DEA Surface Reflectance NBAR (Sentinel-2 MSI)

Sentinel-2 Multispectral Instrument - Nadir BRDF Adjusted Reflectance

Version
1.0.0

Program
Digital Earth Australia

Collection
Geoscience Australia Sentinel-2 Collection 1

Resource type
Baseline

Published Date
12/03/2018

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

Basics

About

DEA Surface Reflectance NBAR (Sentinel-2 MSI) is part of a suite of Digital Earth Australia (DEA)'s Surface Reflectance datasets that represent the vast archive of images captured by the US Geological Survey (USGS) Landsat and European Space Agency (ESA) Sentinel-2 satellite programs, validated, calibrated, and adjusted for Australian conditions — ready for easy analysis.

Background

The light reflected from the Earth's surface (surface reflectance) is important for monitoring environmental resources – such as agricultural production and mining activities – over time.

We need to make accurate comparisons of imagery acquired at different times, seasons and geographic locations. However, inconsistencies can arise due to variations in atmospheric conditions, sun position, sensor view angle, surface slope and surface aspect. 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 has been corrected to account for variations caused by atmospheric properties, sun position and sensor view angle at time of image capture.

These corrections have been applied to all satellite imagery in the Sentinel-2 archive. This is undertaken to allow comparison of imagery acquired at different times, in different seasons and in different geographic locations.

These products also indicate where the imagery has been affected by cloud or cloud shadow, contains missing data or has been affected in other ways. The Surface Reflectance products are useful as a fundamental starting point for any further analysis, and underpin all other optical derived Digital Earth Australia products.

Applications

This product eliminates pre-processing requirements for a wide range of land and coastal monitoring applications and renders more accurate results from analyses, particularly those utilising time series data.

Such applications include various forms of change detection, including:

- monitoring of urban growth, coastal habitats, mining activities, and agricultural production
- compliance surveys
- scientific research emergency management

Access

Data access

Link to data	NCI - THREDDS
Dataset technical metadata	
eCat record	129677
CMI RESTful node ID	189
NCI project code	if87
Security classification	Unclassified
Update frequency	asNeeded

Details

Technical information

The standardised SR data products deliver calibrated optical surface reflectance data across land and coastal fringes. SR is a medium resolution (10/20/60 m) grid based on the Sentinel 2 MSI archive (100x100 km^2 grid cells / tiles in UTM/WGS84 projection) and presents surface reflectance data in 10, 20 and 60m pixels.

Radiance measurements from EO sensors do not directly quantify the surface reflectance of the Earth. Such measurements are modified by variations in atmospheric properties, sun position, sensor view angle, surface slope and surface aspect. To obtain consistent and comparable measures of Earth surface reflectance from EO, these variations need to be reduced or removed from the radiance measurements (Li et al., 2010). This is especially important when comparing imagery acquired in different seasons and geographic regions.

The SR 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 and/or with different sensors.

No data values in NBAR products are expressed as -999.

Accuracy and limitations

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

BRDF correction is based on low resolution imagery (MODIS) which is assumed to be relevant to medium resolution imagery such as Sentinel 2 MSI. BRDF correction is applied to each whole Sentinel 2 MSI tiles and does not account for changes in land cover. It also excludes effects due to topographic shading and local BRDF. This algorithm is dependent on the availability of relevant MODIS BRDF data.

Topographic shading correction algorithm is designed for medium resolution imagery and assumes that hill slopes are resolved by the sensor system (Li et al., 2012). The algorithm assumes that: a. 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 broad leaf vegetation with vertical leaf orientation).

Quality assurance

Atmospheric and BRDF Correction

The algorithm was validated using Landsat data. As detailed in Li et al. (2010), the atmospheric and BRDF correction algorithm was validated in three parts:

1) Validate combined atmospheric and surface BRDF correction using field reflectance measurements at two very different sites, Gwydir, NSW, and Lake Frome, SA - correlation (measured as r) between corrected image values and field data was >0.95.

2) Validate surface BRDF correction using data from image overlap areas of adjacent paths acquired one week apart in northeast Queensland - normalised reflectance factor was very close in corrected images, but not in original images, and difference in reflectance factor values between corrected and uncorrected images can be >0.05.

3) Cross-validate Landsat TM data for accuracy of spectral reflectance using the MODIS reflectance product for Lake Frome correlation (measured as r2) between correctedÂ Landsat TM image values and MODIS reflectance product was 0.93-0.97 in all bands except Landsat TM band 5, which was 0.90.

The results clearly show that the algorithm can remove most of the BRDF effect without empirical adjustment and that cross-calibration between the Landsat ETM+ and MODIS sensors is achievable.

References

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

Processing

Data sources

- Level 1 Satellite Imagery
- Systematic Terrain Correction Imagery
- Ephemeris Data
- Earth rotational angular velocity
- Solar Irradiance
- MODIS BRDF Shape Function
- BRDF Database
- SRTM DSM/DEM data
- Aerosol Optical Depth
- Monthly Ozone Imagery
- MODTRAN Seasons

Processing steps

- Extract metadata from data sources
- Calculate sun and sensor angles per pixel (Vincenty, 1975; Edberg and Oliver, 2013)
- Determine values for six base atmospheric parameters across each image scene
- Derive normalised surface reflectance for sun angle of 45°

Major algorithms

- Surface Reflectance (Li, 2010)

Media

Credits

Owner

Commonwealth of Australia (Geoscience Australia)

License

Rights statement