DEA Surface Reflectance NBART (Landsat 8 OLI-TIRS)

Geoscience Australia Landsat 8 OLI-TIRS NBART Collection 3

Version
3.0.0

Product ID
ga_ls8c_ard_3

Program
Digital Earth Australia

Collection
Geoscience Australia Landsat Collection 3

Resource type
Baseline

Published Date
12/03/2018

View the original metadata page for the most up-to-date information on this product.

Basics

Background

*This is a sub-product of **DEA Surface Reflectance (Landsat 8 OLI-TIRS)**. See the parent product for more information.*

Radiance data collected by Landsat 8 OLI-TIRS sensors can be affected by atmospheric conditions, sun position, sensor view angle, surface slope and surface aspect.

Surfaces with varying terrain can introduce inconsistencies to optical satellite images through irradiance and bidirectional reflectance distribution function (BRDF) effects. For example, slopes facing the sun appear brighter compared with those facing away from the sun. Likewise, many surfaces on Earth are anisotropic in nature, so the signal picked up by a satellite sensor may differ depending on the sensor's position.

These need to be reduced or removed to ensure the data is consistent and can be compared over time.

What this product offers

This product takes Landsat 8 OLI-TIRS imagery captured over the Australian continent and corrects the inconsistencies across land and coastal fringe. It achieves this using Nadir corrected Bi-directional reflectance distribution function Adjusted Reflectance (NBAR).

However, in addition, this product applies terrain illumination correction to correct for varying terrain.

The resolution is a 30 m grid based on the USGS Landsat Collection 1 archive.

Related products

- DEA Surface Reflectance (Landsat 8 OLI-TIRS)
- DEA Surface Reflectance NBAR (Landsat 8 OLI-TIRS)
- DEA Surface Reflectance OA (Landsat 8 OLI-TIRS)

Publications

- Li, F., Jupp, D. L. B., Reddy, S., Lymburner, L., Mueller, N., Tan, P., & Islam, A. (2010). An evaluation of the use of atmospheric and BRDF correction to standardize Landsat data. IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, 3(3), 257–270. https://doi.org/10.1109/JSTARS.2010.2042281

- Li, F., Jupp, D. L. B., Thankappan, M., Lymburner, L., Mueller, N., Lewis, A., & Held, A. (2012). A physics-based atmospheric and BRDF correction for Landsat data over mountainous terrain. Remote Sensing of Environment, 124, 756–770. https://doi.org/10.1016/j.rse.2012.06.018

Access

Data access

Link to data	THREDDS
Code examples	Jupyter notebook
eCat record	132317
Product ID	ga_ls8c_ard_3
CMI RESTful node ID	400
NCI project code	xu18
Security classification	Unclassified
Update frequency	asNeeded

Access notes

Open Data Cube

This product is contained in the Open Data Cube instance managed by Digital Earth Australia (DEA). This simplified process allows you to query data from its sub-products as part of a single query submitted to the database.

See Analysis Ready Data: example queries

Details

Technical information

Radiance measurements

Landsat's Earth Observation (EO) sensors measure radiance (brightness of light), which is a composite of:

- surface reflectance
- atmospheric condition
- interaction between surface land cover, solar radiation and sensor view angle
- land surface orientation relative to the imaging sensor

It has been traditionally assumed that Landsat imagery displays negligible variation in sun and sensor view angles. However, these can vary significantly both within and between scenes, especially in different seasons and geographic regions (Li et al. 2012).

Surface reflectance correction models

This product represents standardised optical surface reflectance using robust physical models to correct for variations and inconsistencies in image radiance values.

It delivers modelled surface reflectance from Landsat 8 OLI-TIRS data using physical rather than empirical models. This ensures that the reflective value differences between imagery acquired at different times by different sensors will be primarily due to on-ground changes in biophysical parameters rather than artefacts of the imaging environment.

This product is created using a physics-based, coupled Bidirectional Reflectance Distribution Function (BRDF) and atmospheric correction model that can be applied to both flat and inclined surfaces (Li et al. 2012). The resulting surface reflectance values are comparable both within individual images and between images acquired at different times.

For more information on the BRDF/Albedo Model Parameters product, see MCD43A1 Collection 6.

Landsat archive

To improve access to Australia's archive of Landsat TM/ETM+/OLI data, several collaborative projects have been undertaken in conjunction with industry, government and academic partners. These projects have enabled implementation of a more integrated approach to image data correction that incorporates normalising models to account for atmospheric effects, BRDF and topographic shading (Li et al. 2012). The approach has been applied to Landsat TM/ETM+ and OLI imagery to create baseline surface reflectance products.

The advanced supercomputing facilities provided by the National Computational Infrastructure (NCI) at the Australian National University (ANU) have been instrumental in handling the considerable data volumes and processing complexities involved with the production of this product.

Image format specifications

band01, band02, band03, band04, band05, band06, band07, band08

Format	GeoTIFF
Resolution	30m
Datatype	Int16
No data value	-999
Valid data range	[1,10000]
Tiled with X and Y block sizes	512x512
Compression	Deflate, Level 6, Predictor 2
Pyramids	Levels: [8,16,32] Compression: deflate Resampling: GDAL default (nearest) Overview X&Y block sizes: 512x512
Contrast stretch	None
Output CRS	As specified by source dataset; source is UTM with WGS84 as the datum

thumbnail

Format	JPEG
RGB combination	Red: band 4 Green: band 3 Blue: band 2
Resolution	X and Y directions each resampled to 10% of the original size
Compression	JPEG, Quality 75 (GDAL default) PHOTOMETRIC colour model: YCBCR

Contrast stretch	Linear Input minimum: 10 Input maximum: 3500 Output minimum: 0 Output maximum: 255
Output CRS	Geographics (Latitude/Longitude) WGS84

Accuracy and limitations

Atmospheric correction accuracy depends on the quality of aerosol data available to determine the atmospheric profile at the time of image acquisition.

BRDF correction is based on low resolution imagery from the Moderate Resolution Imaging Spectroradiometer (MODIS), which is assumed to be relevant to medium resolution imagery such as that captured by Landsat 8 OLI-TIRS. BRDF correction is applied to each whole Landsat 8 OLI-TIRS scene and does not account for changes in land cover. It also excludes effects due to topographic shading and local BRDF.

The algorithm assumes that BRDF effect for inclined surfaces is modelled by the surface slope and does not account for land cover orientation relative to gravity (as occurs for some broadleaf vegetation with vertical leaf orientation).

The algorithm also depends on several auxiliary data sources:

- Availability of relevant MODIS BRDF data
- Availability of relevant aerosol data
- Availability of relevant water vapour data
- Availability of relevant DEM data
- Availability of relevant ozone data

Improved or more accurate sources for any of the above listed auxiliary dependencies will also improve the surface reflectance result.

Quality assurance

Results from the DEA Cal/Val workflow over 17 data takes from 9 field sites were created based on both BRDF Collections 5 and 6.

The results for each collection were averaged and then compared. The comparison showed small changes in individual field sites, but overall there was no significant difference in the average results over all field sites to within 1% at most.

The technical report containing the data summary for the Phase 1 DEA Surface Reflectance Validation is available: DEA Analysis Ready Data Phase 1 Validation Project : Data Summary

Processing

Data sources

- USGS Collection 1 Landsat 8 Optical Land Imager Thermal Infrared Sensor
- SRTM DSM/DEM data
- Ephemeris Data
- Aerosol Optical Depth
- Precipitable Water for Entire Atmosphere
- MCD43A1 Collection 6
- Kuruzc 2005 TOA Solar Irradiance
- Ozone data

Processing steps

- Longitude and Latitude Calculation
- Satellite and Solar Geometry Calculation
- Aerosol Optical Thickness Retrieval
- BRDF Shape Function Retrieval
- Ozone Retrieval
- Elevation Retrieval and Smoothing
- Slope and Aspect Calculation
- Incidence and Azimuthal Incident Angles Calculation
- Exiting and Azimuthal Exiting Angles Calculation
- Relative Slope Calculation
- Terrain Occlusion Mask
- MODTRAN
- Atmospheric Correction Coefficients Calculation
- Bilinear Interpolation of Atmospheric Correction Coefficients
- Surface Reflectance Calculation (NBAR)

Schema / spatial extent

Geoscience Australia Landsat Collection 3

Update frequency	asNeeded
Temporal extent	1987-01-01 00:00:01 – 2019-04-09 21:27:33
Coordinate reference system	Universal Transverse Mercator (variable)
Cell size X	30.00
Cell size Y	30.00

Media

Credits

Owner

Commonwealth of Australia (Geoscience Australia)

Principal contributors

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