Australian Government

Geoscience Australia

Australian Geographic Reference Image (AGRI) Product Information

V1.2

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Unclassified

Table of Contents

Document History

Revision Number	Date	Nature of Change and Reason	Author	Approval
V0.1	10/10/13	Drafted document	R. Coghlan L.W Wang	
V1.0	13/03/14	Final version incorporating PDMG edits and removal of extraneous Platform and Sensor fields.	Chris Penning	For approval
V1.1	6/05/14	Added Geocat reference	Adam Lewis	Approved
V1.2	28/08/15	Minor edits to copyright	Arek Drozda	Adam Lewis D2015-147919

A Description

Sheet A.1 Definition and Usage

Product Name	Australian Geographic Reference Image
Abbreviation	AGRI
Product Suite	Australian Geographic Reference Image
Key Features of Product Suite	- National mosaic - 10m georeferenced image - UTM zone mosaics - 2.5m georeferenced images - Ground Control Point spatial database - Ground Control Point ancillary data (photographs, site sketches and image chips).
Product Overview	The Australian Geographic Reference Image (AGRI) is a consistent and accurate reference image for rectification of imagery from multiple sources at resolutions of 2.5 metres or less. The AGRI can ensure that images are consistently and accurately registered to allow the maximum extraction of information. The AGRI provides a consistent base image which will be an important foundation for future mapping and monitoring across Australia. It is a resource for both users and providers of satellite imagery covering Australia in government agencies, research institutions and academia, the spatial information industry, and international satellite operators.

Planned Product Versions

Version	Features List features that are relevant to successive versions of this product. The following three features describe the ARG suite of products.		
	Image Data Input	**Radiance Corrections**	**Geometric Presentation**
Current-V1.0	ALOS PRISM archive from 2006 to 2010	Radiometric correction using calibration ancillary provided by JAXA	Mosaics projected to WGS84 geographic and UTM grid

Product Background

The Australian Geographic Reference Image (AGRI) is a consistent and accurate reference image for rectification of imagery from multiple sources at resolutions of 2.5 metres or less. The AGRI is needed because the emerging new satellites and other sources of imagery will generate increasing amounts of data. The AGRI can ensure that images from these sources are consistently and accurately registered to allow the maximum extraction of information.

During compilation more than 9560 satellite scenes, totalling over 6 terabytes, were used to produce eight mosaics, covering each of Australia's Universal Transverse Mercator map zones. These mosaics were then combined to produce a single mosaic covering the Australian continent. Intensity and contrast balancing were used to ensure visual consistency across the mosaic while maintaining the dynamic range of the image.

The AGRI was made possible by new scientific and technical capabilities, international collaboration, the Australian spatial information industry, and the leadership and capabilities of Geoscience Australia. Japan's Advanced Land Observing Satellite (ALOS) made possible the complete coverage of high quality imagery, which forms the foundation of the AGRI, as well as accurate data on the satellite orbit. Geoscience Australia was an international collaborator on the ALOS; handling data for the Oceania region.
The Barista software, developed by the Cooperative Research Centre for Spatial Information, made the project feasible in terms of time, logistics, and cost. Barista reduced the image registration problem from correction of almost 10 000 scenes to correction of just 105 orbit segments (Lewis *et al*, 2011).

The expertise and capability of the Australian spatial information industry was used in the design of GIS databases to manage the survey data and to conduct the many field surveys to remote areas of Australia. The expertise and capabilities of Geoscience Australia staff in

Sheet A.1 Definition and Usage

	both Earth observation and geodesy were also essential inputs to the project (Lewis *et al*, 2011). The AGRI provides a consistent base image which will be an important foundation for future mapping and monitoring across Australia. It is a resource for both users and providers of satellite imagery covering Australia in government agencies, research institutions and academia, the spatial information industry, and international satellite operators. The AGRI mosaic and associated datasets are available to the public under the Creative Commons-Attribution licensing terms at cost of transfer from Geoscience Australia.
Potential Applications	Applications: Reference image – image to image rectification, image chip source, quality control layer Basemap – feature revision and verification, reference layer Sectors: Government – Commonwealth, State and Local Research institutions Spatial Information Industry International satellite operators
Expected Lifespan	Ongoing as is
Illustrations	 Figure 1: The location of surveyed GCPs for the Australian Geographic Reference Image. 2885 features were surveyed at 737 sites

Sheet A.1 Definition and Usage

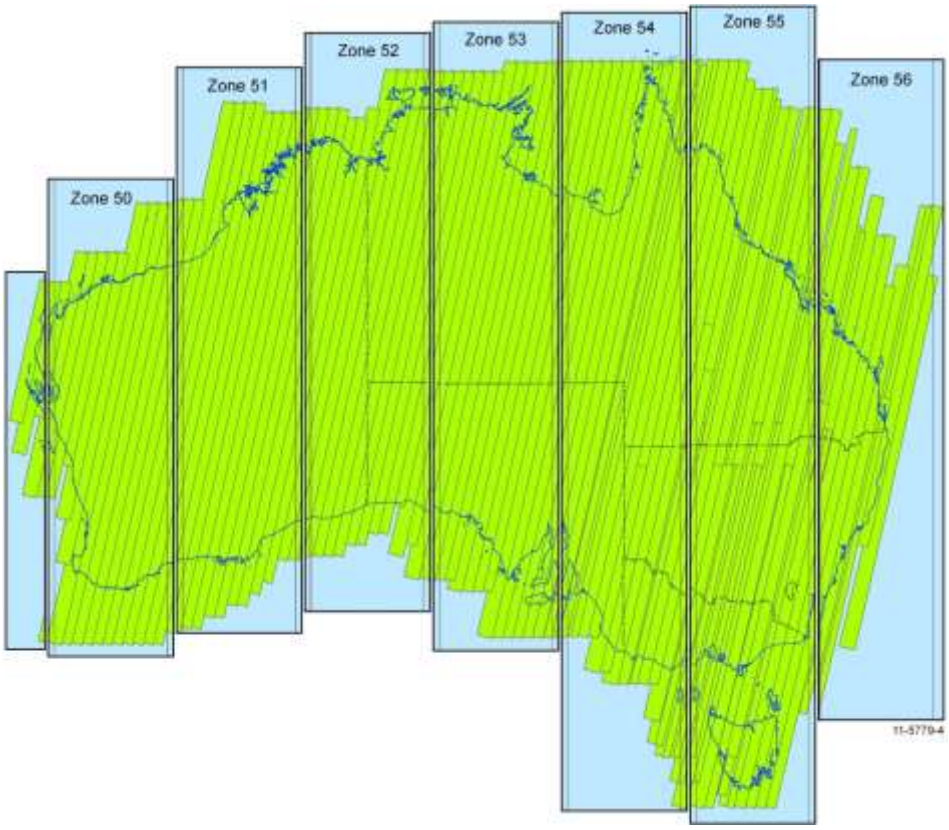

Figure 2: Layout of the zone mosaic images which are part of the AGRI product suite.

Sheet A.1 Definition and Usage

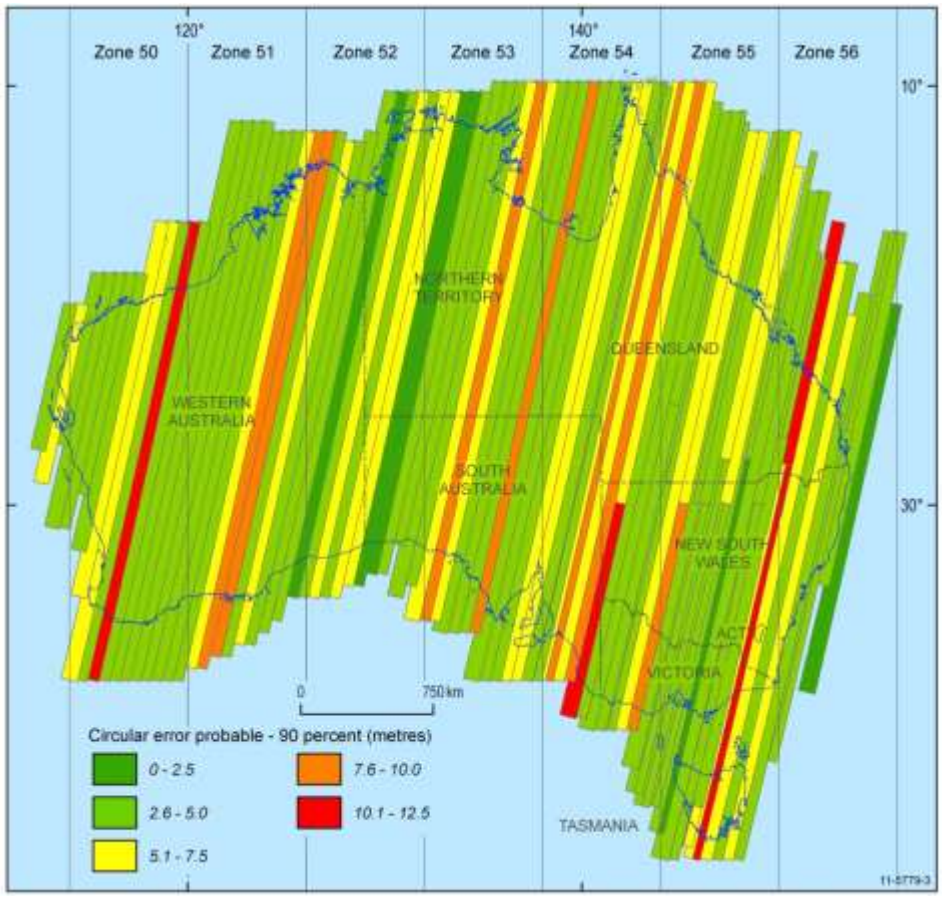

Figure 3: Check point residuals (CEP90) mapped in metres. The accuracy is assessed for each orbit segment. In eastern Australia two or more segments were often used to cover an orbit path.

Example Images

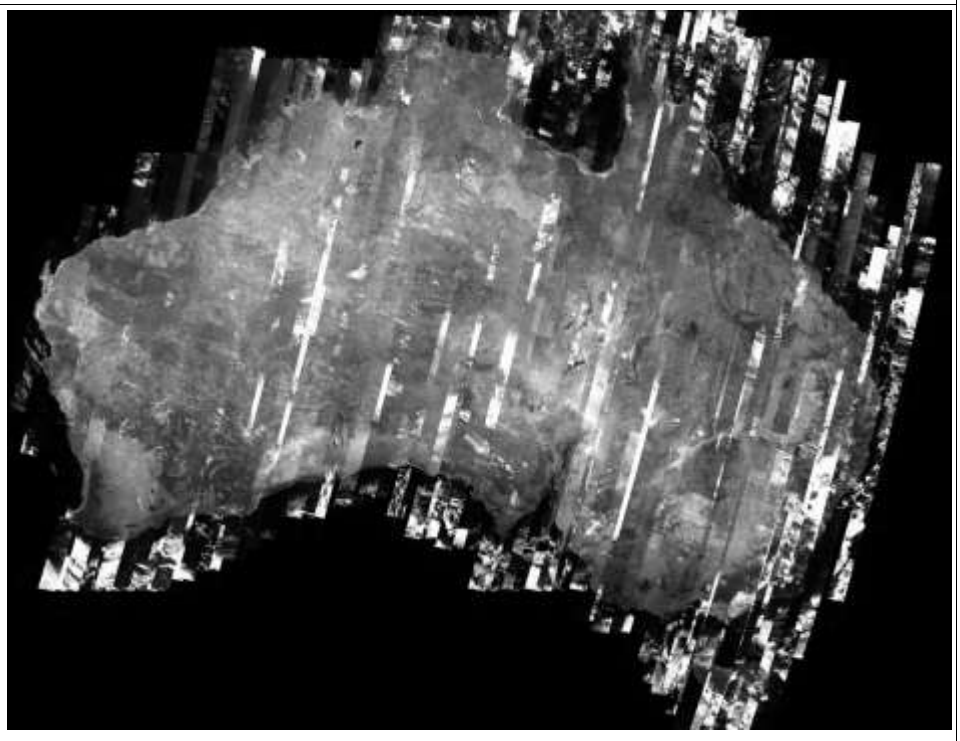

Figure 4: The Australian Geographic Reference Image national mosaic

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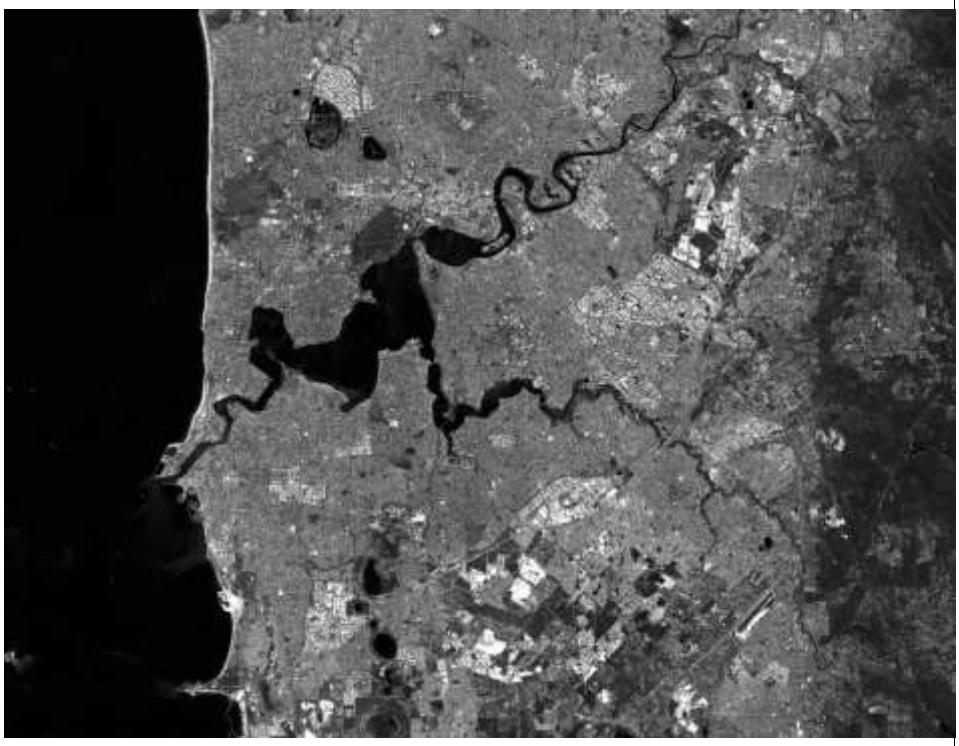

Figure 5: A subset of the Australian Geographic Reference Image over Perth, WA

Figure 6: A subset of the Australian Geographic Reference Image over the Melbourne CBD, VIC

Sheet A.2 Revisions

Revision Number	Date	Nature of Change and Reason	Author/Approval

Sheet A.3 Further Information

References

Lewis, A., Wang, L.W., Coghlan, R. (2011) *AGRI: The Australian Geographic Reference Image. A Technical Report*. Geoscience Australia, Canberra, GeoCat 72657

Glossary

ADEOS	Advanced Earth Observing Satellite
AGRI	Australia Geographic Reference Group
ALOS	Advanced Land Observing Satellite (JAXA, Japan)
ASCII	American Standard Code for Information Interchange
AVNIR	Advanced Visible and Near Infrared Radiometer
CCBY	Creative Commons By Attribution
CCD	Charge-Coupled Device
CEP	Circular Error Probable
CRCSI	Cooperative Research Centre for Spatial Information
DEM	Digital Elevation Model
DSM	Digital Surface Model
ECW	ER Mapper Enhanced Compressed Wavelet
EO	Earth Observation
ERS	ER Mapper ASCII format for extended metadata in raster header files
ESRI	An international supplier of GIS software, web GIS and geodatabase management applications.
GA	Geoscience Australia
GB	Gigabyte (106 KB)
GCP	Ground Control Point
GDA	Geocentric Datum of Australia
GIS	Geographic Information System
GPS	Global Positioning System
GRS	Geodetic Reference System
JAXA	Japan Aerospace Exploration Agency
JERS-1	Japanese Earth Resources Satellite 1
LST	Local Standard Time
MGA	Map Grid of Australia
MOU	Memorandum of Understanding
NaviGAtor	GA data archive and access facility
NEO	National Earth Observation group within Geoscience Australia (formerly the Australian Centre for Remote Sensing, ACRES)
PALSAR	Phased Array type L-band Synthetic Aperture Radar
PRISM	Panchromatic Remote-sensing Instrument for Stereo Mapping
STD	Standard Deviation
TXT	Text File Format

Sheet A.3 Further Information

	UTC	Coordinated Universal Time
	UTM	Universal Transverse Mercator
Websites	http://www.ga.gov.au/image_cache/GA20164.pdf	

B Specification

Sheet B.1 Provenance and Algorithms

<table>
<tr><td rowspan="4">Data Sources</td><td>Primary</td><td colspan="2">ALOS PRISM Level 1B1 imagery</td></tr>
<tr><td>Metadata</td><td colspan="2">Satellite ephemeris data</td></tr>
<tr><td rowspan="3">Ancillary</td><td>Source</td><td>Derived Data</td></tr>
<tr><td>Ground Control Points (GCPs)</td><td>X, Y and Z positional correction information</td></tr>
<tr><td>1-second SRTM DSM</td><td>Height, slope and aspect per pixel for topographic correction</td></tr>
<tr><td>Major Algorithms</td><td colspan="3">Apply ‘full pass’ or 'strip' processing - rectifies a sequential strip of images taken during a single segment of a satellite’s orbit. the metadata for each separate scene are merged to produce a single, continuous set of orbit and attitude parameters, such that the entire strip of tens of images can be treated as a single image, even though the separate scenes are not actually merged. The merging of orbit data results in a considerable reduction in both the number of unknown orientation parameters and the number of control points required in the sensor orientation adjustment.

(See technical report and reference papers http://www.ga.gov.au/image_cache/GA20164.pdf)</td></tr>
<tr><td>Processing Sequence</td><td colspan="3">• Identify cloud-free ALOS PRISM passes
• Ingest scenes from the same pass into BARISTA software
• Identify Ground Control Points
• Full pass processing using bundle adjustment
• Ortho-processing using DSM</td></tr>
<tr><td>Validation of Underlying Algorithms</td><td colspan="3">Independent Check Points from GPS survey.</td></tr>
<tr><td>Accuracy and Limitations</td><td colspan="3">• Absolute geometric accuracy: 5.6m CEP90
• Cloudy over some area</td></tr>
</table>

Sheet B.2 Technical Characteristics

Sheet B.2.1 Relevant Platforms

Full Name		Advanced Land Observing Satellite
Abbreviation		ALOS
Agency		Japan Aerospace Exploration Agency (JAXA)
Application Areas		Cartography, Regional Observation, Disaster Monitoring, Resource Surveying
Launch Date		24 January 2006
End of Life		21 April 2011
Orbit	**Type**	Sun-synchronous, near polar
	Direction	Ascending
	Altitude	691.65 Km at equator (accuracy 2.0 x 10^{-6}° with GCP)
	Inclination	98.16°
	Period	98.7 minutes
	Repeat Cycle	46 days (sub-cycle 2 days)
	Equatorial Crossing Time	10:10 LST
Sensors		Advanced Visible and Near Infrared Radiometer type 2 (AVNIR-2)
		Phased Array type L-band Synthetic Aperture Radar (PALSAR)
		Panchromatic Remote-sensing Instrument for Stereo Mapping (PRISM)

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.2 Relevant Sensors

Full Name	Panchromatic Remote-sensing Instrument for Stereo Mapping			
Abbreviation	PRISM			
Platform	ALOS satellite			
Operational	No			
GA Data Reception	2007–2010; MOU expired December 2010			
Sensing Mode	Passive			
Scanning Method	Opto-mechanical—Push broom for three telescopes: Forward (8 CCDs), Nadir (6 CCDs) and Backward (8 CCDs)			
Application Areas	Digital Elevation Models			
Spectral Bands	**Band**	**Spectral Range (µm)**	**EM Region**	**Application**
	1	0.52–0.77	Panchromatic	Digital elevation models, image sharpening, topographical mapping, disaster and environmental monitoring
Radiometric Quantisation	8 bits			
Swath Width	Triplet mode: 35 km (nadir); Wide mode: 70 km (nadir)			
Ground Sampling Interval (GSI or pixel size)	**Band**		**Metres**	
	1		2.5 m (nadir)	
Repeat Coverage Interval	See ALOS Satellite details			

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.3 Product Details

Frequency	N/A				
Temporal Extent	29/11/2006 to 28/10/2010				
Spatial Extent	**Geographic Coverage**	**NW**	9.976°S latitude, 112.117°E longitude		
		NE	9.976°S latitude, 157.3667°E longitude		
		SW	44.2009°S latitude, 112.117°E longitude		
		SE	44.2009°S latitude, 157.3667°E longitude		
	Grid Dimensions	**W–E**	8,059,504 grid cells		
		N–S	6,095,848 grid cells		
Mapping Base for Continental Mosaic	**Datum**	World Geodetic System (WGS) 84			
	Ellipsoid	WGS84	**Semi-major axis (a)**	6,378,137 m	
			Inverse Flattening (1/f)	298.257223563	
			Eccentricity (e^2)	0.006694379990	
Image Grid for Continental Mosaic	**Projection**	Plate Carrée (Equirectangular)			
	Cell Size	0.0001 deg			
	Type	Custom Grid			
	Pixel Origin	Top Left			
	Orientation	North Upwards			
	Resampling Method	Cubic Convolution			
Mapping Base for Zone Mosaics	**Datum**	World Geodetic System (WGS) 84			
	Ellipsoid	WGS84	**Semi-major axis (a)**	6,378,137 m	
			Inverse Flattening (1/f)	298.257223563	
			Eccentricity (e^2)	0.006694379990	
Image Grid for Zone Mosaics	**Map Co-ordinate System**	Projected			
	Projection	Universal Transverse Mercator (UTM)			
	Origin	Centre of UTM zone			
	Cell Size	2.5m			
	Type	Custom Grid			
	Pixel Origin	Top Left			
	Orientation	North Upwards			
	Resampling Method	Cubic Convolution			
Grid Bit Depth	8 bit (256 levels)				

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.3a Product Details for Grid-Based Products

Spectral Bands	**Data**	**Band 1**	Observed values from ALOS PRISM band 1
	Quicklook	**Band 1**	n/a
Data Range	**Band Type**		Panchromatic – 0 to 255

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.3b Product Details for Vector-Based Products

Filename	AGRI_GCP	
Description	The database contains the precise survey locations of all of the control points. It also contains tables relating to supporting ancillary data (photographs, sketches, and image chips) for each survey point where applicable.	
Format	ESRI File Geodatabase	
Datum	Geocentric Datum of Australia (GDA) 1994	
Projection	Geographic	
Feature Layer	AGRI_GCP	
Layer Attributes	**GcpID**	A unique identifier assigned to each GCP
	GPS_Long	Longitude of the GCP (GDA94 decimal degrees) as supplied by Surveyor
	GPS_Lat	Latitude of the GCP (GDA94 decimal degrees) as supplied by Surveyor
	GPS_Ht	Height of the GCP (GDA94 ellipsoidal height) supplied by Surveyor
	GcpStatus	Determination of whether the GCP was a proposed GCP or a new GCP
	Descriptn	Brief description of the surveyed point including the type of intersection if applicable.
	SiteID	The unique site identifier the GCP was part of
	DateSurvey	The date the GCP was surveyed
	Surveyor	The company which surveyed the GCP
	NumSat	Number of Satellites during capture
	Averaging	Number of observations taken to obtain the average
	PDOP	Position Dilution of Precision (PDOP) value as supplied by the surveyor
	GPS_Hz_Acc	Horizontal positional accuracy at 1 STD expressed in metres
	GPS_Vt_Acc	Vertical positional accuracy at 1 STD expressed in metres
	Zone	UTM zone the GCP falls within
	Folder	The folder supporting data (photos, sketches) are stored in
	Photos	The number of photos available in the supporting folder of the GCP
	Sketches	The number of sketches available in the supporting folder of the GCP
	Chips	The number of image chips available in the supporting folder of the GCP
Feature Tables	gcpChips	
	gcpPhoto	
	gcpSketch	
Table Attributes	**GcpID**	A unique identifier assigned to each GCP
	FileName	The filename of the ancillary file
	Direction	The direction the photograph was taken (only applicable to photos)
	Description	Brief description of the surveyed point including the type of intersection if applicable.

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.3b Product Details for Vector-Based Products

Filename	AGRI_mosaic_metadata	
Description	The database contains approximate positions of each of the ALOS PRISM scenes and paths used to create the mosaics and associated metadata. The data layers can be used to relate metadata fields to the mosaic products.	
Format	ESRI File Geodatabase	
Datum	World Geodetic System (WGS) 1984	
Projection	Geographic	
Feature Layers	AGRI_PRISM_ortho_scenes	
	Zone_**_PRISM_scenes	
Layer Attributes	**Platform**	The satellite name
	Instrument	The instrument on-board the satellite used
	Resolution	The resolution of the image
	Path	A number used to identify the descending path of the satellite
	Row	A number used to identify the placement along the path of the particular image
	Orbit_Numb	A number used to identify the orbit of the satellite
	Acq_Start	The date and time (UTC) image acquisition started
	Acq_Stop	The date and time (UTC) image acquisition stopped
	Collec_Site	The ground segment the data was downlinked to
	Oper_Mode	The operation mode of the instrument
	Acq_Date	The acquisition date of the image
	Path_ID	A unique sequence assigned to identify paths that make up the AGRI mosaics
Feature Layers	Continental_mosaic_metadata	
	AGRI_PRISM_path_accuracy	
	Zone_**_mosaic_metadata	
Layer Attributes	**Path_ID**	A unique sequence assigned to identify paths that make up the AGRI mosaics
	Acq_Date	The acquisition date of the image
	DateString	The acquisition date represented as a number string
	Path_Order	The order in which satellite paths were overlayed to form the final mosaicked products. The lowest number (1) appears in the mosaic as the top layer. The highest number (110) appears in the mosaic as the bottom layer.
	N	The total number of check points.
	Minimum	The minimum of the observed check point errors
	Maximum	The maximum of the observed check point errors
	Median	The median of the observed check point errors
	Mean	The mean of the observed check point errors
	Stdev	The standard deviation of the observed check point errors
	CEP90	The Circular Error Probable – 90 percent. Estimated as the 90th percentile of the check point error sample, this is a non-parametric estimate of the distance from true location within which 90 percent of points are expected lie.
Filename	Ancillary_data_tiles	

Sheet B.2 Technical Characteristics (continued)

Sheet B.2.3b Product Details for Vector-Based Products

Description	The spatial layer used to index ancillary (photographs, sketches, and image chips) data.	
Format	Shapefile	
Datum	Geocentric Datum of Australia (GDA) 1994	
Projection	Geographical	
Layer Attributes	**Zone**	The UTM zone the ancillary data falls within
	Folder	The folder the ancillary data falls within
	Location	The location the ancillary data falls within

C Availability

Sheet C.1 Licencing and Access	
Support	Supported
Licencing	Creative Commons 4.0 Attribution International licence: http://creativecommons.org/licenses/by/4.0/legalcode
Search Tool	NEO Webpage/NaviGAtor http://www.ga.gov.au/search/index.html
Preview Facility	N/A
Ordering and Distribution	GA Sales Centre

Sheet C.2 Delivery Information

File Name	PRISM_UTMnn_type Where: nn: UTM zone for zone mosaics type: Compressed for ECW compressed files Continental_Mosaic			
File Format	**Data**	ASCII ERS/ECW, File Geodatabase, Shapefile		
	Metadata	TXT		
	Quicklook	n/a		
Data Volume	**Total Product (GB)**		**ASCII ERS**	**ECW**
		Continental Mosaic (10m)	142.46	11.17
		Zone 49 Mosaic (2.5m)	74.78	1.24
		Zone 50 Mosaic (2.5m)	296.62	19.47
		Zone 51 Mosaic (2.5m)	376.25	15.63
		Zone 52 Mosaic (2.5m)	354.37	28.62
		Zone 53 Mosaic (2.5m)	381.81	28.88
		Zone 54 Mosaic (2.5m)	472.50	26.79
		Zone 55 Mosaic (2.5m)	474.06	29.49
		Zone 56 Mosaic (2.5m)	387.50	11.41
		TOTAL	2960.36	172.69