Landscape Assessment: Remote Sensing (AusCover)

In this document the Themes and Data Products in the Landscape Assessment Remote Sensing (AusCover) facility are described. Table 1 provides a description of the Landscape Assessment Remote Sensing Themes. Table 2 contains a classification and a general outline of the data contents of each downloadable dataset type. Table 3 provides a description of the temporal and spatial coverage and resolution of the datasets in the Data Products in the Landscape Assessment Remote Sensing facility, as well as the description of the files containing the datasets. The dimensions, geospatial attributes, and layers of these datasets are described in a separate Google Sheet spreadsheet ('AusCoverDatasets_Desc').

Table 1. Detailed description of the Landscape Assessment Remote Sensing (AusCover) Themes.

Theme	Description
Land Cover Dynamics & Phenology (24 data product types)	Datasets characterise the changes in vegetation cover due to seasonal (phenological) or long term (climatic) influences. They provide baseline information for vegetation conditions and changes at the national scale. Fractional vegetation cover and persistent green vegetation data products show the state and changes in time and space of the green (photosynthetically active) vegetation component relative to the brown, dry or dead (non-photosynthetically active) vegetation and bare soil components. The phenology and dynamic land cover products provide metrics for seasonal growth cycles in terms of the start, end and duration of each growth event.
Vegetation Structural Properties & Biomass (36 data product types)	Data sets that describe a range of structural properties of vegetation communities, including measures of cover, height, and biomass. Core data includes Wooded Extent (where woody vegetation occur) and Persistent Green Vegetation Fraction (fraction of persistently green vegetation, normally foliage on woody vegetation) across Australia. Similar products for Foliage Projective Cover are also available for Queensland and New South Wales.

	Biomass information can be derived from TERN AusCover's vegetation height, cover and age class map of Australia (based on Landsat), radar (PALSAR), and laser altimeter information (ICESat/GLAS). This information combined with TERN's library of field data can be used to assess the spatial distribution of biomass in Australia
Vegetation Composition & Diversity (12 data product types)	Species composition data identify the dominant tree and/or shrub species in an area. Species diversity data characterise the variety of tree and/or shrub species in an area. Vegetation composition and diversity information is important for assessing and managing ecosystem change, as well as for fine-grained remote sensing product validation. Dominant species and species diversity data are collected as part of the TERN AusCover field surveys, notably the SLATS transects and leaf chemistry activities. Individual tree data can be derived from the airborne LiDAR, while the airborne Hyperspectral data can be used to discriminate species and vegetation health. With appropriate ground validation this data can also be used to characterise an entire field survey site.
Field Survey Datasets (11 data product types)	Field data for remote sensing calibration and validation (cal/val) at selected sites located within representative and/or conservation significant biomes of Australia. AusCover promotes a set of nationally agreed and developed field data collection protocols relevant to remote sensing cal/val (see TERN AusCover Good Practice Guidelines). AusCover cal/val sites are typically homogenous in terms of vegetation composition and structural characteristics. As much as possible, TERN AusCover cal/val sites are co-located with field sites of other TERN facilities such as OzFlux, SuperSites, and AusPlots. TERN AusCover also hosts suitable field data collected by other organisations.
Fire Dynamics & Impact (10 data product types)	Bushfire-related data of two main categories: burnt area mapping (scars), and active fire fronts (hot spots). Burnt area maps are produced on a monthly scale to track vegetation and landscape changes. They are aggregated over multiple years to assess recurrence and cumulative impact of fires. Active fire fronts are tracked can be tracked with satellites by examining the thermal bands of their sensors, which typically are saturated in active fires. Thus, monitoring fire fronts using satellites is dependent on the frequency and time of overpass of the satellites. Currently, TERN AusCover uses MODIS to monitor active fire fronts. The MODIS sensors on NASA's Terra and Aqua satellites pass over most areas in Australia twice per day (~ at 10 am and 2 pm local solar time). The Himawari-8 satellite is geostationary and records imagery every 10 minutes, which can allow more active fire front tracking. TERN AusCover will deliver bushfire related datasets from Himawari-8 in late 2016. In future, TERN AusCover will provide information on fuel moisture and fuel load. These products can be difficult to generate and validate from remote

	sensing because much of the fuel load, in a fire management sense, is under the canopy.
Airborne Datasets (4 data product types)	LiDAR and Hyperspectral data collected over the primary TERN AusCover field sites. LiDAR (Light Detection and Ranging) is a remote sensing method that uses light in the form of a pulsed later to measure ranges (variable distances) to Earth. LiDAR data are used to derive high resolution digital elevation, terrain and/or surface models, and to identify individual trees and features for relating to field data. LiDAR datasets are of good to high quality. TERN AusCover plans to deliver a set of derived products from the LiDAR data in future. The Hyperspectral data can be used for species discrimination and to derive vegetation health and leaf chemistry information. These data are of variable quality due to onboard instrument issues pre-2015. Sites flown after and including Warra (Feb 2015) and Injune (July 2015) are of good quality. TERN AusCover have non-exclusively partnered with Airborne Research Australia to collect airborne data over most of the TERN AusCover field sites to date. Some high-resolution satellite imagery (e.g., WorldView-2) has been acquired to complement the field site surveys and airborne data. An emerging area of research is remotely piloted aircraft systems (RPAS) or unmanned aerial vehicles or systems (UAV or UAS). Some preliminary data from hyperspectral, optical or infrared cameras and sensors have been collected over selected landscapes, including some AusCover sites. These datasets will be made available in future.
Corrected Surface Reflectance Products (6 data product types)	Base data from which many of the terrestrial biophysical parameters are derived.Base data from which many of the terrestrial biophysical parameters are derived. Corrected surface reflectance means that the satellite data have been corrected for atmospheric, instrumental spectral response, and satellite positioning effects. Corrected surface reflectance products can be considered "Analysis Ready Data" for most terrestrial applications. However, they may not be suitable for all applications, particularly if angular or atmospheric correction effects may be important to the application. The data may have additionally been corrected for satellite instrument view-angle, sun angle, and terrain illumination effects. Satellite view and sun angle corrections use a Bi-directional Reflectance Distribution Function (BRDF) that models the spectral response across the full range of angles and corrects the data to a common angle, typically at nadir or overhead. Products that have been corrected in this way will have BRDF or NBAR (Nadir BRDF-Adjusted Reflectance) acronyms in their titles or descriptions. Terrain illumination effects occur in mountainous or deep valley regions where the sun's illumination of the surface is obscured by topography and consequently the reflectance readings at the satellite are reduced. Higher spatial resolution satellite data (e.g., Landsat) and airborne data are more influenced by terrain illumination effects than lower spatial resolution satellite data (e.g., MODIS, AVHRR).

Other Environmental Data (8 data product types)	Data products not directly derived from, or that do not provide validation for remote sensing products, but are available through the TERN AusCover systems. TERN AusCover does not directly fund or support the development of the data products in this category. The data may, however, be hosted on TERN AusCover systems and the metadata may be managed in the AusCover system or by the custodian's own systems. These products may be produced by TERN AusCover partners supplementary to their TERN AusCover products, or by TERN AusCover associates where the product may be generated from an aggregation of TERN AusCover products. In any case, the products are made available because it is beneficial for users to access them alongside TERN AusCover products. Examples include: the 'GEOSS ecosystems map for Australia' produced by TERN AusCover partners as an aggregation of spatial layers including remote sensing data; the 'MCAS-S spatial layers' produced by ABARES as an TERN AusCover partner; and the 'State or Forests reports' produced by Dept. Environment as an aggregation including TERN AusCover products.

Table 2. General characterization of the data in of the Data Products in the Landscape Assessment (AusCover) facility that currently can be downloaded. In *pink* data products that currently can be downloaded. *Columns 2-9*: Classification of the data according to the broad AusCover Themes. *Column 10*: Description of the data. *Column headers*: LCD&P = Land Cover Dynamics & Phenology; VSP&B = Vegetation Structural Properties & Biomass; VC&D = Vegetation Composition & Diversity; FSD = Field Survey Datasets; FD&I = Fire Dynamics & Impact; AD = Airborne Datasets; CSR = Corrected Surface Reflectance Products; OED = Other Environmental Data.

Data Product	AusCover Themes								Data Description
	LCD&P	VSP&B	VC&D	FSD	FD&I	AD	CSR	OED	
Active-fire based burned area - MODIS, MCD64A1(v5.1) mosaic					✔				Mapping and dating of burned areas using an automated algorithm on 500-m MODIS imagery coupled with 1-km MODIS active fire observations. The algorithm identifies rapid changes in the daily surface reflectance dynamics. By combining active-fire and reflectance data, the algorithm adapt regionally over a wide range of pre- and post-burn conditions and across multiple ecosystems.
Airborne hyperspectral - raw and QA data for all sites			✔			✔			Site descriptions and field measurements of the different cover fractions at sites across Australia. The data were collected by government agencies in all states and the Northern Territory as part of the 'Ground cover monitoring for Australia' project.
Airborne LiDAR - raw and QA data for all sites		✔	✔			✔			Collection of raw and quality assessed or processed (where applicable) data files for each survey site that has been flown. Airborne hyperspectral data can be used for species identification, leaf (canopy) chemistry and tree health.
Annual fire scars - Landsat, Qld					✔				Collection of raw and quality assessed or processed (where applicable) data files for each survey site that has been flown. Airborne LiDAR can be used to derive high resolution terrain or surface models and canopy structural information including individual tree identification.
Australian Gridded Climate Data								✔	Statewide annual composite of fire scars (burnt area) derived from all available Landsat 5, 7, and 8 images in each year. Characterising historic patterns of burning and changing fire regimes over time is important for improving our understanding and management of fire, climate, land-use and vegetation interactions. These products can assist the development of appropriate fire management practices benefiting a range of conservation and resource management objectives, as well as ongoing scientific research.
Australian Ground Cover Reference Sites Database - ABARES	✔	✔		✔					High-quality set of historical and ongoing real-time climate analyses for Australia. The climate analyses include the following variables: rainfall, temperature (maximum and minimum) as well as vapour pressure at daily and monthly timescales.
Biomass plot library		✔	✔	✔					Site descriptions and field measurements of the different cover fractions at sites across Australia. The data were collected by government agencies in all states and the Northern Territory as part of the 'Ground cover monitoring for Australia' project.
BRDF and Albedo - MODIS, MCD43A(c5) mosaics							✔		Estimates of mean biomass in sites across most of Australian bioregions. The are obtained by a collation of stem inventory data across federal, state and local government departments, universities, private companies, and other agencies.. Data provided for each project by the various source organisation were imported to a PostGIS database in their native form and then translated to a common set of tree, plot and site level observations. However, currently only estimates of site level mean biomass are available. The aim of estimates is the calibration and validation of remotely sensed above-ground biomass data (i.e. Landsat, LiDAR, and ALOS PALSAR data).
Burnt area and approximate day of					✔				Surface reflectance data adjusted using a BRDF to model the values as if they were taken from nadir view (nadir-adjusted BRDF). Includes BRDF model parameters and

	1	2	3	4	5	6	7	Description
burn - MODIS								albedo information. Derived from NASA's MODIS Land Products. Australian sections of these products are then: (1) mosaiced and remapped using MRT, (2) split into individual bands to reduce file size, and (3) formatted for consistency.
Chlorophyll Fraction of Photosynthetic Radiation (fPARchl) - MODIS		✔						Locations of areas affected by fire and approximate day of burning. These are estimated by looking for sudden changes in reflectance, persistent over multiple days, in atmospherically corrected time series of daily day time observations from MODIS sensors on NASA's Terra and Aqua satellites. Variations in observation and illumination geometry are taken into account through application of a kernel driven BRDF model.
Dynamic Land Cover Dataset - MODIS	✔	✔					✔	Fraction of photosynthetic radiation (fPAR) absorbed by chlorophyll (fPAR chl), where total fPAR can be separated on two main components: the green leaves (fPARgreen), and woody stems and branches portions of the canopy (fPARbrown). Subsequently, fPARgreen can be parted into fPAR from the photosynthetic chlorophyll (fPARchl) and the non-photosynthetic (e.g. cellulose; fPARnon-chl) components of the canopy. fPAR and its components are commonly used in ecosystem modelling.
Ecosystem Disturbance Index - MODIS	✔	✔					✔	First nationally consistent and thematically comprehensive land cover reference for Australia. It provides a baseline for reporting on change and trends in vegetation cover and extent.
Enhanced Vegetation Index (EVI) - MODIS, MOD13Q1(c5) mosaic despiked	✔	✔						The Disturbance Index (Mildrexler et al. 2007) algorithm is based on the consistent radiometric relationship between LST and EVI computed on a pixel-by-pixel basis. Identifies the timing, location and magnitude of major ecosystem disturbances such as wildfire, flooding, climate change and human-triggered land use.
Enhanced Vegetation Index (EVI) and Land Surface Temperature (LST) - MODIS, spatially and temporally interpolated	✔	✔						EVI time series with spikes removed ('spikes' and sharp drops that sometimes appear in EVI TS do not represent biophysical changes on the Earth's surface). Basis of the Dynamic Land Cover Map.
Fire frequency - AVHRR					✔			Simultaneous measurement of EVI and LST. Enables observation of changes in vegetation cover and surface temperature, which can facilitate effective mapping of vegetation stress, surface characteristics, evapotranspiration and vegetation greenness-dryness.
Fire severity - MODIS					✔			Average number of fires affecting an area in a given time period. It is the inverse of the fire return interval. The fire frequency product is derived from the whole time series of AVHRR burnt area maps.
Fraction of Photosynthetically Active Radiation (fPAR) - AVHRR		✔						Immediate impact of fire on vegetation. The MODIS Fire severity product provides two classes: non- severe, and severe. Non-severe fires only impacted the understorey, while severe fires have impacted the tree canopy as well.
Fractional cover - Landsat, JRSRP algorithm	✔	✔						Australia-wide, monthly fPAR absorbed by vegetation derived from Advance Very High Resolution Radiometer data. fPAR is linearly related to fractional foliage cover. Here fPAR is split into estimates of persistent (i.e. non-deciduous perennial) vegetation and of recurrent (i.e. (i.e. annual, ephemeral, and deciduous) vegetation. Data are pre-eminently suited to the analysis of long-term dynamics (trends) in vegetation cover.
Fractional cover - MODIS, CSIRO algorithm	✔	✔						Represents the exposed proportion of green, non-green, and bare cover within each pixel. Landsat-scale ground cover information is important for the estimation of soil erosion and nutrient flux into the stream network, as well as assessing the impact of human activities.
Fractional Cover - MODIS, Monthly Median Composites	✔	✔						Represents the exposed proportion of green, non-green, and bare cover within each pixel. MODIS-scale ground cover provides monthly information for soil erosion and vegetation dynamics at continental and global scales. The algorithm is validated for Australia. A global product using the same algorithm is also produced.
Fractional Cover Metrics - MODIS	✔	✔						Represents the exposed proportion of green, non-green, and bare cover within each pixel. This product is a composite for all Australian MODIS fractional cover images for

Name									Description
									the month.
Grassland curing - MODIS					✔				Statistical summaries of the MODIS fractional cover product (v2.1 and v2.2). Consists of rasters of mean, standard deviation, minimum value, maximum value, time of minimum and time of maximum, for the PV, NPV and BS themes.
Green Accumulation Index - Landsat, JRSRP algorithm, NSW	✔	✔							Dead fraction of grassland, expressed as a percentage, strictly by dried weight. Curing values are computed from surface reflectance data estimated from cloud-free MODIS observations using five alternative algorithms. These algorithms have been trained and assessed using field observations. Four algorithms were developed by the Bushfire CRC Project A1.4 on grassland curing (methods A, B, C, D) and one developed by the Victorian Country Fire Authority (MapVictoria). The Bushfire CRC algorithms have been trained on approximately 25 sites with a limited distribution across Australia, while MapVictoria has been trained on around 200 sites restricted to Victoria.
Gross Primary Productivity - MODIS, MOD17A2(c5) mosaic		✔	✔						Shows how long an area stays green following a greening event, such as grass growth in response to rainfall. Areas exhibiting the highest values are the areas of NSW that respond with high green cover for a long period after a greening event. Variation in greenness can be useful for a variety of mapping and planning tasks. Areas of green vegetation are important for native species habitat and human recreation activities. Fractional cover layers representing the amount of bare ground, green vegetation, and dead vegetation for each pixel on a specific date were derived from Landsat images. The green accumulation index map was created combining fractional cover layers derived from Landsat images from 1988 to 2012.
Hemispherical photography		✔	✔	✔					Cumulative composite of GPP estimates based on the radiation-use efficiency concept. GPP can be used as input to models to calculate terrestrial energy, carbon, water cycle processes, and biogeochemistry of vegetation. Derived from NASA's MODIS Land Products (GPP product). Australian sections of these products are then: (1) mosaiced and remapped using MRT, (2) split into individual bands to reduce file size, and (3) formatted for consistency.
Hyperspectral ground calibration data						✔		✔	Set of georeferenced raw images (3 photos per sampled point collected at different exposures) and ancillary data. These images have multiple applications, including: estimation of the leaf area index (LAI); study of canopy architecture; measurement of light environment; and provide measurements for calibration and validation of LiDAR derived estimates of fractional cover and LAI.
Hyperspectral surface reflectance - Hyperion							✔		Field spectroradiometer measurements for calibration and validation of at-surface reflectance of airborne hyperspectral image data. Once the at-surface reflectance values of the hyperspectral image data have been validated, the data can be used for up-scaling Landsat and MODIS data to medium spatial resolution data to calibrate and validate NBAR products.
Land Cover Dynamics - MODIS, MCD12Q2(c5) mosaic	✔	✔	✔						Derived from Hyperion L1R calibrated radiance data from the USGS as follows: (1) data are processed to surface reflectance using the Auscover/Curtin Hyperion Enhancement and Atmospheric correction Technique; (2) in file missing lines due to failed pixels in the detector array are replaced; (3) spectral smile, a change in wavelength response across the detector array, is then corrected by an interpolation technique; and (4) the resulting file is atmospherically corrected using radiative transfer model data. Each processed file contains hyperspectral surface reflectance data for each pixel contained in the original L1R scene.
Land Cover Type - MODIS, MCD12Q1(c5.1) mosaic	✔	✔	✔						Estimates of the timing of vegetation phenology at global scales. It identifies the vegetation growth, maturity, and senescence that mark seasonal cycles.
Land surface temperature and Emissivity - MODIS, MxD11A(c5) mosaics							✔		USGS MODIS land product MCD12Q1.051 mosaiced and reprojected for Australia. Five global land cover classification schemes.
Land surface temperature day-night difference - MODIS							✔		Land surface temperature and emissivity derived from MODIS sensors on NASA's Terra and Aqua satellites products. MODIS products are produced daily using the generalized split-window LST algorithm, which optimally separates the ranges of atmospheric column water vapor and lower boundary air surface temperatures into tractable sub-ranges. Australian sections of these products are then: (1) mosaiced and remapped using MRT, (2) split into individual bands to reduce file size, and (3) formatted for consistency.

Product								Description
Leaf area index (LAI) and Fraction of photosynthetically active radiation (fPAR) - MODIS, MOD15A2(c5) mosaic		✔						LST difference between day and night observations, for the estimation of diurnal variation of LST. LST is a key variable for monitoring climatological processes and surface energy interactions at regional to global scales. Diurnal variation of LST is a crucial parameter for the assessment of solar insolation, surface characteristics and climate variability. It combines day and night time LST data layers and a third layer, day-night difference layer, into a single netCDF file. These datasets were quality filtered based on the QC layers provided with the MODIS data. MODIS data were reprojected to geographic projection (WGS 84 datum).
Mangrove monitoring - collection of data, Mangrove monitoring sites		✔		✔		✔		LAI defines the number of equivalent layers of leaves relative to a unit of ground area, while fPAR measures the proportion of available radiation in the photosynthetically active wavelengths that is absorbed by a canopy. They can be used for calculating surface photosynthesis, evapotranspiration, and net primary production, which in turn can be used to calculate terrestrial energy, carbon, water cycle processes, and biogeochemistry of vegetation. Both variables are derived from NASA's MODIS Land Products. Australian sections of these products are then: (1) mosaiced and remapped using MRT, (2) split into individual bands to reduce file size, and (3) formatted for consistency.
Near real-time burnt area - MODIS					✔			Collection of derived and quality assessed data files for the mangrove monitoring system for Australia. These data are used to assess historical and current mangrove dieback and health.
Normalised difference vegetation index (NDVI) - AVHRR	✔	✔						Locations of areas affected by fire in near real-time (usually available within 2h of the satellite overpass). Derived from daily day time observations from MODIS sensors on NASA's Terra and Aqua satellites. Observations are atmospherically corrected and the resulting time series is investigated for sudden changes in reflectance, persistent over multiple days. Variations in observation and illumination geometry are taken into account through application of a kernel driven BRDF model.
Normalised difference vegetation index (NDVI) and Enhanced vegetation index (EVI) - MODIS, MOD13Q1(c5) mosaic	✔	✔						Vegetation indices provide consistent spatial and temporal comparisons of vegetation conditions. NDVI provides a measure of the amount of live green vegetation. This product represents one of the longest time-series of consistent satellite data for measuring the status and dynamics of vegetation across Australia.
Persistent Green-Vegetation Fraction and Wooded Mask	✔	✔						Vegetation indices provide consistent spatial and temporal comparisons of vegetation conditions. Enhanced Vegetation Index (EVI) minimises canopy background variations and maintains sensitivity over dense vegetation.
Phenology - MODIS, derived from MOD13C1 EVI	✔		✔					Woody-vegetation cover of Australia for the decade from 2000 to 2010, derived from field, airborne and satellite image data.
Seasonal cover deciles - Landsat, JRSRP algorithm	✔	✔						Characterisation of phenological cycles of greening and browning as well as quantification of the cycles' inter and intra annual variability.
Seasonal fractional cover - Landsat, JRSRP algorithm	✔	✔						Two decile products (total and green) derived from the historical time-series of seasonal fractional cover images. These products compare, at per-pixel level, the cover for a specific season of interest against the long term cover for that same season. For each pixel all cover values over the entire time-series of seasonal images are classified into deciles. The cover value for the pixel in the season of interest is then classified according to the decile in which it falls.This is a very useful approach to identify areas of low or high cover, relative to what is normal at that location at that time of year.
Seasonal ground cover - Landsat, JRSRP algorithm	✔	✔						Seasonal medians of fractional cover, with landcover fractions representing the proportions of green, non-green, and bare cover. Compositing seasonal images has multiple benefits, including: the creation of a regular time-series capturing seasonal variability, as well as the minimisation of missing data and contamination present in single date imagery.
Seasonal Persistent Green Cover - Landsat, JRSRP	✔	✔						Combination of information from the Persistent Green and Seasonal fractional cover products that allows the estimation of the 'true' ground cover for each season. Restricted to areas of less than 60% woody vegetation.

algorithm								
SLATS Star transects		✔	✔	✔					Estimate of persistent green cover per season.This is intended to estimate the portion of vegetation that does not completely senesce within a year, which primarily consists of woody vegetation (trees and shrubs).
Sub-pixel fire patchiness (fraction pixel burnt) - MODIS					✔				Spatial datasets with In situ records of vegetative and non-vegetative fractional cover. Data is collected in three strata: non-woody vegetation including vegetative litter near the soil surface, woody vegetation less than 2m, and woody vegetation greater than 2m. Produced regularly (monthly, seasonally, annually) to monitor change in ground cover. These data are used to calibrate and validate large area fractional cover spatial datasets derived from remote sensing.
Sunphotometer Aerosol Optical Depth				✔			✔		Estimate of the fraction of a pixel that has been burnt. Derived from daily day time observations from MODIS sensors on NASA's Terra and Aqua satellites. These observations are atmospherically corrected and the fraction of pixel burnt is estimated through spectral unmixing.
Sunphotometer Ozone				✔			✔		Aerosol optical thickness data captured by sunphotometers (MicroTops instruments). These data are used for atmospheric correction of remotely sensed image data and validation of aerosol products (e.g. MOD04 and the reflectance change method). DataSunphotometer measurements capture data on atmospheric particles and properties including aerosols. The data are used for atmospheric correction of airborne and satellite imagery.
Surface reflectance - MODIS, MxD09 mosaics						✔			Ozone data captured by sunphotometers (MicroTops instruments). These data are used for atmospheric correction of remotely sensed image data.
Terrestrial laser scans - DWEL, raw and QA data for all sites		✔		✔					Estimate of the surface spectral reflectance as it would be measured at ground level in the absence of atmospheric scattering or absorption (low-level data are corrected for atmospheric gases and aerosols). Derived from NASA's MODIS Land Products (MODIS Surface Reflectance products). Australian sections of these products are then: (1) mosaiced and remapped using MRT, (2) split into individual bands to reduce file size, and (3) formatted for consistency.
Terrestrial laser scans - Individual tree point clouds and cylinder models, Rushworth Forest		✔		✔					3D measurements directly related to the quantity and distribution of plant materials in the canopy obtained using a version of the dual wavelength echidna lidar (DWEL), a full-waveform recording Terrestrial Laser Scanning (TLS) instrument. DWEL dual wavelength can discriminate green and woody vegetation. The measurements can be used for applications requiring: quantification of vegetation structure parameters, tree and stand reconstruction, and terrain analysis.
Terrestrial laser scans - Riegl, raw and QA data for all sites		✔		✔					Single trees were extracted from the Terrestrial Laser Scans (TLS; also known as Ground LiDAR) data acquired in native Eucalypt Open Forest. Estimates of tree volumes were derived directly from these point cloud data using quantitative structure models. Above-ground biomass was inferred from the derived volumes and basic wood density information. Finally, the inferred biomass data were compared with estimates of above-ground biomass derived from allometric equations and destructive sampling.
Thermal anomalies (fire hotspots) - MODIS, MOD15A2(c5) mosaic					✔				3D measurements directly related to the quantity and distribution of plant materials in the canopy obtained using two Riegl VZ400 waveform recording Terrestrial Laser Scanning (TLS; also known as Ground LiDAR) instruments. These measurements can be used for applications requiring: quantification of vegetation structure parameters, tree and stand reconstruction, and terrain analysis.
Top of atmosphere reflectance for red and near-infrared bands - MODIS							✔		Locations of fire primarily derived from MODIS 4- and 11-micrometer radiance data. The fire detection method is based on absolute detection of a fire (when the fire strength is sufficient to detect), and on detection relative to its background (to account for variability of the surface temperature and reflection by sunlight). Numerous tests are employed to reject typical false alarm sources like sun glint or an unmasked coastline.
Total Cover - MODIS, Land Condition Index (LCI) algorithm	✔	✔							Top of-atmosphere (TOA) reflectances for MODIS bands 1 (i.e. Red) and 2 (i.e. Near-Infrared, NIR), with oceans masked out. It is ready to use for semi-automatic mapping of burned areas. This product is derived from daily daytime observations by MODIS sensors on NASA's Terra and Aqua satellites.
Tree structural		✔	✔	✔					Index of total vegetation cover (green and non-photosynthetic vegetation), and so is

characteristics									also an index of soil exposure. This product can be used for assessing and monitoring soil exposure across extensive agricultural regions at risk of soil erosion.
Vegetation height and structure		✔	✔						Data include a characterization of a sample of trees by the basal wedge method, and for each tree measurements of its structural characteristics. These data can be used for the calibration and validation of LiDAR derived products of tree height, canopy height profiles and allometrically derived Diameter Breast Height (DBH).
Water Count and Prevalence - Landsat, JRSRP algorithm, NSW	✔							✔	Vertical plant profiles for the Australian continent, including summaries of height, cover, age class, and L-band backscatter characteristics. Derived from the ICESat and Landsat time-series and ALOS PALSAR datasets.
Western NSW Refugia - Collection, JRSRP algorithm	✔	✔						✔	Provides an indication of the presence and persistence of water in the landscape.
Woody Extent and Foliage Projective Cover - SPOT, OEH algorithm, NSW	✔	✔	✔						Collection of spatial layers that can be used to identify potential refugia in the arid and semi-arid region of western NSW including: green accumulation index and green-feature classes, water count and water prevalence classes, woody extent and FPC, and topographic layers.

Table 3. Description of the temporal and spatial coverage and resolution of the datasets in the Data Products in Landscape Assessment (AusCover) facility, as well as the description of the files containing the datasets. In *pink* data products that currently can be downloaded. *Acronyms*: CRS = Coordinate Reference System, nc = NetCDF

Data Product	Temporal		Spatial		File			
	Coverage	Resolution (composite period)	Coverage	Resolution	Product sub-type	Format	Layers number	Typical Size (KB)
Active-fire based burned area - MODIS, MCD64A1(v5.1) mosaic	2000-Ongoing	1 month	Australia	500m				
Active-fire based burned area - MODIS, MCD64A1(v5.1) mosaic	2010 - 2014 (specific capture dates for each site)	1 day	Australia	100m		nc	3: **burn_date**, typical_mask, quality	5,666
Airborne hyperspectral - raw and QA data for all sites	2012-Ongoing, (specific capture dates for each site)	1 day	AusCover field sites	0.3 m				
Airborne LiDAR - raw and QA data for all sites	2012-Ongoing (specific capture dates for each site)	1 day	AusCover field sites	0.3 m				
Annual fire scars - Landsat, Qld	1987 - 2015	1 year.	Queensland	30m		tif	1	118,743
Australian Gridded Climate Data (AGDC)	1900-Ongoing	1 day & 1 month	Australia	5km		nc	1	15,873
Australian Ground Cover Reference Sites Database - ABARES	2010 - 2014 (specific capture dates for each site)	1 day.	Australia	100m				
Biomass plot library	1936-Ongoing (Specific dates for each site)	1 day	Australia wide sites	0.05 to 1 ha				
Bidirectional Reflectance Distribution Function (BRDF) and Albedo - MODIS, MCD43A(c5) mosaics	2000-Ongoing	16 day	Australia	500m				
Burnt area and approximate day of burn - MODIS	2000-Ongoing	1 month	Australia	250m (0.0025°)				
Chlorophyll Fraction of Photosynthetic Radiation (fPARchl) - MODIS	2000 - 2014	1 month	Australia	5km (0.05°)				
Dynamic Land Cover Dataset - MODIS	2000 - 2008	Single layer from data	Australia	250m		zip ->	1	Zip:

						tif		251,289 (with 13 tif files) tif:280,9 38
Ecosystem Disturbance Index - MODIS	2003 - 2013	1 year	Australia and New Zealand	500m				
Enhanced Vegetation Index (EVI) - MODIS, MOD13Q1(c5) mosaic despiked	2000 - 2011	16 days	Australia	250m		ENVI: hdr (head er) + img	To be tested: Only hdr downloaded due to img size	Hdr: 12 Img: 136 GB
Enhanced Vegetation Index (EVI) and Land Surface Temperature (LST) - MODIS, spatially and temporally interpolated	2000 - 2014	16 days	Australia	500m				
Fire frequency - AVHRR	1997 - 2011	15 year	Australia	1km (0.01°, 112 to 14 E, -10 to -44 N)		tif	1	1,094
Fire severity - MODIS	2002-Ongoin g	1 month	North Australia	250m (0.0025°)				
Fraction of Photosynthetically Active Radiation (fPAR) - AVHRR	8km: 1981 - 2011 1km and 5km: 1995 - 2011	1 month	Australia	Resolution: 1km, 5km, and 8km.				
Fractional cover - Landsat, JRSRP algorithm	2000 - 2011	≥ 1 image / (standard calendar season)	Australia	30m				
Fractional cover - MODIS, CSIRO algorithm	2000-Ongoin g	8 day & 1 month.	Australia and Global	500m for the Australian coverage & 5km for the Global coverage.		tif	1	22,544
Fractional Cover - MODIS, Monthly Median Composites	2000-Ongoin g	1 month	Australia	500m		img	1	94,297
Fractional Cover Metrics - MODIS	2000 - 2014	1 month, 3 months (1 season), & 1 year.	Australia	500m		GNU Zipped	1	Img.g z= 17,795 img = 31,061
Grassland curing - MODIS	2000-Ongoin g	8 day	Australia	500m		nc	3: land_mask, **curing**, observation_date	278,966
Green Accumulation Index - Landsat, JRSRP algorithm, NSW	1988 - 2012	Single layer	New South Wales	30m		img	1	353,917

Gross Primary Productivity (GPP) - MODIS, MOD17A2(c5) mosaic	2000-Ongoing	8 day	Australia	1km		nc	4: **gpp**, psn, typical_mask, quality	18,626
Hemispherical photography	2011-Ongoing (specific capture dates for each site)	1 day.	AusCover field sites.	1ha.				
Hyperspectral ground calibration data	2011-Ongoing (specific capture dates for each site)	1 day	AusCover field sites	10m				
Hyperspectral surface reflectance - Hyperion	2001 - 2010 (acquired scenes)	1 day	Australia	30m				
Land Cover Dynamics - MODIS, MCD12Q2(c5) mosaic	2001-Ongoing	2 year	Australia	500 m		nc	16: **onset_greenness_increase_cycle1**, onset_greenness_increase_cycle2, onset_greenness_maximum_cycle1, onset_greenness_maximum_cycle2, onset_greenness_decrease_cycle1, onset_greenness_decrease_cycle2, onset_greenness_minimum_cycle1, onset_greenness_minimum_cycle2, nbar_evi_greenness_minimum_cycle1, nbar_evi_greenness_minimum_cycle2, nbar_evi_greenness_maximum_cycle1, nbar_evi_greenness_maximum_cycle2, nbar_evi_greenness_area_cycle1, nbar_evi_greenness_area_cycle2, quality, typical_mask	369,238
Land Cover Type - MODIS, MCD12Q1(c5.1) mosaic	2001-Ongoing	2001-Ongoing Composite: 2 year.	Australia	500 m	'Scanned Map'	gif	1	147,456
						nc	9: **lc_type_igbp**, lc_type_umd, lc_type_lai_fpar, lc_type_npp,	58,405

							lc_type_pft, lc_type_assessm ent_igbp, lc_type_seconda ry_igbp, quality, typical_mask	
Land surface temperature and Emissivity - MODIS, MxD11A(c5) mosaics	2000-Ongoin g Composite: 1 day and 8 day	1 day & 8 day	Australia	1km		nc	8: **lst_day**, lst_night, emissivity_10780 _11280nm, emissivity_11770 _12270nm, typical_mask_da y, quality_day, typical_mask_nig ht, quality_night	29,473
Land surface temperature (LST) day-night difference - MODIS	2000 - 2014	8 day	Australia and New Zealand	1km				
Leaf area index (LAI) and Fraction of photosynthetically active radiation (fPAR) - MODIS, MOD15A2(c5) mosaic	2000-Ongoin g	8 day	Australia	1km		nc	5: **fpar**, lai, typical_mask_fpa r, typical_mask_lai, quality	11,236
Mangrove monitoring - collection of data, Mangrove monitoring sites	TBA	TBA	Mangrove monitoring sites.	5km				
Near real-time burnt area - MODIS		1 day as per satellite overpass Last 60 day from present	Australia	250m (0.0025°)		tif	1	5,050
Normalised difference vegetation index (NDVI) - AVHRR	1992 - 2014	10 days & 1 month.	Australia	1 km & 5 km		nc	1	61,593
Normalised difference vegetation index (NDVI) and Enhanced vegetation index (EVI) - MODIS, MOD13Q1(c5) mosaic	2000-Ongoin g	16 days.	Australia	250m	NDVI	nc	3: **ndvi**, typical_mask, quality	246,911
					EVI	nc	3: **ev**i, typical_mask, quality	237,000
Persistent Green-Vegetation Fraction and Wooded Mask	2000 - 2010	Single layer for coverage.	Australia	30m				
Phenology - MODIS, derived from MOD13C1 EVI	2000 - 2015	1 year	Australia	5km (0.05°.)				
Seasonal cover deciles - Landsat, JRSRP algorithm	1986-Ongoin g	≥ 1 image / (standard calendar season)	Australia	30m	Green - Aus	vrt	1	17

					Green - Qld	tif	1	514,273
					Total - Aus	vrt	1	17
					Total - Qld	tif	1	513,118
Seasonal fractional cover - Landsat, JRSRP algorithm	1986-Ongoing	≥ 1 image / (standard calendar season)	Australia	30m	Aus	vrt	1	17
					Aus - Bare	vrt	1	5
					Aus - Green	vrt	1	5
					Aus - Non Green	vrt	1	5
					Qld	tif	1	4,034,023
Seasonal ground cover - Landsat, JRSRP algorithm	1990-Ongoing	≥ 1 image / (standard calendar season)	Australia	30m	Aus	No file	No file	No file
					Qld	tif	1	8,150,794
Seasonal persistent green cover - Landsat, JRSRP algorithm	1990 - 2013	≥ 1 image / (standard calendar season)	Australia	30m	Aus	vrt	1	18
					Qld	tif	1	1,450,140
SLATS Star transects	2011-Ongoing A sample taken every ~10'. (specific capture dates for each site)	1 day	AusCover field sites.	1ha.		csv	Cannot (directly) create raster from '.csv'	648
Sub-pixel fire patchiness (fraction pixel burnt) - MODIS	2002-Ongoing	1 month	Australia	250m (0.0025°)				
Sunphotometer Aerosol Optical Depth	2011-Ongoing A sample taken every ~10'. (specific capture dates for each site)	1 day	AusCover field sites.	1ha.				
Sunphotometer Ozone	2011-Ongoing A sample taken every ~10'. (specific	1 day	AusCover field sites.	1ha.				

	capture dates for each site)							
Surface reflectance - MODIS, MxD09 mosaics	2000-Ongoing	1 day & 8 day.	Australia	250m, 500m, and 1000m				
Terrestrial laser scans - DWEL, raw and QA data for all sites	2014-Ongoing (specific capture dates for each site)	1 day	AusCover field sites.	30m radius from point of measurement				
Terrestrial laser scans - Individual tree point clouds and cylinder models, Rushworth Forest	04/May/2012	1 day	Rushworth forest, Victoria, Australia	40m				
Terrestrial laser scans - Riegl, raw and QA data for all sites	2012-Ongoing (specific capture dates for each site)	1 day	AusCover field sites.	30m radius from point of measurement				
Thermal anomalies (fire hotspots) - MODIS, MOD15A2(c5) mosaic	2000-Ongoing	8 day	Australia	1km		nc	3: **fire_mask**, typical_mask, quality	835
Top of atmosphere reflectance for red and near-infrared bands - MODIS	2000-Ongoing	1 day	Australia	250m				
Total cover - MODIS, Land Condition Index (LCI) algorithm	2000 - 2011	16 days produced every 8 days	Australia	500m				
Tree structural characteristics	2011-Ongoing (specific capture dates for each site)	1 day	AusCover field sites.	1ha				
Vegetation height and structure	2003 - 2009	Single layer	Australia	30m		kea	Cannot (directly) create raster from '.kea'	9,741,689
						tif	1	1,611,416
Water count and prevalence - Landsat, JRSRP algorithm, NSW	1988 - 2012	Single layers	Western New South Wales.	30m				
Western NSW refugia - Collection, JRSRP algorithm	1988 - 2012	Single layers	Western New South Wales.	30m	Topographic layers	tif	1	785,568
					Woody Ext. & Projected Cover	tif	1	3,933,057

	2011	Single layer for coverage	New South Wales	5m		tif	1	1,936,462
Woody extent and foliage projective cover - SPOT, OEH algorithm, NSW						img	1	11,608