEGETATION WATCH

J. Adams, I.Khokhar.

The Vegetation Watch project involves the creation of weekly, fortnightly and semi-monthly NDVI composites from MODIS and NOAA data sourced from 6 different receiving stations across Australia. These stations include WASTAC's NOAA station at Curtin University and also its MODIS/NOAA station located at Murdoch University. Composite data is supplied to Dept of Agriculture WA, Australian Plague Locust Commission for location of potential locust breeding sites and ERIN for use in its exceptional circumstances program. NDVI is also used as a baseline dataset for the Pasture Growth Rate (PGR) and Food On Offer (FOO) programs. Hardcopy images are sent monthly to many regional FESA, AgWA and CALM offices. Vegetation watch imagery from MODIS data, both as daily images and weekly composites, can be viewed online (at http://vegetationwatch.dli.wa.gov.au) where NDVI time traces can be performed through the entire MODIS NDVI historical dataset (see figure 1).

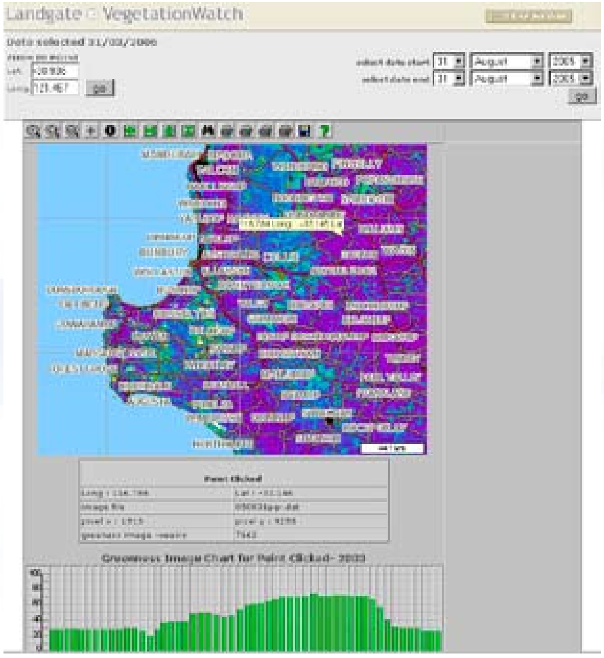

Figure 1: Example MODIS NDVI composite image of southwest WA from Vegetation Watch website. The 2003 time trace shown uses the earliest data processed from MODIS. Later years are graphed beneath the one shown allowing comparison across and between seasons.

SEA SURFACE TEMPERATURE (SST)

J. Adams

SST data derived from both MODIS and NOAA-AVHRR sensors are routinely generated for each satellite pass received from 6 stations located around Australia (including both WASTAC receiving stations)(Figure 2). These datasets are then forwarded to a partner agency in Canberra called Earthinsite, who have developed a website at seasurface.com which features continental SST imagery for the past week. Clients can access data by Single Purchase, Multiple Purchase Packs and by Unlimited Use Packs (Weekly, Quarterly or Annual). Clients can further refine their requirements for Multiple Purchase and Unlimited Use Packs for a small additional fee by nominating their area of interest under the SST Express service. This then allows the user to be taken straight to images which have data covering their specified area and optionally processed in a way suited to the client. Other options available cover slow internet connections and group discounts for fishing cooperatives. SST data is also supplied to the Royal Australian Navy who assist in improvement of this service. Chlorophyll data from the MODIS sensor is currently being trialled to enhance SST-related information.

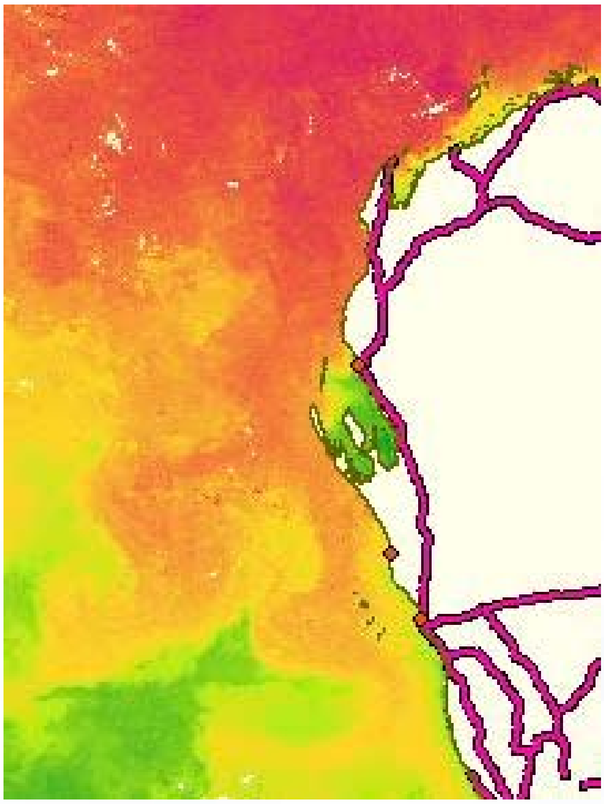

Figure 2: 4-day composite SST image from July 2005 for the northwest of WA.

PASTURES FROM SPACE - MODIS FEED ON OFFER

Richard Smith, Matthew Adams, Stephen Gherardi[1], Richard Stovold, Stewart Gittins[1]
[1]Department of Agriculture, Western Australia

In Mediterranean annual pastures, green Feed on Offer (FOO) following the break of season is a critical determinant of grazing animal intake. Sheep can achieve positive energy balance once levels reach between 500 and 1000 kg/ha. Improved stocking rate and supplementary feeding decisions require an accurate knowledge of FOO during the period of early pasture growth. FOO is not easy to estimate for large areas at frequent intervals. Therefore an attempt has been made to develop a remote method of measurement using the daily coverage of the MODIS sensor at 250 m resolution. To minimise cloud affects a maximum value composite of the Normalised Difference Vegetation Index (NDVI) over a two week period is used.

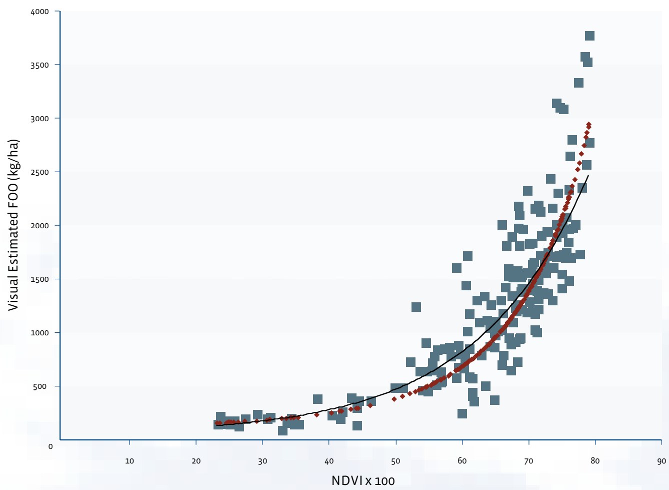

Figure 3: Experimental results in 2005 and predictive model to be used in 2006

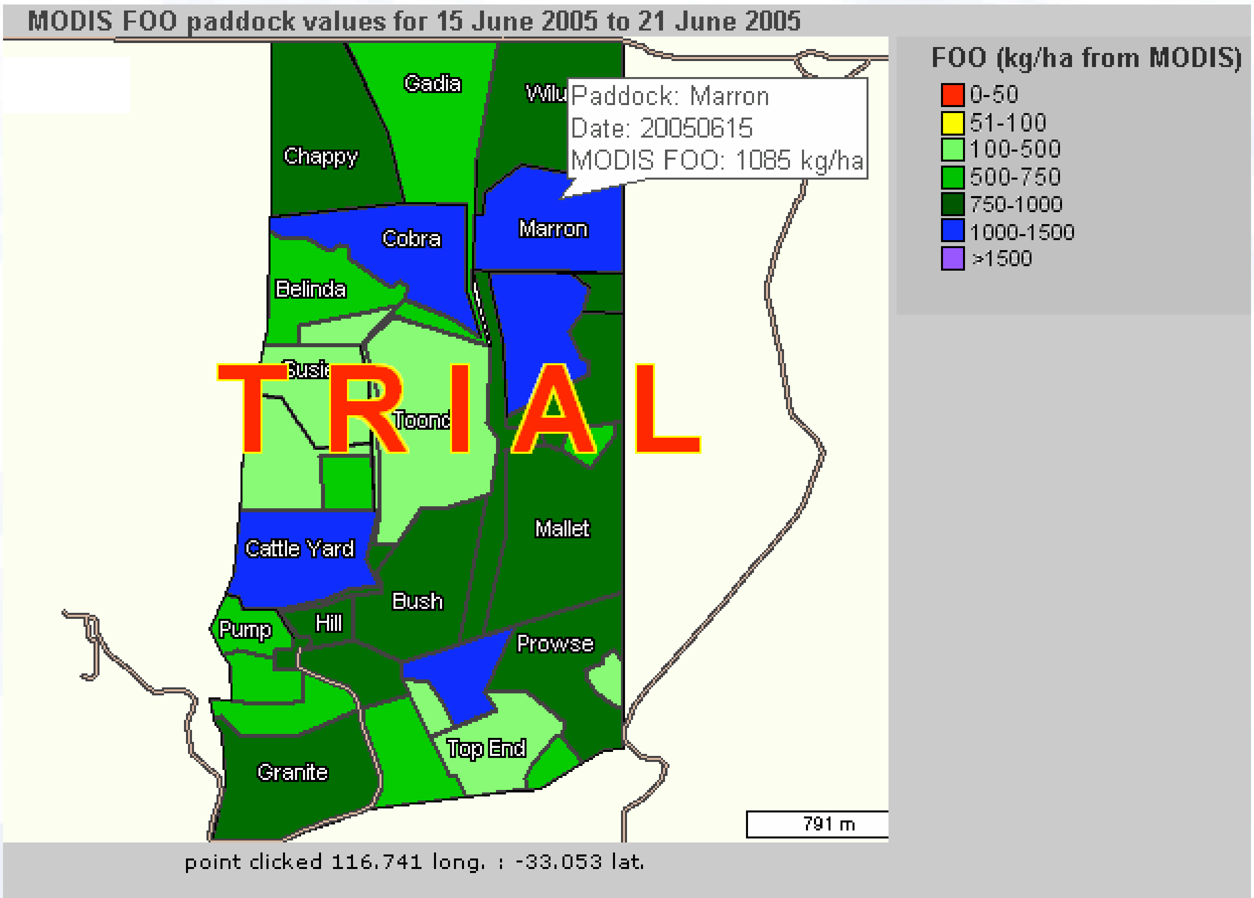

Figure 4: Web map presentation of the FOO product for a Farm with a query of an individual field.

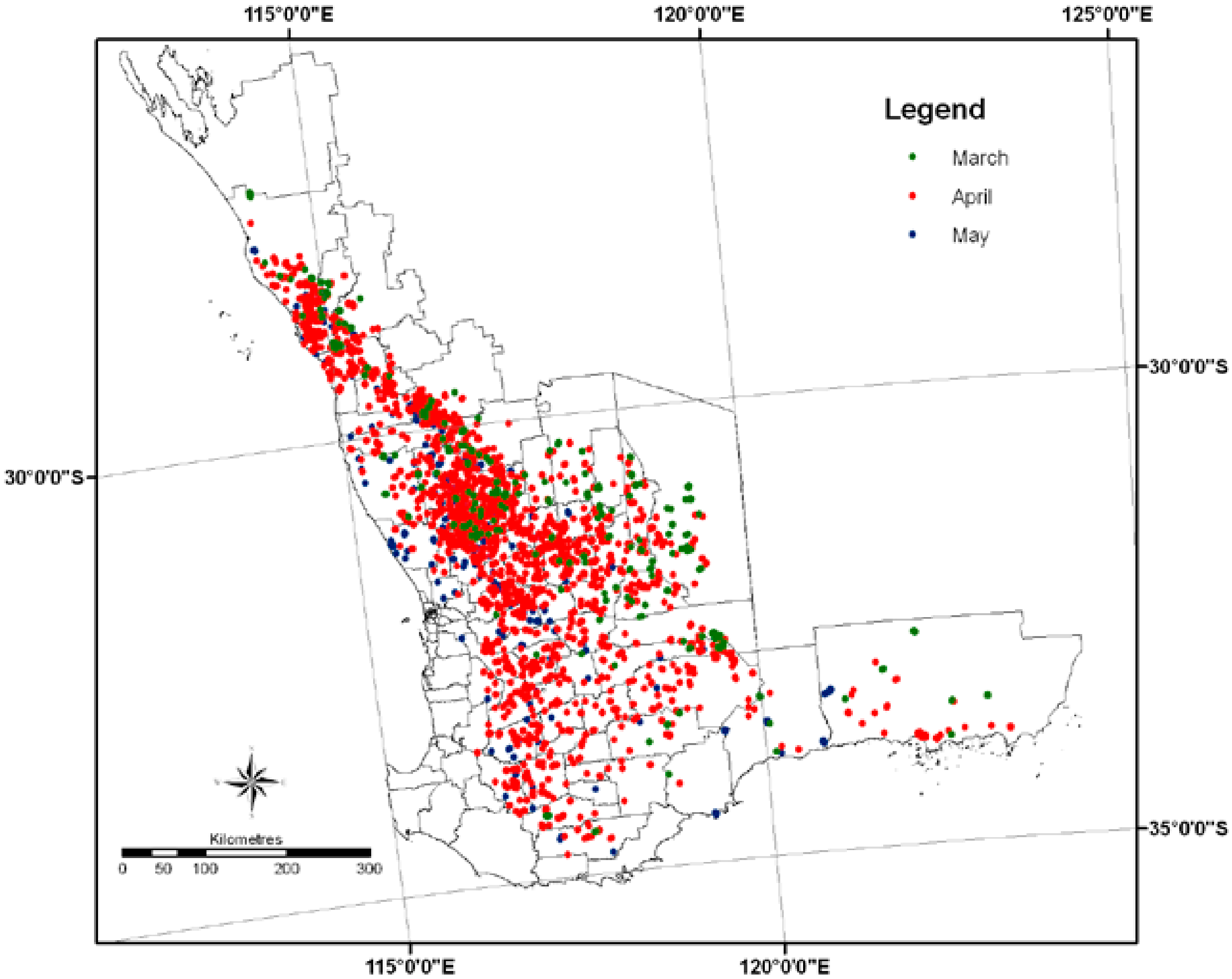

Figure 5 Fire hotspots detected by MODIS for March-April-May 2005 in southwestern Western Australia

The FOO product was developed by relating the MODIS NDVI at field scale to visual estimates of green FOO made by the WA Department of Agriculture in 2004 and 2005. This measure is highly sensitive to FOO between 0 and 1000kg DM/ha (Figure 3). An estimate of MODIS FOO is only valid for the vegetative phase of pasture growth and for FOO levels below 2,000 kg DM/ha.

This is caused by the NDVI being closely related to absorbed photosynthetic active radiation, which depends on leaf chlorophyll content, and leaf area index.

Paddock level MODIS FOO will be made available on a trial basis to subscribers to Pastures from Space via the Web (Figure 4) or Fairport Technologies Pasture Watch software in 2006.

ESTIMATING THE LEVEL OF STUBBLE BURNING IN WESTERN AUSTRALIA FROM MODIS

Richard Smith, Matthew Adams, Agnes Kristina and Ian Maling[1]
[1]Silverfox Solutions Pty Ltd, 1B/1 Sarich Way, Technology Park, Bentley, W. Australia 6102

Using MODIS on Aqua and Terra, 3240 unique fire hot spots (FHS) were detected in the 12 weeks from 1 March to 23 May 2005, in the cropping area of south western Australia (Figure 5). To determine the total area of stubble burning associated with these 3240 FHS, 2066 farmers were surveyed for the number of stubble burns, average area burnt (A), crop types burnt, dates and time of day of burning. Responses were received from 273 farms, 38% of whom reported over 500 stubble burns. The FHS were intersected with the polygons of the farm boundaries to determine the proportion (P) of stubble burns detected by the MODIS sensor.

Total area burnt was calculated from the satellite and survey data as A*3240/P. Only 13% (±3%) of the stubble burns recorded in the farm survey were detected from MODIS. Average field size burnt was 75 ha (±6 ha). The estimated area burnt from these data were 1.87 million ha which is about 27% of the total cropped area in south-western Australia.

Neither cloud cover nor field size was significantly correlated with the detection rate. We concluded that the low detection rate was mainly due to a lack of coincidence between time of the MODIS overpasses and the time of stubble burning in the late afternoon. Therefore additional use of the Advanced Very High Resolution Radiometer daytime fire detection algorithm should improve the accuracy of the technique.

LIGHTNING STRIKES AND FIRE HOTSPOTS

Agnes Kristina

Preliminary research assessed the relationship between burnt areas and lightning strikes within the 11 Interim Biogeographical Regions of Australia (IBRA), from September 2003 to August 2005. The distribution of lightning strikes within burnt areas was determined within the 11 IBRA regions. Highest occurrence of lightning strikes within burnt areas was found in the tropics. (Refer to Figure 6).

On the 2nd of November 2005, Firewatch detected numerous fire hotspots together with lightning strikes in the Pilbara Region, illustrated in Figure 7. Several fire scars were detected from 1 km resolution NOAA AVHRR satellite imagery, using band 2 and band 5. Lightning data is available on the Firewatch website (http://firewatch.dli.wa.gov.au) and is updated every ten minutes.

Figure 6: Eleven IBRA regions with North West Tropics, North Tropics and North East Tropics in red.

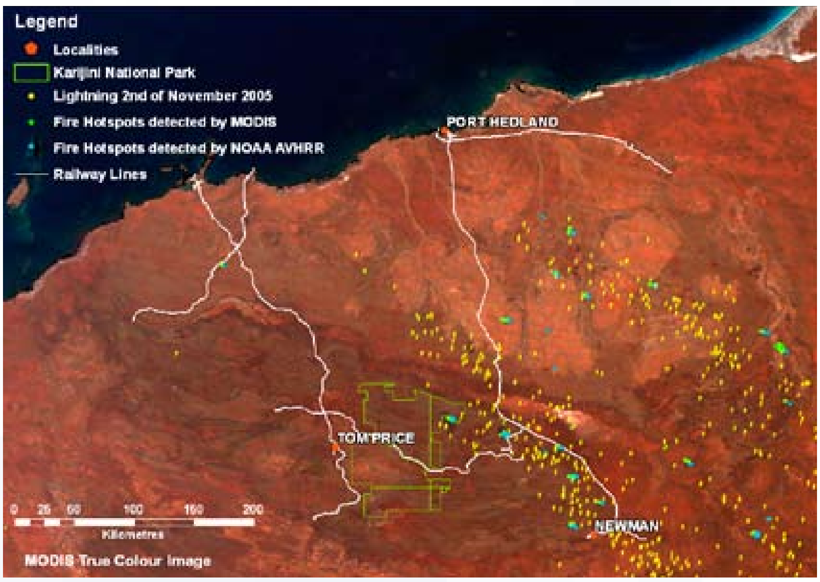

Figure 7: Lightning and fire hotspots detected on the 2nd of November 2005

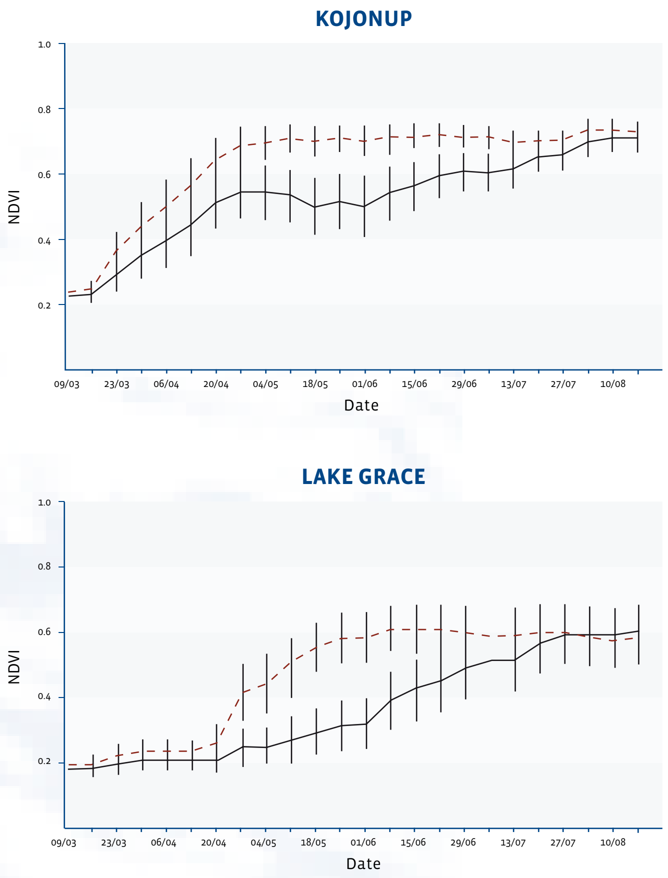

Figure 8: Temporal development of the Normalized Difference Vegetation Index (NDVI) for pasture (dashed line) and crop (solid line) in the Shires Kojonup and Lake Grace, as detected by the classification procedure for 2005. The error bars show the standard deviation.

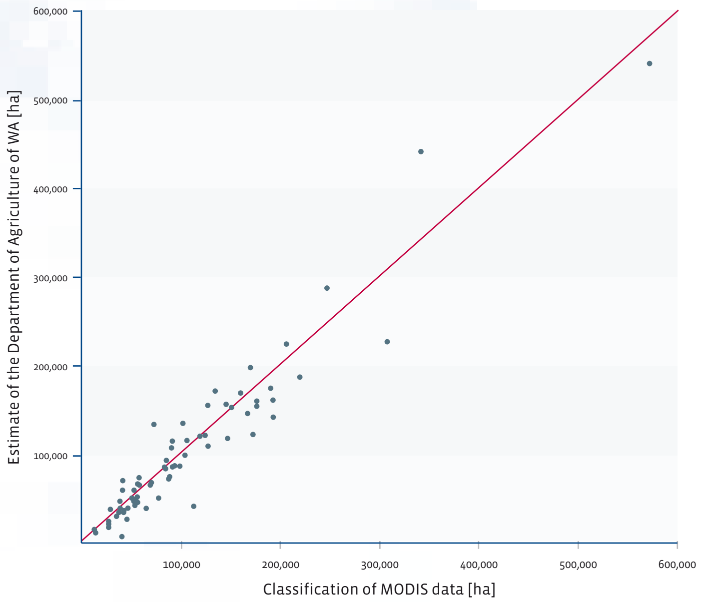

Figure 9: Comparison of the total cropped area derived by the classification of MODIS data taken between May and June 2005 with the estimates of the Department of Agriculture of WA made in November 2005. Each dot represents one Shire.

CROPPED AREA MAPPING FROM MULTI-TEMPORAL MODIS IMAGERY

Richard Smith, Stefan Maier, Ursula Gessner

From year to year the total area which is cropped in the wheatbelt of southwestern Australia changes due to variations in environmental conditions, world prices and agricultural customs.

As a result of tillage practices, cropped paddocks and pastures show different temporal development of greenness following the break of season. This difference in greenness can be used to distinguish crop from pasture by classifying time series of the MODIS Normalized Difference Vegetation Index (NDVI).

Climatic features vary distinctly across the southwestern Australian wheatbelt. This includes differences in the date of the break of season (the onset of rainfall in autumn) and the duration of the vegetation period. In addition, regional farming practices can cause variations in the temporal characteristics of paddock greenness. Figure 8 shows examples for the typical temporal development of greenness of crop and pasture as detected by the classification procedure. The graph of Kojonup illustrates the conditions of a Shire located in the western part of the region of investigation whereas the diagram of Lake Grace shows the conditions of a Shire located in the eastern part. Due to these obvious spatial variations across the wheatbelt, a regional approach for mapping the cropped area has to be applied.

Figure 9 compares the total cropped area per Shire as derived by the classification procedure with the estimates of the Department of Agriculture of Western Australia. The estimate of the Department of Agriculture was made in November 2005, whereas the classification can be performed in June. The total estimated cropped area from MODIS was 7.30 million ha while the total cropped area predicted by DAWA was 6.71 million ha. Some of the difference is probably due to the misclassification of first year's pasture and other poorly developed pastures as crop as well as to uncertainties in DAWA's estimations.

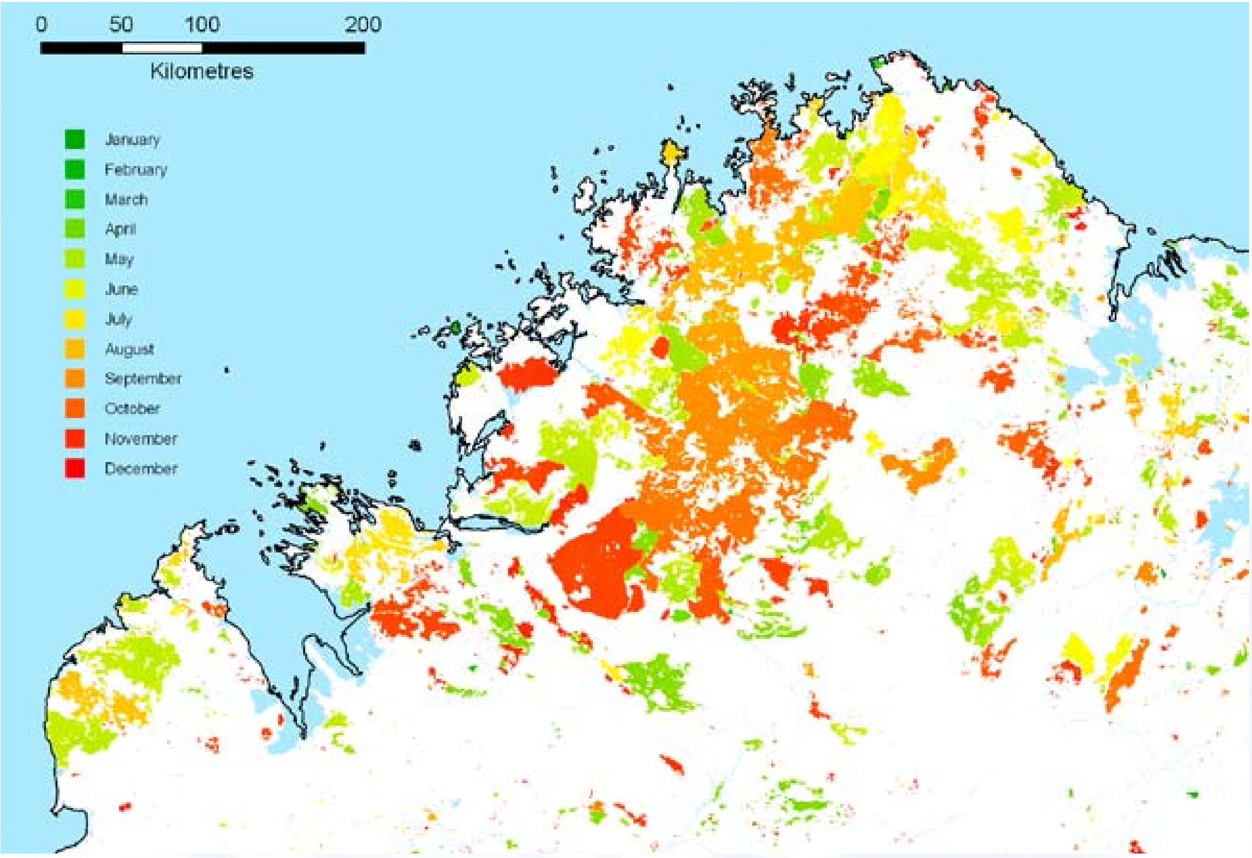

Figure 10: 2005 burnt area map for the Kimberley region of Western Australia. The colours represent the month of burning.

AUTOMATIC BURNT AREA MAPPING WITH MODIS

Stefan W. Maier

The continuous reception via Direct Broadcast (DB) and the quality of the MODIS data makes it possible to automatically map burnt areas in near real time (within a few hours of the satellite observation). This enables fire managers to monitor the progression of fires for managing active fires and for post event analysis. The near real time burnt area product complements the active fire hotspot product by providing a time integrated view which fills the gaps in the active fire hotspot information due to overpass time and cloud coverage. In addition it is available at 250m spatial resolution. The algorithm uses atmosphere corrected surface reflectances and viewing geometry dependant reflectance factor information (BRDF) from previous overpasses to detect rapid changes in surface reflectance associated with rapid land cover changes.

As there are up to two observations available per day (depending on cloud cover), it is possible to determine the approximate day of burning. Figure 10 shows the 2005 burnt area map for the Kimberley region of Western Australia: the different colours represent different dates of burning. Early to mid dry season fires are marked in green to yellow colours whereas the usually very intense and destructive late dry season fires are marked in orange to red colours.

The near real time burnt area maps are being generated on an operational trial base for the whole continent. Future work will include the further validation of the product using high resolution satellite images and ground assessments and the reduction of commission errors due to rainfall events. The burnt area maps are available on DLI's FireWatch web page (http://firewatch.dli.wa.gov.au).

NDMP- FLOODMAP

Andrew Buchanan

The National Disaster Mitigation Programme – FloodMap, is a state and federal government collaborative project consisting of the following agencies- Department of Water, W.A.., Department of Land Information, W.A., Fire and Emergency Services, W.A. and the Bureau of Meteorology (BoM). Its objective is to develop an integrated approach to

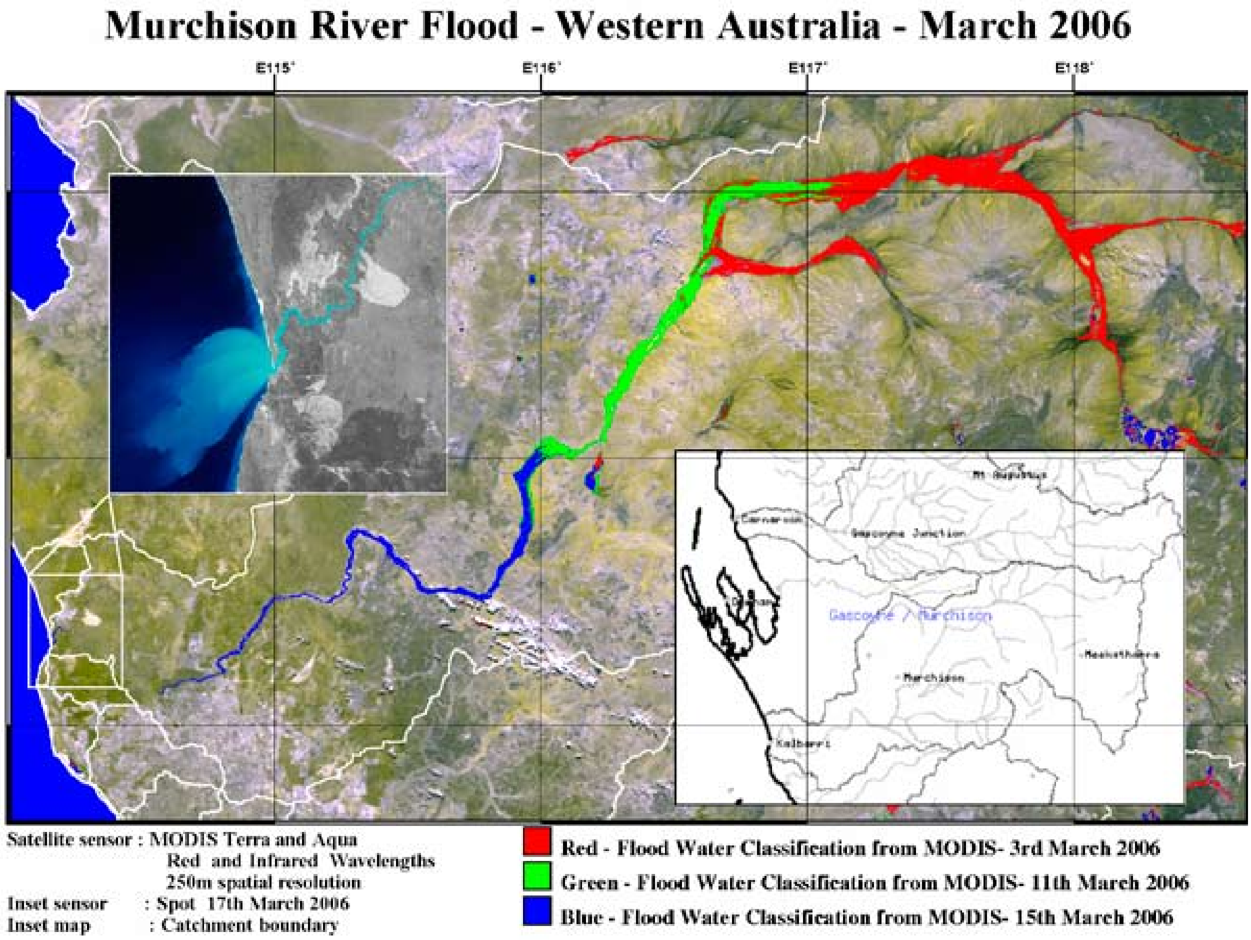

Figure 11: MODIS image of the Murchison River flood in Western Australia during March 2006.

mapping, monitoring and forecasting of flooding in remote areas of Australia.

An example case study of the project is the Murchison River flood in Western Australia during March 2006 (Figure 11). This mostly un-instrumented catchment was monitored in near-real time from daily capture of MODIS Aqua and Terra passes supplied by the WASTAC consortium. The daily monitoring, using the MODIS data, provided the BoM with a powerful aid for its flood forecasting bulletins. The synoptic view and daily updates of surface water movement, provided by the satellite, allowed the BoM hydrologists to estimate the spatial extent of flood water inundation and predict the location of the flood front. In addition the post flood analysis of the archived data has provided the rural and resource sector a valuable environmental risk-management tool.

PASTURES FROM SPACE.

Richard Stovold, Matthew Adams, Sarfraz Khokhar, Graham Donald[1]

[1]CSIRO Livestock Industries

MODIS satellite derived Pasture Growth Rate (PGR) data is routinely being used by farmers to give a weekly measurement of their PGR within paddocks. The PGR information is delivered every week as a subscription service over the internet. The information is being delivered through Fairport Technologies Pasture Watch software to producers in southern Australia.

Farmers in Western Australia and the Eastern States are using this new technology to assist them to improve their management decisions resulting in higher profitability. Farmers are achieving increased pasture utilization using Pasture Growth Rate (Figure 12) and Feed On Offer maps resulting in more wool and profit per hectare.

Farmers have increased their overall sheep gross margin by AUD$23 to AUD$90/winter grazed hectare by using this information to increase sheep production and pasture utilisation. The satellite derived PGR data is providing 2-3 weeks lead time and improves farmers confidence level in stock management decisions. Other on farm management uses for the information include improved decisions on grazing rotations, stocking rates, feed budgeting and fertiliser applications .

The Department of Land Information who process the satellite information to PGR measurements based on the CSIRO Livestock Industries PGR model and Department of Agriculture ground data, have set up a new web site within the Farm Channel of their Landgate service with free publicly viewable Pastures From Space information. A 10 year graphical historical PGR product (Figure 13) is presently being tested with farmer groups and consultants. This historical information will allow farmers to view and implement management strategies based on the season trends and assist in whole farm budgeting.

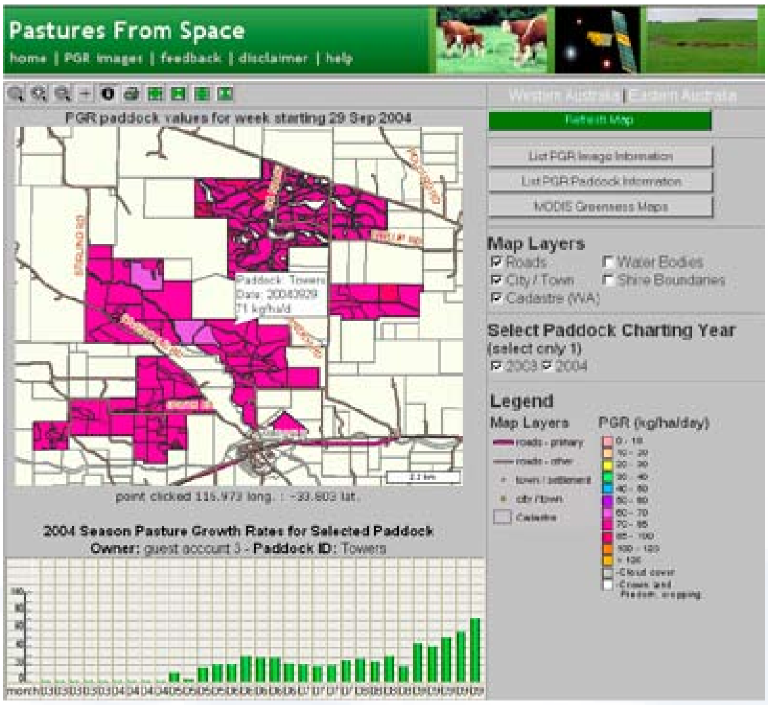

Figure 12: A pasture growth rate map of a farm property delivered weekly to the farmers computer and viewable in Fairports PastureWatch software.

To view the Pastures From Space information visit http://www.pasturesfromspace.csiro.au
To visit the Landgate website http://www.landgate.com.au (go to the Farm channel)
For information on the Fairport subscription service visit http://www.fairport.com.au/pasturewatch

PASTURE GROWTH RATE

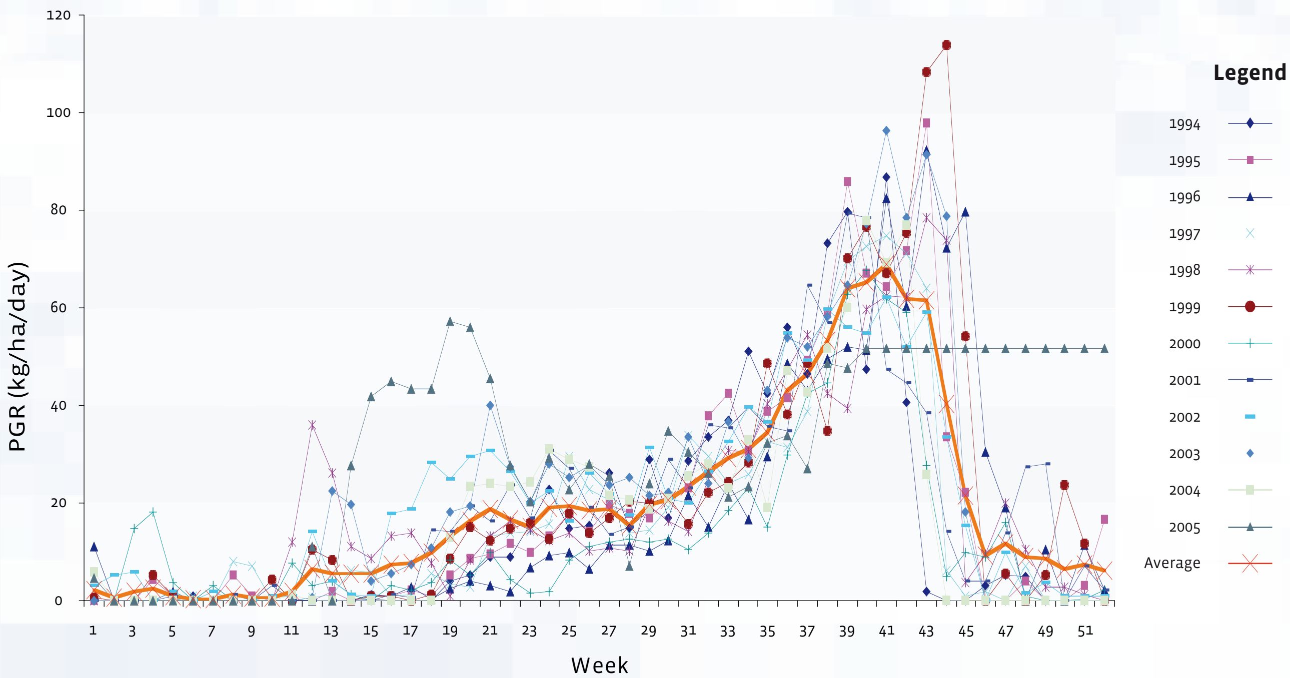

Figure 13: Historical PGR graph. A 10 year weekly trace of Pasture Growth Rates for a property in WA.

07 Research Developments 2005

Investigations of novel techniques for processing and applying satellite data are under way at Curtin University and DLI. This section outlines some of the research being undertaken to underpin and improve the operational products described earlier.

CURTIN UNIVERSITY OF TECHNOLOGY

(Remote Sensing and Satellite Research Group)

REMOTELY SENSING SEASONAL AND INTERANNUAL OCEANIC PRIMARY PRODUCTION FOR WESTERN AUSTRALIAN WATERS

Leon J. Majewski

An algorithm was developed to estimate phytoplankton primary production from remotely sensed sea surface reflectance data (collected in situ or via space based platforms). MODIS-Aqua ocean colour data were input to the algorithm to obtain estimates of phytoplankton absorption, the light field within the water column and primary production at three field sites over the course of the Strategic Research Fund for the Marine Environment (SRFME) field program (2002-2004).

The in situ model was applied to data collected using a hyperspectral profiling radiometer (HydroRad-2) and compared to co-located measurements of primary production. An example of the output for the three SRFME production sites (A, C and E) from the January 2004 field experiment aboard the Southern Surveyor (SS2004/01) is displayed in Figure 1. In general, retrievals at sites C and E fall within 25% of collocated measurements. Retrievals at station A are problematic, with consistent underestimation of production in the shallow (< 15-m) coastal waters.

The model to estimate production from space-based platforms was applied to MODIS-Aqua data over the course of the SRFME field experiments. Figure 2 displays the results at Station C. The general trend of production with time is recreated at stations C and E (not shown), yet some of the variability is not represented.

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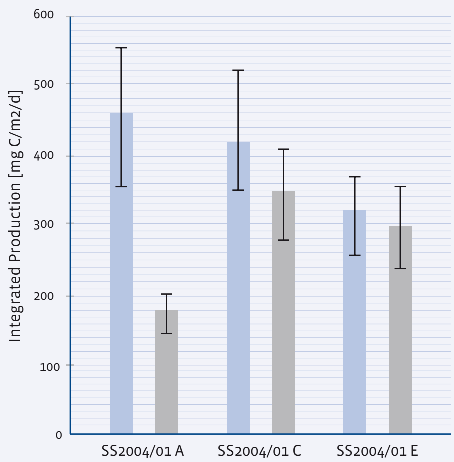

Figure 1: Comparison of measured and modelled primary production at three SRFME stations (A, C and E) during SS2004/01. The blue bars represent 24 hour 14C incubations (courtesy of S. Pesant), while grey bars indicate results from the model using in situ HydroRad profiles. Agreement (within uncertainty) is not achieved at the shallow, coastal site (depth of 15m).

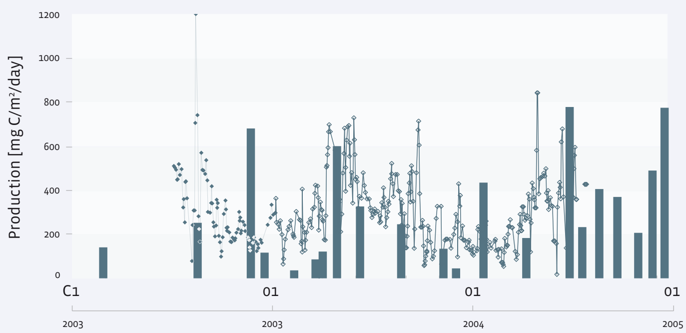

Figure 2: Integrated phytoplankton primary production at station C for the period of the SRFME field experiments. Teal bars indicate the results of 24 hour 14C incubations (courtesy of S. Pesant), connected teal diamonds are remotely sensed estimates (MODIS-Aqua)

DETERMINATION OF AEROSOL OPTICAL DEPTHS OVER BRIGHT TARGETS

Mark Broomhall
Stefan Maier and Brendon McAtee (DLI)

Currently the MODIS institutional algorithms that provide aerosol information (MOD04 and MOD09) are either inaccurate or do not retrieve information over bright surfaces common to the Australian continent. Consequently a method that is more conducive to local conditions that can be run in near-real time is being investigated.

A reflectance change determination is produced operationally at DLI and can be used for a number of processes such as burn scar mapping and cloud masking. This project will extend this process to look at atmospheric constituents. The reflectance change is made possible by the Bidirectional Reflectance Distribution Function (BRDF) produced on a pixel by pixel basis for every MODIS overpass. The BRDF is determined using the previous 7 days of cloud free observation from MODIS data that has been corrected using the Simple Method for Atmospheric Correction code (SMAC). The actual observation used in the reflectance change determination is also corrected using SMAC. The SMAC code currently uses fixed inputs for most atmospheric constituents (apart from atmospheric pressure). Ozone and water vapour information will soon be included meaning that the only significant atmospheric contribution to the satellite received signal will be from aerosol. The BRDF is essentially a slowly varying average of surface reflectance. The atmospheric contribution (especially that from aerosols) will change far more rapidly so it is expected that by examining the time-series data the higher frequency variation from the signal induced from the aerosol can be separated.

Figure 3 shows the spectral dependence of the reflectance change signal over a smoke plume in the forest south of Perth in January 2006. As expected the signal is stronger at lower wavelengths and almost non-existent at higher wavelengths in accordance with Mie scattering theory. This would indicate the presence of aerosol rather than an actual change in surface reflectance. Some actual changes in surface reflectance can be seen in bands 2 and 5 where the fire scar at the far right of the plume is visible. Band 7 shows what is most likely the active fire. Due to the size of the fire the emission is actually greater than the surface reflectance over this area so it appears as a red halo where the fire is burning.

It is anticipated that this work will lead to an inversion scheme to extract aerosol properties (specifically aerosol optical depth) from MODIS Direct Broadcast time series data to provide near real-time input to the atmospheric correction for the WASTAC surface reflectance products.

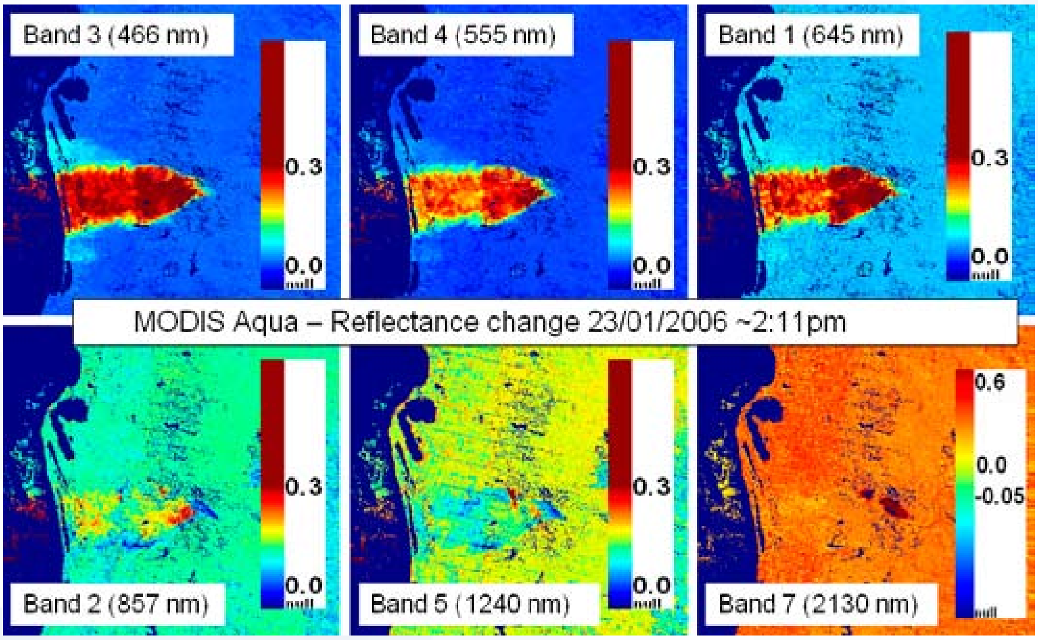

Figure 3: These images shows the reflectance change determined by subtracting the forward predicted BRDF bottom of atmosphere reflectance from the bottom of atmosphere actual reflectance after simple atmospheric reflection. Each image shows the reflectance change for one of the MODIS reflectance bands.

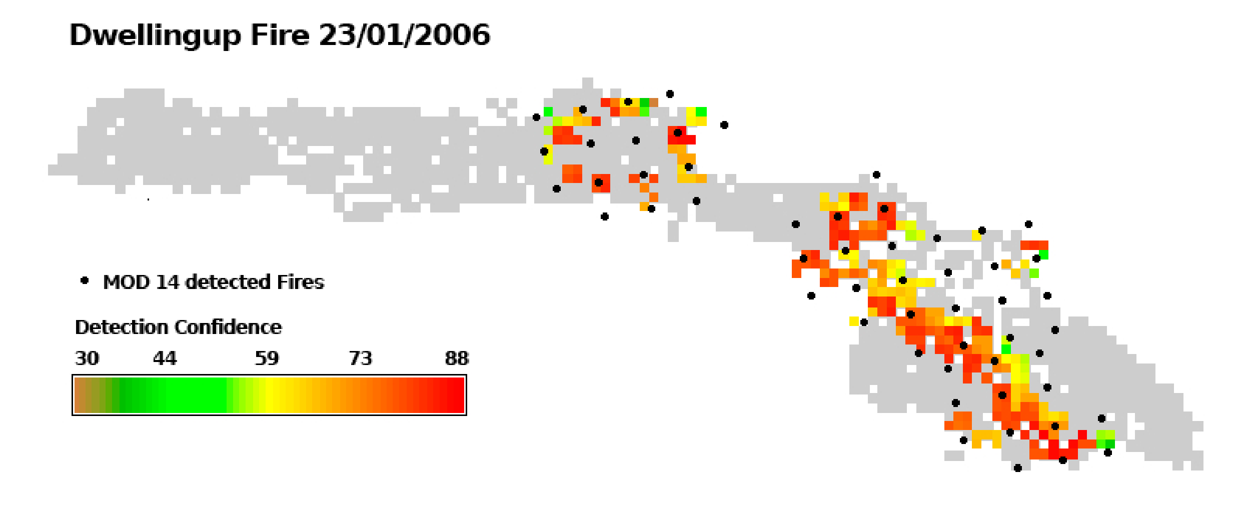

Figure 4: MODIS image showing the fire south of Dwellingup on the 23rd of January 2006. The coloured areas are fires detected from the 2.1 micron data. The black dots show the corresponding detections of the MOD14 algorithm at 1 km resolution. The grey area outlines the burn scar caused by the fires between the 22nd and 24th of January.

HIGHER RESOLUTION FIRE DETECTION FROM MODIS

Florian Goessmann

Current algorithms to detect fires from MODIS only make use of its thermal channels. Their spatial resolution is thus limited to 1 km. The main objective of this study is to develop a methodology that allows the detection of fires at a higher spatial resolution without compromising the spatial coverage and timeliness of current algorithms.

Simulation of fire contaminated MODIS data (figure 4) has shown that, providing its average temperature is above a certain threshold, a fire significantly contributes to a pixel's spectral radiance in the 2.1 micron channel (500 metre resolution) of MODIS. Combining MODIS observations at 2.1 microns with the Bidirectional Reflectance Distribution Function (BRDF) data from previous observations as an estimate of the expected reflectance, it is possible to detect fires from MODIS at 500 meter resolution.

This has the potential to help those responsible for fire management locate the areas of high fire intensity more precisely as well as to provide new means of validation of other fire observation products.

DATA ARCHIVING DEVELOPMENTS

Mark Gray

RSSRG staff in partnership with the advanced computing centre iVec are developing a prototype system for archiving data and providing simple, timely access to WASTAC data and related data products. The current system design has two primary elements;

1) A facility for processing direct broadcast data from current satellites (under development).

2) A spatial database application for quick access to data storage, meaningful data searching and an on demand processing system for product retrieval (to be developed).

The partnership with iVec means that the WASTAC archive will have significant computing power available for processing of the data in the archive. In addition, location of the data at the WASTAC facility with modern, online storage means that the entire WASTAC data archive will be available to WASTAC members at all times. Long time-series applications and access to advanced data products will become enormously simplified and WASTAC users can experiment with advanced applications free of the burden of data management.

DEPARTMENT OF LAND INFORMATION

Satellite Remote Sensing Services

SENSITIVITY OF SURFACE REFLECTANCE TO ATMOSPHERIC PARAMETERS

Brendon McAtee

As part of the ongoing development of an operational system for the atmospheric correction of reflectance data from the MODIS satellite sensor in Near Real-Time a sensitivity study was conducted to assess how heavily atmospheric parameters impact the surface reflectance measured by MODIS.

The three atmospheric parameters investigated were Aerosol Optical Depth (AOD), water vapour and ozone concentration.

The figure illustrates that AOD is the most important parameter in the visible part of the electromagnetic spectrum. On the X axis the scale shows change in AOD at 550 nm from a mean value of 0.6 . This simulates measurement uncertainty in the AOD values used in the atmospheric correction process. The modelled reflectance retrieved MODIS is on the y-axis. These plots are of data for a surface with an assumed reflectance of 0.05, ozone concentration of 300 DU and water vapour concentration of $2g/cm^2$. A change in the simulated reflectance from its value describes the impact of the atmosphere upon the signal reaching the satellite sensor.

In the figure, from left to right the ozone concentration of the atmosphere used in the simulations increase from 200 DU to 400 DU. From top to bottom, the water vapour concentration increases from 0 g/cm^2 to 4 g/cm^2. It is clear that differences between the curves from left to right and top to bottom are far less significant than the change in retrieved surface reflectance as the AOD varies as denoted on the X axis. The figure makes it clear that AOD is the parameter of greatest importance in the atmospheric correction of MODIS bands 1 to 7.

In each of the figures, the order of MODIS bands plotted, from most affected to least affected, is Band 3 (469 nm), Band 4 (555 nm), Band 1 (645 nm), Band 2 (858 nm), Band 5 (2140 nm), Band 6 (1640 nm), and Band 7 (2130nm).

The figure emphasises the results to date which suggest that AOD is the most important parameter in the atmospheric correction process, and that it should be accurately estimated to avoid large errors in atmospherically corrected surface reflectance data.

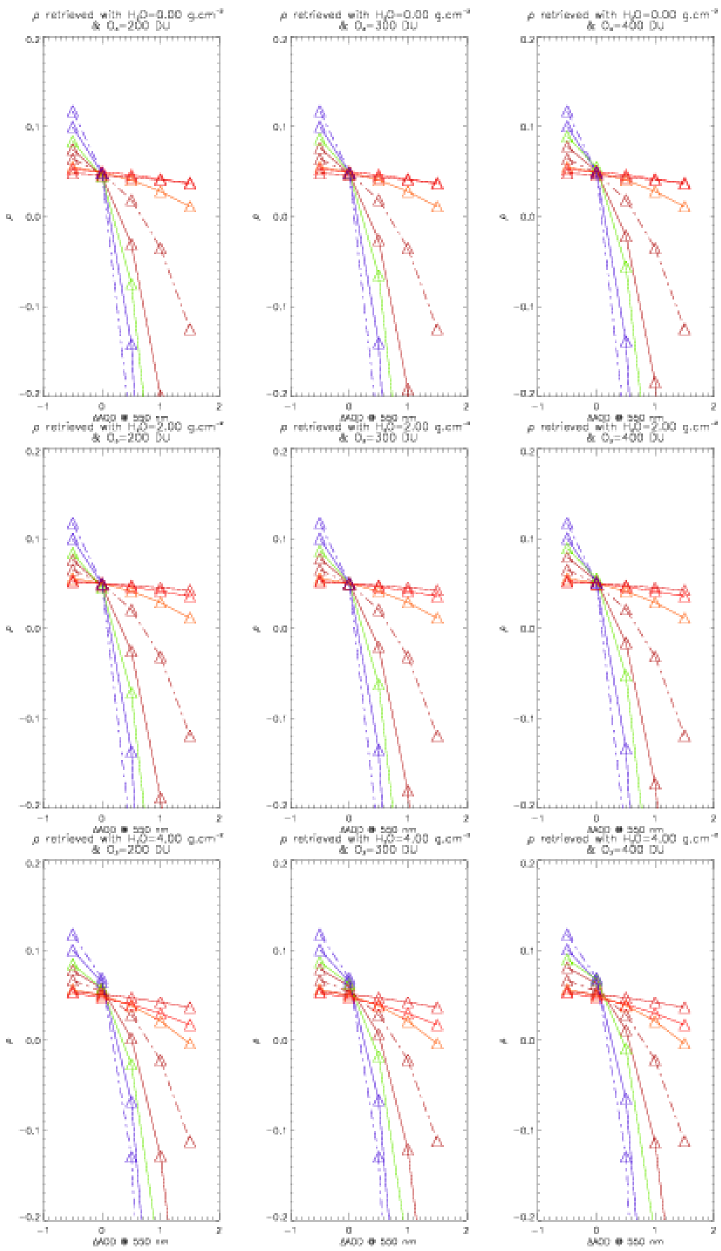

Figure 1: Surface reflectance retrieved from MODIS. Ozone concentration varies along rows. Water vapour increases down the columns and each individual plot is for a different AOD.

WASTAC

ANNUAL REPORT 2005
FINANCIAL STATEMENTS

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WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM L BAND

INDEPENDENT AUDITOR'S REPORT

We have audited the attached financial statements for the year ended 31st December 2005 and in our opinion they fairly represent the transactions of the Consortium pertaining to L-Band for the year then ended, the financial status as at 31st December 2005 and associated cash flows The statements are based on proper accounts and records

STAN PALASSIS
Managing Partner
Stamfords Advisors Consultants

24th July 2006

WASTAC L-BAND BUDGET 2006

		2005	$ per annum 2006
Estimated expenditure for the year, January 2006 – December 2006			
1.	Telstra Rental	7000	4000
2.	Data Tapes	2000	2000
3.	System Maintenance/Repairs	8600	112000
4.	Telecommunications Lic/Maint of Facility	1500	1500
5.	Consultants	2000	2000
6.	Sundry Consumables	1500	1500
7.	Travelling—Airfares	3000	3000
8.	Provision for Major Equipment	12000	12000
9.	Annual Report	10000	10000
	TOTAL:	**$125,000**	**$148,000**
Estimated income/revenue for the year, January 2006 – December 2006			
1.	Contributions received ($10,000 each)	40000	40000
2.	Interest	6000	6000
	TOTAL INCOME:	**$46,000**	**$46,000**
Extra-ordinary expenditure, January 2006 – December 2006			
1.	Capital Reserve:		
1.1	Antenna replacement and componentry	80,000	80,000
1.2	Ingest system LINUX upgrade	0	20,000
	TOTAL:	**$80,000**	**$100,000**

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM
L BAND INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2005

	2005 $	2004 $
REVENUE		
Contributions Received	30,000	50,000
Interest Received	10,824	8,491
Total Revenue	**40,824**	**58,491**
EXPENDITURE		
Telephone Rent & Calls	4,311	6,482
Service and Equipment Charges	1,608	0
Microwave Licences	1,685	2,635
Computer Maintenance Costs	334	209
Application Software	5,578	0
External Printing Costs	6,694	6,436
Other Consumables	1,032	0
Furniture <$1000	-	1,007
Depreciation Expenses	2,105	4,262
Total Expenditure	**23,347**	**21,031**
Net Operating Result for the Year	**17,477**	**37,460**

Michelle Noble
A/Director—Management Accounting

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM
L BAND BALANCE SHEET AS AT 31 DECEMBER 2005

	NOTE	2005 $	2004 $
CURRENT ASSETS			
Cash at Bank		262,868	242,304
TOTAL CURRENT ASSETS		**262,868**	**242,304**
NON - CURRENT ASSETS			
Property, plant and equipment	2	11,162	13,267
TOTAL NON - CURRENT ASSETS		**11,162**	**13,267**
TOTAL ASSETS		**274,030**	**255,571**
CURRENT LIABILITIES			
Accrued expenses		982	-
TOTAL CURRENT LIABILITIES		**982**	**0**
TOTAL LIABILITIES		**982**	**-**
NET ASSETS		**273,048**	**255,571**
EQUITY			
Retained Funds	4	273,048	255,571
TOTAL EQUITY		**273,048**	**255,571**

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM
L - BAND CASH FLOW STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2005

	Note	2005	2004
CASH FLOWS FROM OPERATING ACTIVITIES		$	$
Receipts			
Contributions Received:			
Department of Land Information		10,000	10,000
CSIRO		10,000	10,000
Bureau of Meteorology		10,000	10,000
Curtin University of Technology for 2003			10,000
Curtin University of Technology for 2004			10,000
Interest Received		*10,824*	*8,491*
Total Receipts		**40,824**	**58,491**
Payments			
Payments to suppliers		(20,260)	(16,769)
Total Payments		**(20,260)**	**(16,769)**
Net cash provided by operating activities	**3**	**20,564**	**41,722**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payments for property, plant and equipment		0	(1,168)
Net cash used in investing activities		**0**	**(1,168)**
Net increase/(decrease) in cash		20,564	40,554
Cash at the beginning of the year		242,304	201,750
Cash at the end of the year		**262,868**	**242,304**

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 to all the years presented unless otherwise stated.

(a) Basis of Preparation

The Western Australian Satellite Technology and Applications Consortium (WASTAC) financial report has been prepared in accordance with Australian equivalents to International Financial Reporting Standards (IFRS), other authoritative pronouncements of the Australian Accounting Standards Board and Urgent Issues Group Consensus Views.

Compliance with AIFRS

Australian Accounting Standards include Australian equivalents to International Financial Reporting Standards (AIFRS). Compliance with AIFRS ensures that the financial statements and notes comply with IFRS.

Application of AASB 1 First-time Adoption of Australian Equivalents to International Financial Reporting Standards

These financial statements are the first to be prepared in accordance with AIFRS. AASB 1 First-time Adoption of Australian Equivalents to International Financial Reporting Standards has been applied in preparing these financial statements.

The WASTAC financial statements until 31 December 2004 had been prepared in accordance with previous Australian Generally Accepted Accounting Principles (AGAAP). AGAAP differs in certain respects from AIFRS. When preparing the WASTAC 2005 financial statements, management has amended certain accounting methods applied in the AGAAP financial statements to comply with AIFRS. The comparative figures in respect of 2004 were restated to reflect these adjustments.

Reconciliations and descriptions of the effect of transition from previous AGAAP to AIFRS on WASTAC's equity are given in note 5.

Historical cost convention

These financial statements have been prepared on the accrual basis of accounting using the historical cost convention.

(b) Acquisition and disposal of assets

In accordance with AASB 116 "Property, Plant & Equipment", all property, plant and equipment is shown at cost, less subsequent depreciation and impairment. 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.

All other repairs and maintenance expenditures are charged to the Income Statement during the financial period in which they are incurred.

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

(c) Depreciation of non-current assets

All non-current assets having a limited useful life are depreciated or amortised 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(d)).

(d) Impairment of property, plant and equipment

In accordance with AASB 136 "Impairment of Assets", 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.

2 PROPERTY, PLANT AND EQUIPMENT

	2005	2004
Computer Equipment		
At cost	121,222	121,222
Accumulated depreciation	(121,222)	(121,222)
	0	**0**
Other Equipment		
At cost	190,258	209,758
Accumulated depreciation	(179,096)	(196,491)
	11,162	**13,267**
Total Property, Plant and Equipment	**11,162**	**13,267**

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	-	13,267	13,267
Additions	-	-	0
Depreciation expense	0	(2,105)	(2,105)
Carrying amount at end of year	**0**	**11,162**	**11,162**

3 Notes to the Cash Flow Statement

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

	2005	2004
Net operating result	17,477	37,460
Depreciation expense	2,105	4,262
Movement in Current Liabilities	982	-
Net cash provided by operating activities	**20,564**	**41,722**

4 RETAINED EARNINGS

Balance at beginning of the year	255,571	218,111
Operating surplus/(deficit) for the year	17,477	37,460
Balance at end of the year	**273,048**	**255,571**

5 Explanation of Transition to Australian Equivalents to IFRS

	Notes	At the transition date: 1 January 2004			At the end of last period: 31 December 2004		
		Previous AGAAP 1 Jan 2004	Effect of transition to AIFRS	AIFRS 1 Jan 2004	Previous AGAAP 31 Dec 2004	Effect of transition to AIFRS	AIFRS 31 Dec 2004
(a) This note provides a reconciliation of equity reported under previous AGAAP to equity under AIFRS							
CURRENT ASSETS							
Cash at Bank		201,750	-	201,750	242,304	-	242,304
TOTAL CURRENT ASSETS		**201,750**	**0**	**201,750**	**242,304**	**0**	**242,304**
NON-CURRENT ASSETS							
Property, plant and equipment	1	49,104	(32,744)	16,361	36,549	(23,282)	13,267
TOTAL NON-CURRENT ASSETS		**49,104**	**(32,744)**	**16,361**	**36,549**	**(23,282)**	**13,267**
TOTAL ASSETS		250,855	(32,744)	218,111	278,853	(23,282)	255,571
TOTAL LIABILITIES		-	-	0	-	-	0
NET ASSETS		**250,855**	**(32,744)**	**218,111**	**278,853**	**(23,282)**	**255,571**
EQUITY							
Retained Funds	2	250,855	(32,744)	218,111	278,853	(23,282)	255,571
TOTAL EQUITY		**250,855**	**(32,744)**	**218,111**	**278,853**	**(23,282)**	**255,571**

	Notes	Previous AGAAP	Effect of transisiton to AIFRS	AIFRS
(b) Reconciliation of net operating result for the year ended 31 December 2004				
REVENUE				
Contributions Received		50,000	-	50,000
Interest Received		8,491	-	8,491
TOTAL REVENUE		**58,491**	**0**	**58,491**
EXPENDITURE				
Telephone Rent & Calls		6,482		6,482
Microwave Licenses		2,635		2,635
Computer Maintenance Costs		209		209
External Printing Costs		6,436		6,436
Furniture <$1000		1,007		1,007
Depreciation	1	13,724	(9,462)	4,262
TOTAL EXPENDITURE		**30,493**	**(9,462)**	**21,031**
NET OPERATING RESULT FOR THE YEAR		**27,998**	**9,462**	**37,460**

(c) Notes to the reconciliation

1. PROPERTY, PLANT AND EQUIPMENT

Under the new AASB 136 “Impairment of Assets”, non-current assets are subject to assessment for impairment. Impairment must be measured for classes of non-current assets with indications of impairment. Impairment is measured by comparing the class of assets’ recoverable amount with its carrying amount. The class of asset is considered impaired if the recoverable amount is less than the class of assets’ carrying value.

ADJUSTMENTS TO OPENING BALANCE SHEET (1 JANUARY 2004)

Property, plant and equipment has reduced by $32,744 after the assessment for impairment.

ADJUSTMENTS TO 31 DECEMBER 2004 BALANCE SHEET

Property, plant and equipment has reduced by $23,282. This comprises the adjustment as at 1 January 2004, $32,744, less a reduction in depreciation of $9,462 as a result of the impairment adjustment.

Adjustments to Income Statement for the year ended 31 December 2004
Depreciation expense decreased by $9,462 as a result of the 1 January 2004 impairment.

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WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM X BAND

INDEPENDENT AUDITOR'S REPORT

We have audited the attached financial statements for the year ended 31st December 2005 and in our opinion they fairly represent the transactions of the Consortium pertaining to X-Band for the year then ended, the financial status as at 31st December 2005 and associated cash flows The statements are based on proper accounts and records.

STAN PALASSIS
Managing Partner
Stamfords Advisors Consultants

24th July 2006

WASTAC X-BAND BUDGET 2006	**2005**	**$ per annum 2006**
Estimated expenditure for the year, January 2006 – December 2006		
1. Data Tapes	3,000	3,000
2. System maintenance	145,000	35,000
3. System repairs	4,000	4,000
4. Consultants,product development	20,000	20,000
5. Sundry consumables	2,000	2,000
6. Travelling—Airfares	8,000	8,000
7. Provision for major equipment, plus with holding payment to SeaSpace $31,815 exc GST	20,000	52,000
TOTAL:	**$204,000**	**$124,000**
Estimated income/revenue for the year, January 2006 – December 2006		
1. Annual Contributions ($20,000 each)	70,000	80,000
2. Interest	6,000	6,000
TOTAL INCOME:	**$76,000**	**$86,000**
Additional committed expenditure, January 2007 – December 2007		
1. Receiver upgrade for NPP/NPOES satellites (due in 2007)	80,000	80,000
TOTAL:	**$80,000**	**$80,000**

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM
X - BAND INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2005

	2005	2004
	$	**$**
REVENUE		
Contributions Received	70,000	80,000
Interest Received	10,213	11,813
TOTAL REVENUE	**80,213**	**91,813**
EXPENDITURE		
Outsourced Work	0	46,804
Visiting Specialist	0	3,000
Travel	0	1,374
Venue Hire	0	743
Insurance Premium	2,205	0
Maintenance	12,620	10,896
Computer Equipment Purchase	0	(21,783)
External Printing Costs	2,650	0
IDM Media Costs	2,700	3,200
Other Consumables	709	153
Depreciation	157,437	75,468
TOTAL EXPENDITURE	**178,321**	**119,855**
NET OPERATING RESULT FOR THE YEAR	**(98,108)**	**(28,042)**

Michelle Noble
A/Director — Management Accounting

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATIONS CONSORTIUM
X - BAND BALANCE SHEET AS AT 31 DECEMBER 2005

	NOTE	2005	2004
		$	**$**
CURRENT ASSETS			
Cash at Bank		167,554	222,108
TOTAL CURRENT ASSETS		**167,554**	**222,108**
NON-CURRENT ASSETS			
Property, plant and equipment	2	373,371	416,925
TOTAL NON-CURRENT ASSETS		**373,371**	**416,925**
TOTAL ASSETS		**540,925**	**639,033**
TOTAL LIABILITIES		-	-
NET ASSETS		**540,925**	**639,033**
EQUITY			
Retained Funds	4	540,925	639,033
TOTAL EQUITY		**540,925**	**639,033**

WESTERN AUSTRALIAN SATELLITE TECHNOLOGY AND APPLICATION CONSORTIUM
X - BAND CASH FLOW STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2005

CASH FLOWS FROM OPERATING ACTIVITIES	NOTE	2005 $	2004 $
Receipts			
Contributions Received:			
Department of Land Information		20,000	20,000
CSIRO		20,000	20,000
Bureau of Meteorology		10,000	20,000
Geoscience Australia		20,000	20,000
Interest Received		10,213	11,813
Total Receipts		**80,213**	**91,813**
Payments			
Payments to suppliers		(20,884)	(66,170)
Total Payments		**(20,884)**	**(66,170)**
Net cash provided by operating activities	3	**59,329**	**25,643**
CASH FLOWS FROM INVESTING ACTIVITIES			
Payments for property, plant and equipment		(113,883)	-
Net cash used in investing activities		**(113,883)**	**0**
Net increase/(decrease) in cash		**(54,554)**	**25,643**
Cash at the beginning of the year		222,108	196,466
Cash at the end of the year		**167,554**	**222,108**

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 to all the years presented unless otherwise stated.

(a) Basis of Preparation

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These financial statements are the first to be prepared in accordance with AIFRS. AASB 1 First-time Adoption of Australian Equivalents to International Financial Reporting Standards has been applied in preparing these financial statements.

The WASTAC financial statements until 31 December 2004 had been prepared in accordance with previous Australian Generally Accepted Accounting Principles (AGAAP). AGAAP differs in certain respects from AIFRS. When preparing the WASTAC 2005 financial statements, management has amended certain accounting methods applied in the AGAAP financial statements to comply with AIFRS. The comparative figures in respect of 2004 were restated to reflect these adjustments.

Reconciliations and descriptions of the effect of transition from previous AGAAP to AIFRS on WASTAC's equity are given in note 5.

Historical cost convention

These financial statements have been prepared on the accrual basis of accounting using the historical cost convention.

(b) Acquisition and disposal of assets

In accordance with AASB 116 "Property, Plant & Equipment", all property, plant and equipment is shown at cost, less subsequent depreciation and impairment. 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

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

(c) Depreciation of non-current assets

All non-current assets having a limited useful life are depreciated or amortised 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(d)).

(d) Impairment of property, plant and equipment

In accordance with AASB 136 "Impairment of Assets", 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.

2 Property, Plant and Equipment

	2005	2004
Computer Equipment		
At cost	41,373	21,783
Accumulated depreciation	(15,080)	(7,658)
	26,293	**14,125**
Other Equipment		
At cost	711,206	616,913
Accumulated depreciation	(364,128)	(214,113)
	347,078	402,800
Total Property, Plant and Equipment	**373,371**	**416,925**

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	14,125	402,800	416,925
Additions	19,590	94,293	113,883
Depreciation expense	(7,422)	(150,015)	(157,437)
Carrying amount at end of year	**26,293**	**347,078**	**373,371**

3 Notes to the Cash Flow Statement

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

	2005	2004
Net operating result	(98,108)	(28,042)
Depreciation expense	157,437	75,468
Impairment expense		
Non cash expenses		(21,784)
Net cash provided by operating activities	**59,329**	**25,642**

4 Retained Earnings

Balance at beginning of the year	639,033	667,075
Operating surplus/(deficit) for the year	(98,108)	(28,042)
Balance at end of the year	**540,925**	**639,033**

5 Explanation of Transition to Australian Equivalents to IFRS

(a) This note provides a reconciliation of equity reported under previous AGAAP to equity under AIFRS

	Notes	At the transition date: 1 January 2004			At the end of last period: 31 December 2004		
		Previous AGAAP 1 Jan 2004	Effect of transition to AIFRS	AIFRS 1 Jan 2004	Previous AGAAP 31 Dec 2004	Effect of transition to AIFRS	AIFRS 31 Dec 2004
CURRENT ASSETS							
Cash at Bank		196,466	0	196,466	222,108	0	222,108
TOTAL CURRENT ASSETS		**196,466**	**0**	**196,466**	**222,108**	**0**	**222,108**
NON-CURRENT ASSETS							
Property, plant and equipment	1	482,344	(11,735)	470,609	446,327	(29,402)	416,925
TOTAL NON-CURRENT ASSETS		**482,344**	**(11,735)**	**470,609**	**446,327**	**(29,402)**	**416,925**
TOTAL ASSETS		**678,810**	**(11,735)**	**667,075**	**668,435**	**(29,402)**	**639,033**
TOTAL LIABILITIES		**-**	**-**	**0**	**-**	**-**	**0**
NET ASSETS		**678,810**	**(11,735)**	**667,075**	**668,435**	**(29,402)**	**639,033**
EQUITY							
Retained Funds	2	678,810	(11,735)	667,075	668,435	(29,402)	639,033
TOTAL EQUITY		**678,810**	**(11,735)**	**667,075**	**668,435**	**(29,402)**	**639,033**

(b) Reconciliation of net operating result for the year ended 31 December 2004

	Notes	Previous AGAAP	Effect of transisiton to AIFRS	AIFRS
REVENUE				
Contributions Received		80,000		80,000
Interest Received		11,813		11,813
TOTAL REVENUE		**91,813**	**0**	**91,813**
EXPENDITURE				
Outsourced Work		46,804		46,804
Visiting Specialist		3,000		3,000
Travel		1,374		1,374
Venue Hire		743		743
Maintenance		10,896		10,896
Computer Equipment Purchase		(21,783)		(21,783)
External Printing Costs		0		0
IDM Media Costs		3,200		3,200
Other Consumables		153		153
Depreciation	1	57,801	17,667	75,468
TOTAL EXPENDITURE		**102,188**	**17,667**	**119,856**
NET OPERATING RESULT FOR THE YEAR		**(10,375)**	**(17,667)**	**(28,042)**

(c) Notes to the reconciliation

1. PROPERTY, PLANT AND EQUIPMENT

Under the new AASB 136 “Impairment of Assets”, non-current assets are subject to assessment for impairment. Impairment must be measured for classes of non-current assets with indications of impairment. Impairment is measured by comparing the class of assets’ recoverable amount with its carrying amount. The class of asset is considered impaired if the recoverable amount is less than the class of assets’ carrying value.

ADJUSTMENTS TO OPENING BALANCE SHEET (1 JANUARY 2004)

Property, plant and equipment has reduced by $11,735 after the assessment for impairment.

ADJUSTMENTS TO 31 DECEMBER 2004 BALANCE SHEET.

Property, plant and equipment has reduced by $29,402. This comprises the adjustment as at 1 January 2004, $11,735, plus additional depreciation of $17,667 as a result of the impairment adjustment.

ADJUSTMENTS TO INCOME STATEMENT FOR THE YEAR ENDED 31 DECEMBER 2004

Depreciation expense increased by $17,667 as a result of the 1 January 2004 impairment.