Australian Government
Geoscience Australia

Digital Earth AUSTRALIA

Datacubes as a tool for Analysis Ready Data Inter-Comparison

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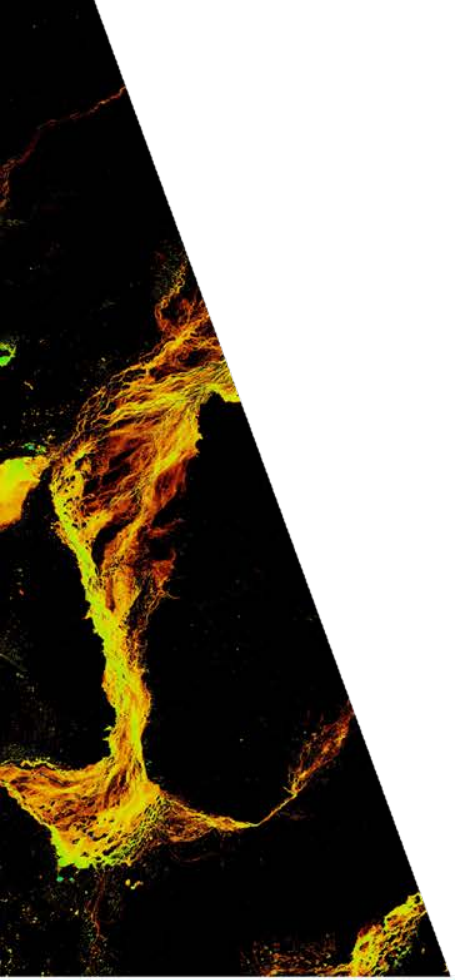
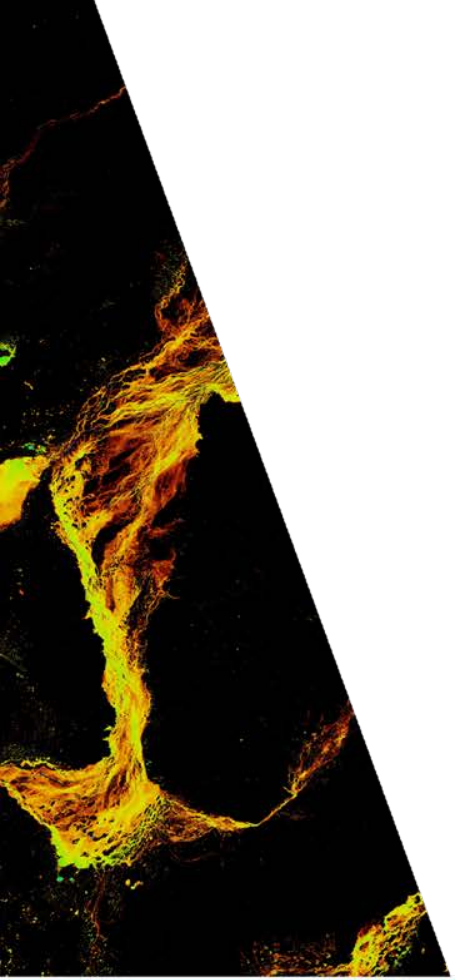


Overview

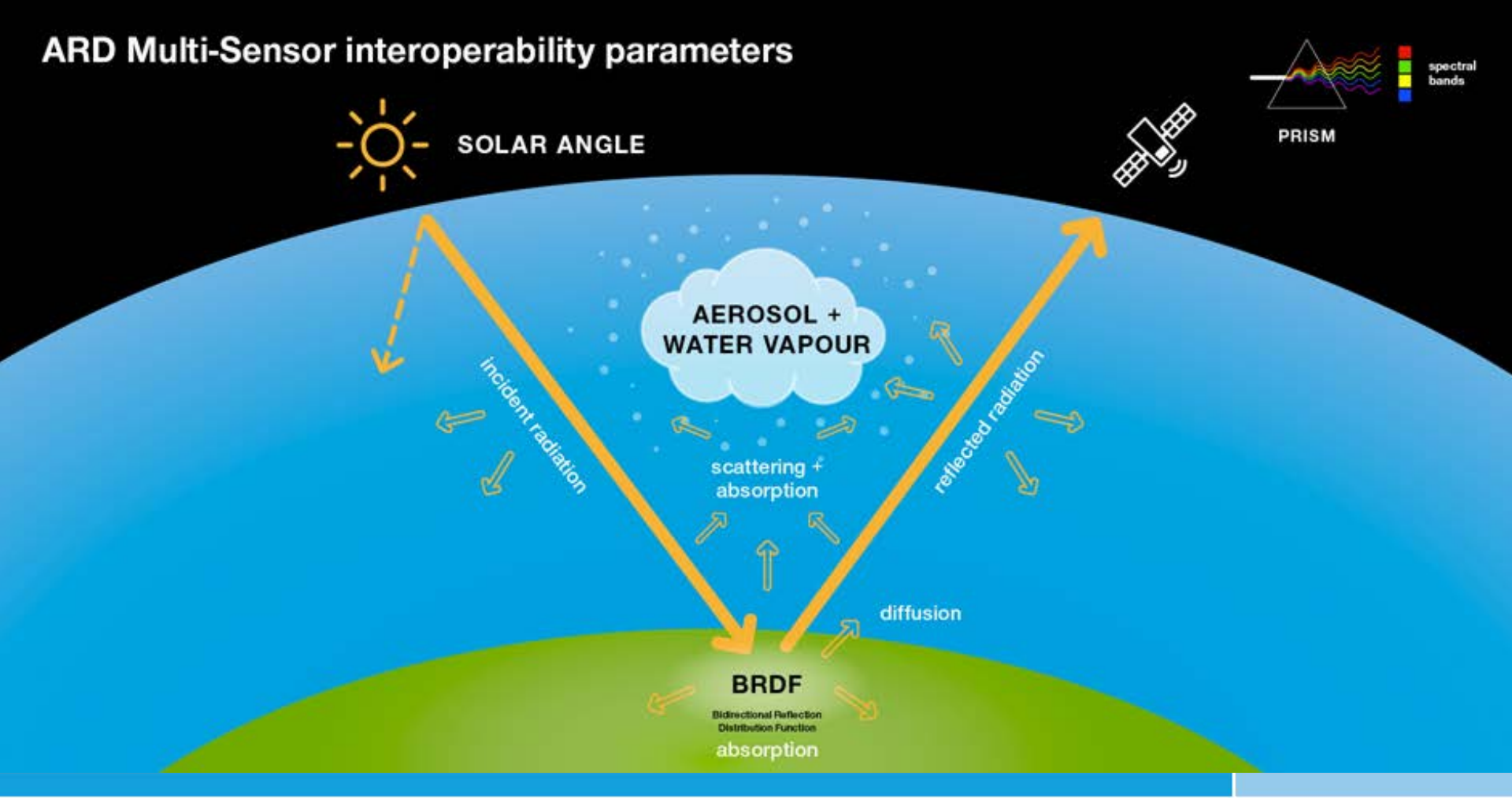
- Context
- Surface reflectance correction
- Understanding the differences
- Impacts on information products using:
  - self-normalising ratios of reflectance
  - reflectance thresholds
- Experimental design and broader objectives
- Examples using Landsat and OpenDataCube
- Future work

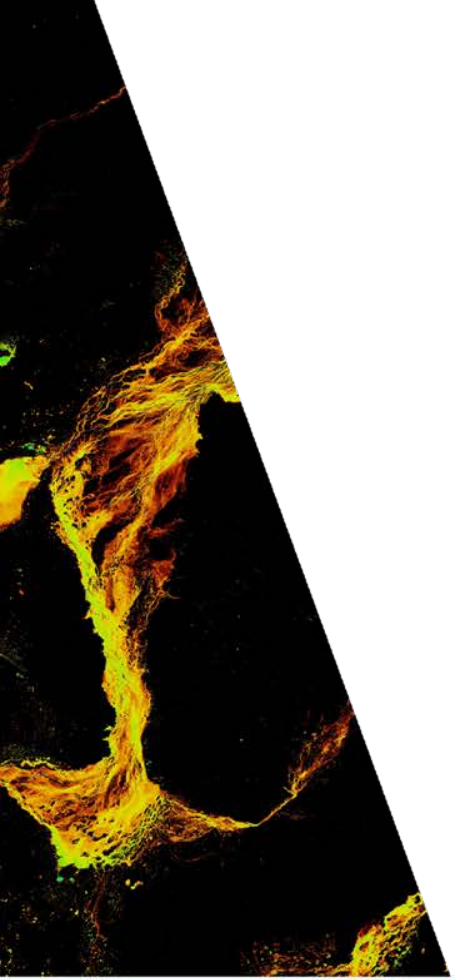


Context

- Analysis Ready Data increasingly adopted
- A range of surface reflectance corrections are possible
- ARD from data providers could replace in-house capabilities
- How should agencies with in-house capability form an evidence-based decision on this?
- Datacubes have allowed users to focus on analysis without being concerned with data correction
- Datacubes can also inform users about the data they contain.

ARD Multi-Sensor interoperability parameters

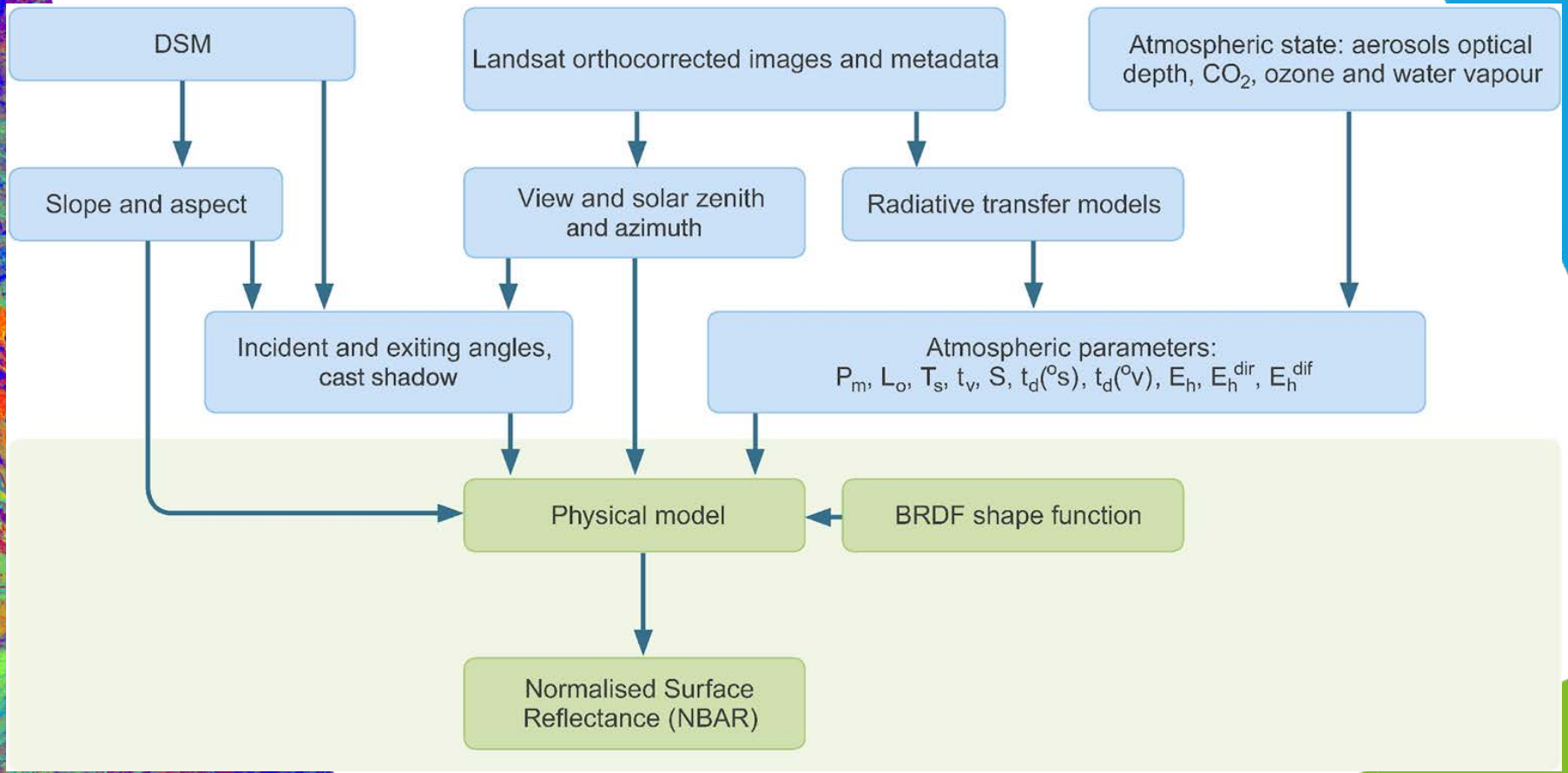


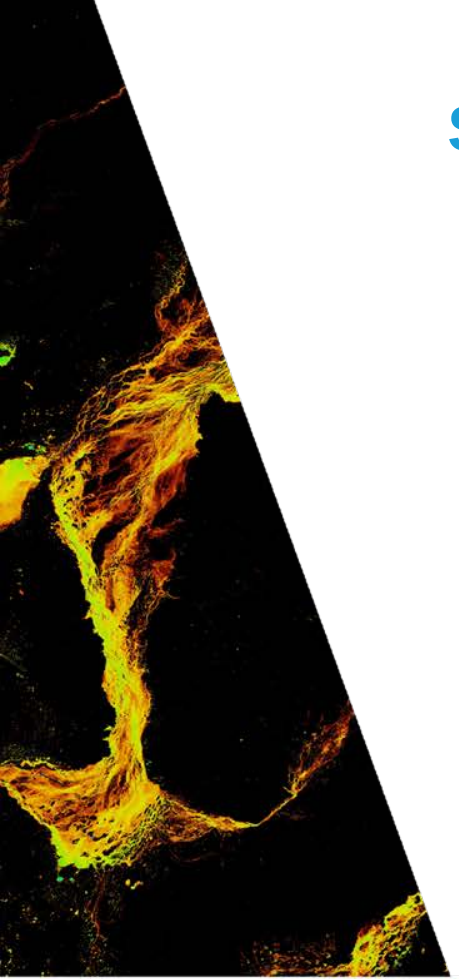


Analysis Ready Data

The core elements in ARD preparation may include:

- Geometric correction for co-registration
- Quality masks, e.g., null data, bad data and cloud
- Atmospheric correction
- *Bidirectional Reflectance Distribution Function (BRDF) correction*
- *Terrain illumination correction in areas sensed on mountainous areas*
- *Sun and sky glint correction in areas sensed on open water surfaces*





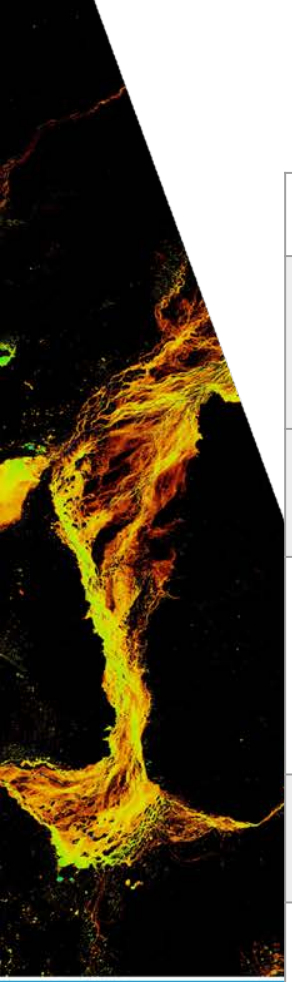
Surface Reflectance products for Landsat

USGS Surface Reflectance:

1. Landsat 4 to 7 - Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS)
2. Landsat 8 - Landsat Surface Reflectance Code (LaSRC)

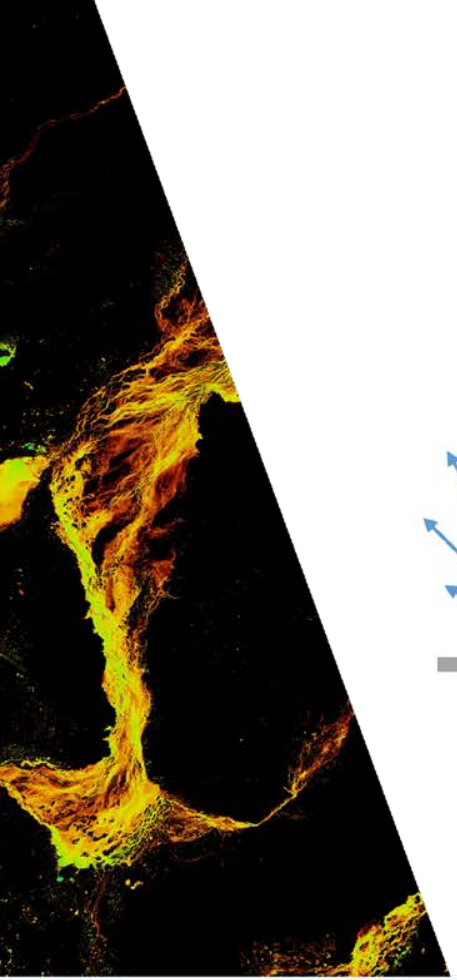
Geoscience Australia “wagl” system Landsat 5/7/8:

1. Lambertian
2. Nadir Bidirectional Reflectance Distribution Function (BRDF) Adjusted Reflectance (NBAR)
3. Nadir BRDF Adjusted Reflectance with Terrain Illumination Correction (NBART)



Landsat Surface Reflectance Correction

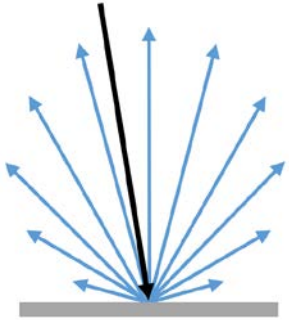
Correction	USGS L2	GA Lambertian	GA NBAR	GA NBART
BRDF: - **solar angle**	X	X	✓	✓
BRDF: - **view angle**	X	X	✓	✓
Atmospheric: - **solar angle** - **view angle**	✓ ✓	✓ ✓	✓ ✓	✓ ✓
Terrain illumination	X	X	X	✓
Adjacency	X	X	X	X

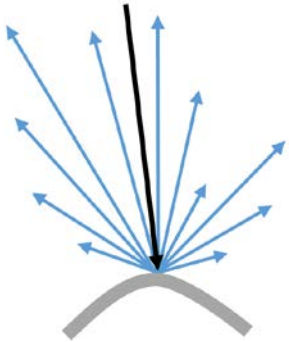


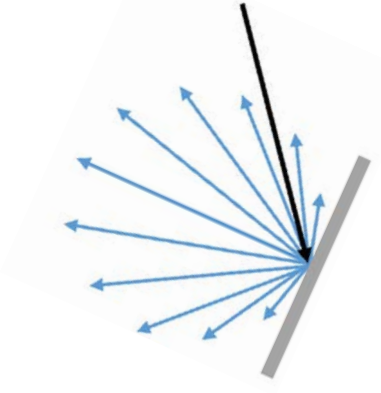
Lambertian

BRDF

Terrain

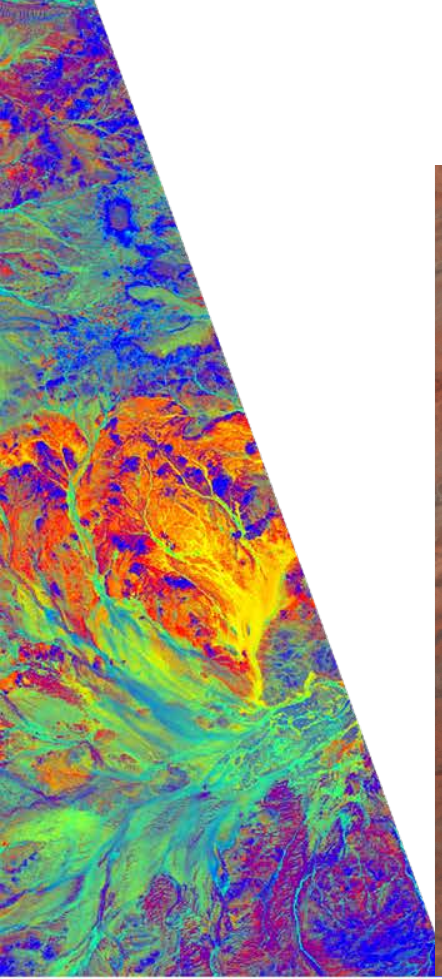


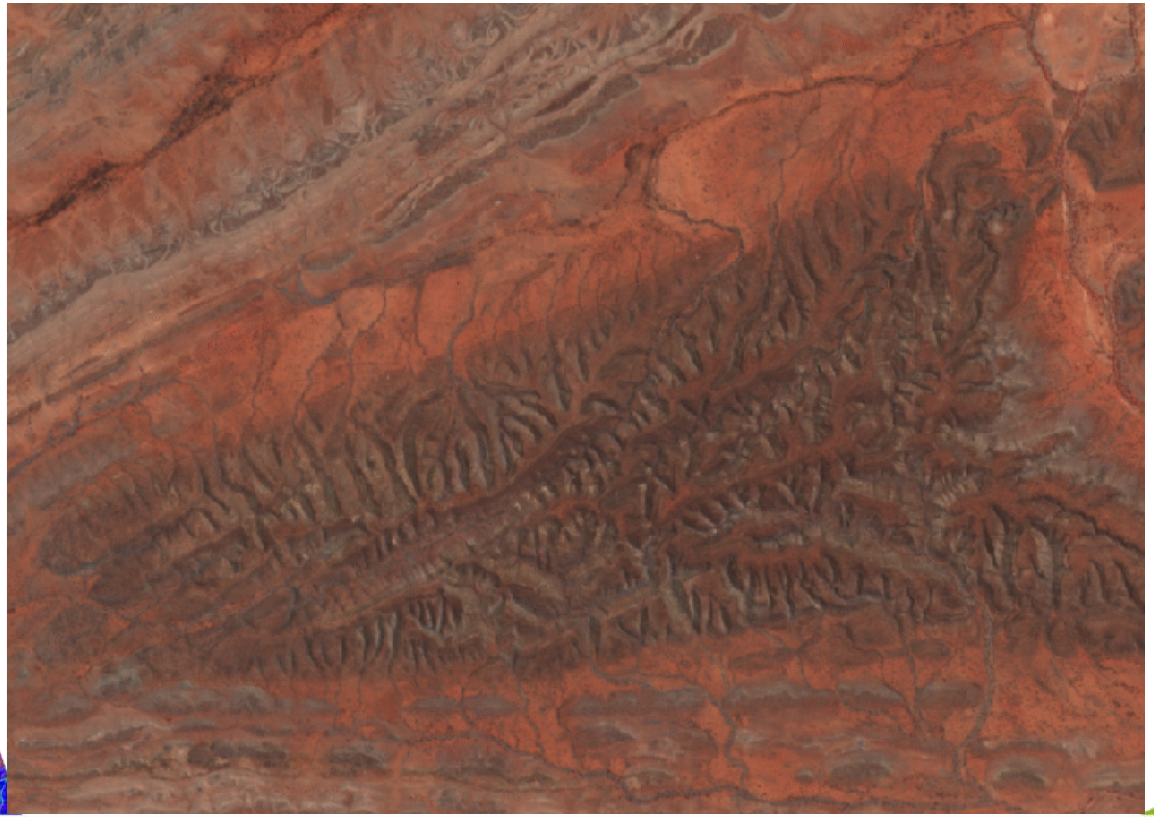


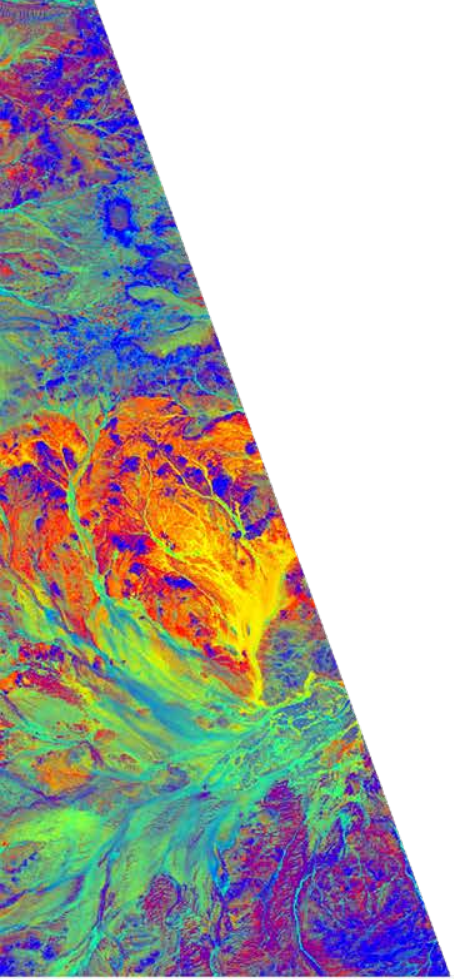


Model complexity + compute intensity

Terrain illumination correction







Open Data Cube

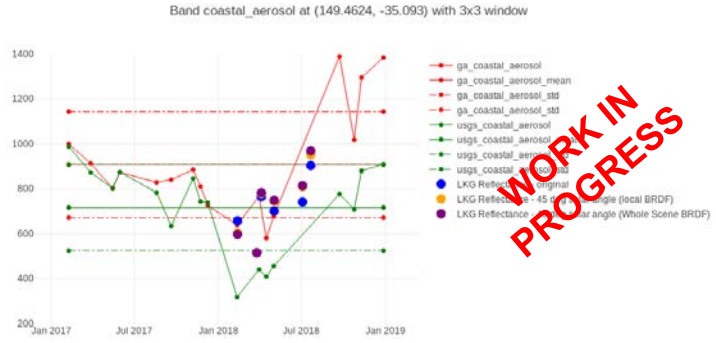
- Underpins numerous national and continental-scale initiatives including Digital Earth Australia
- Reduces barriers to non-expert user analysis
- Provides a means for efficiently analysing time-series at scale
- Also can be used to compare collections of similar products

Digital Earth AUSTRALIA

OPEN DATA CUBE

Experimental design

1. Assess ARD correction parameter **sensitivity**
2. Assess **temporal stability** - comparison of measurements from corrections through time (GA Lambertian/NBAR/NBART vs LEDAPS/LaSRC)
3. Field **validation** - comparison with in-situ measurements (historical and current)



Landsat Path/row	Number of scenes	Sensor and acquisition date
091/084	927	Landsat 5/7/8; 1986 ~ 2017
092/084	896	
093/084	887	
091/086	879	
092/086	892	
093/086	812	
094/074	894	
095/074	897	
096/074	895	
108/082	855	
109/082	858	
110/082	857	

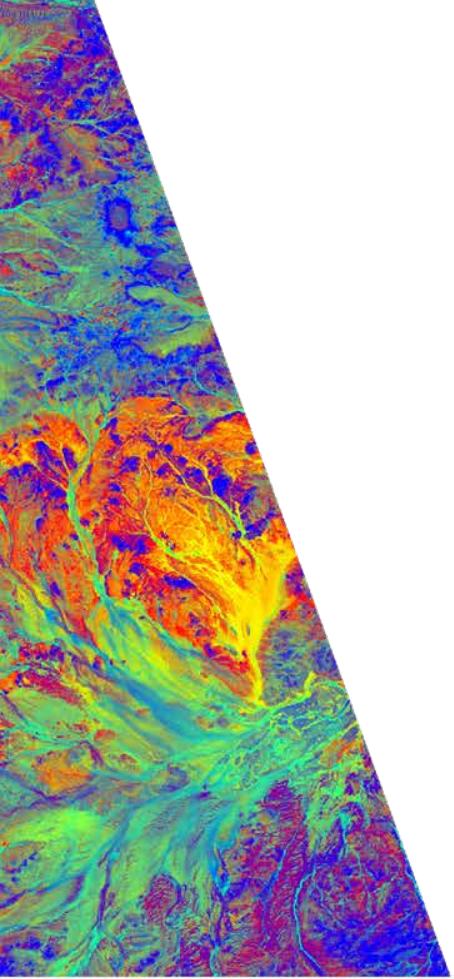
Low vegetation cover areas (low BRDF)

LAKE LEFROY

Supplemental Area

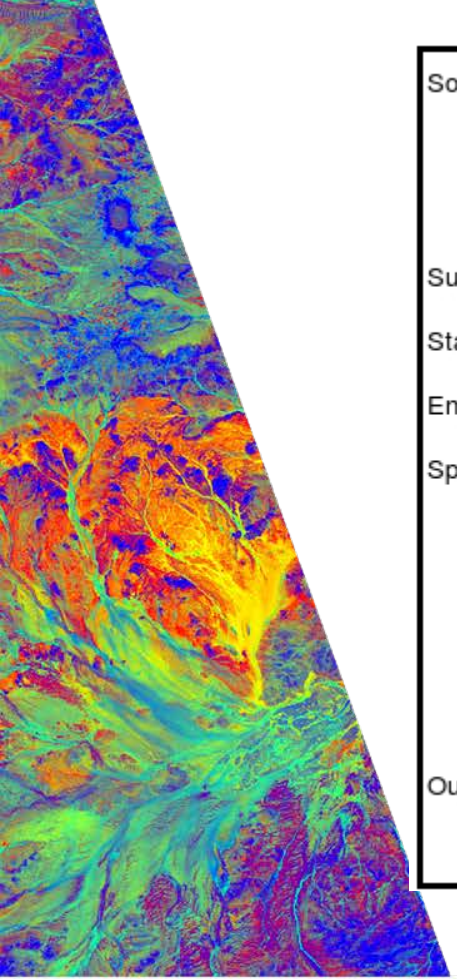
Medium vegetation cover

High BRDF targets



Method

- Level 1 collection 1 data retrieved from USGS
- USGS Level 2 Surface Reflectance products acquired on-demand through ESPA
- Geoscience Australia modified production code to match the USGS Level 2 product (assumes lambertian / ideal diffuse target)
- Level 2 data indexed to ODC instance
- Python tool developed to enable 1:1 comparison
- Use inter-comparison tool to interrogate datasets

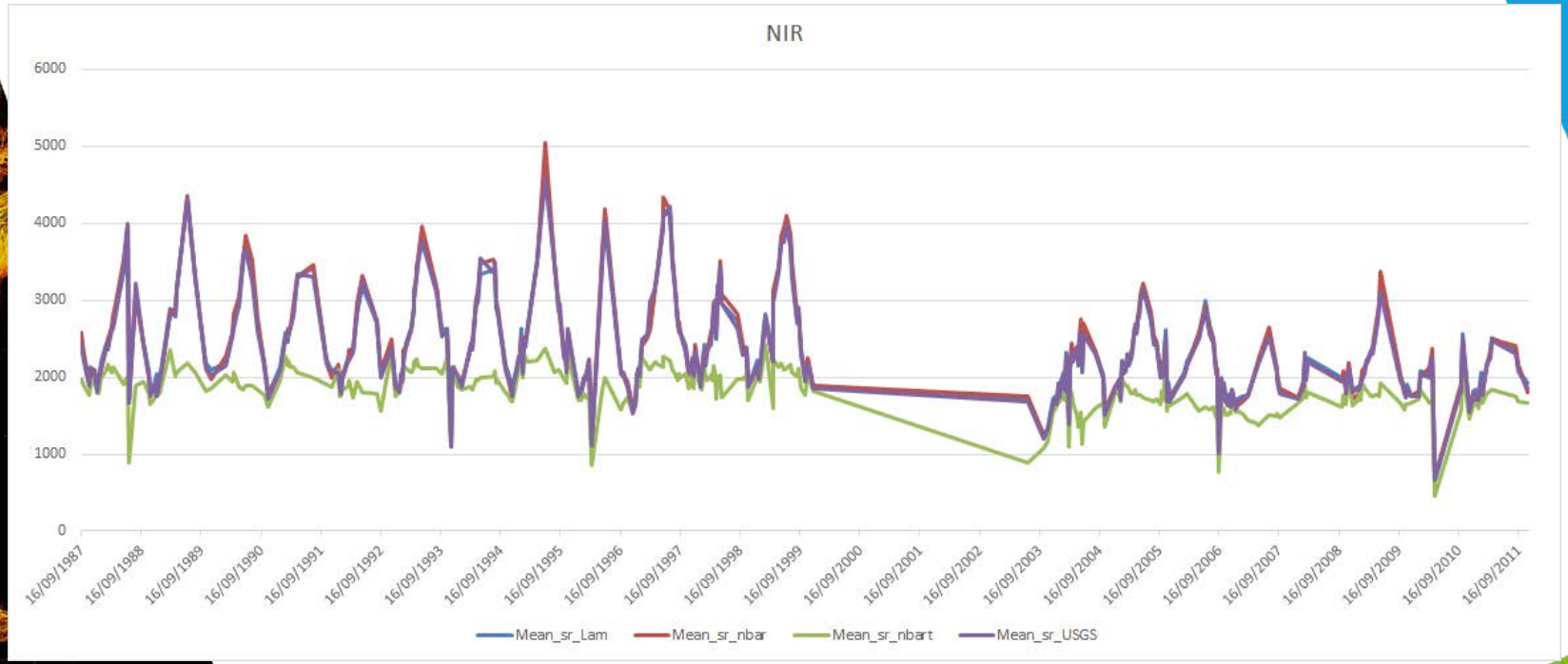


Source products	ls5_ard ls7_ard ls8_ard
Sub product to compare	lambertian
Start Date	2018-04-01
End Date	2018-12-31
Spatial location	Single lon/lat | Multiple lon/lat | Single polygon | Multiple polygo
Longitude	142.9384
Latitude	-22.5275
Window Size	3
Ouptut folder	/g/data/v10/tmp/intercomparison

Extract Products

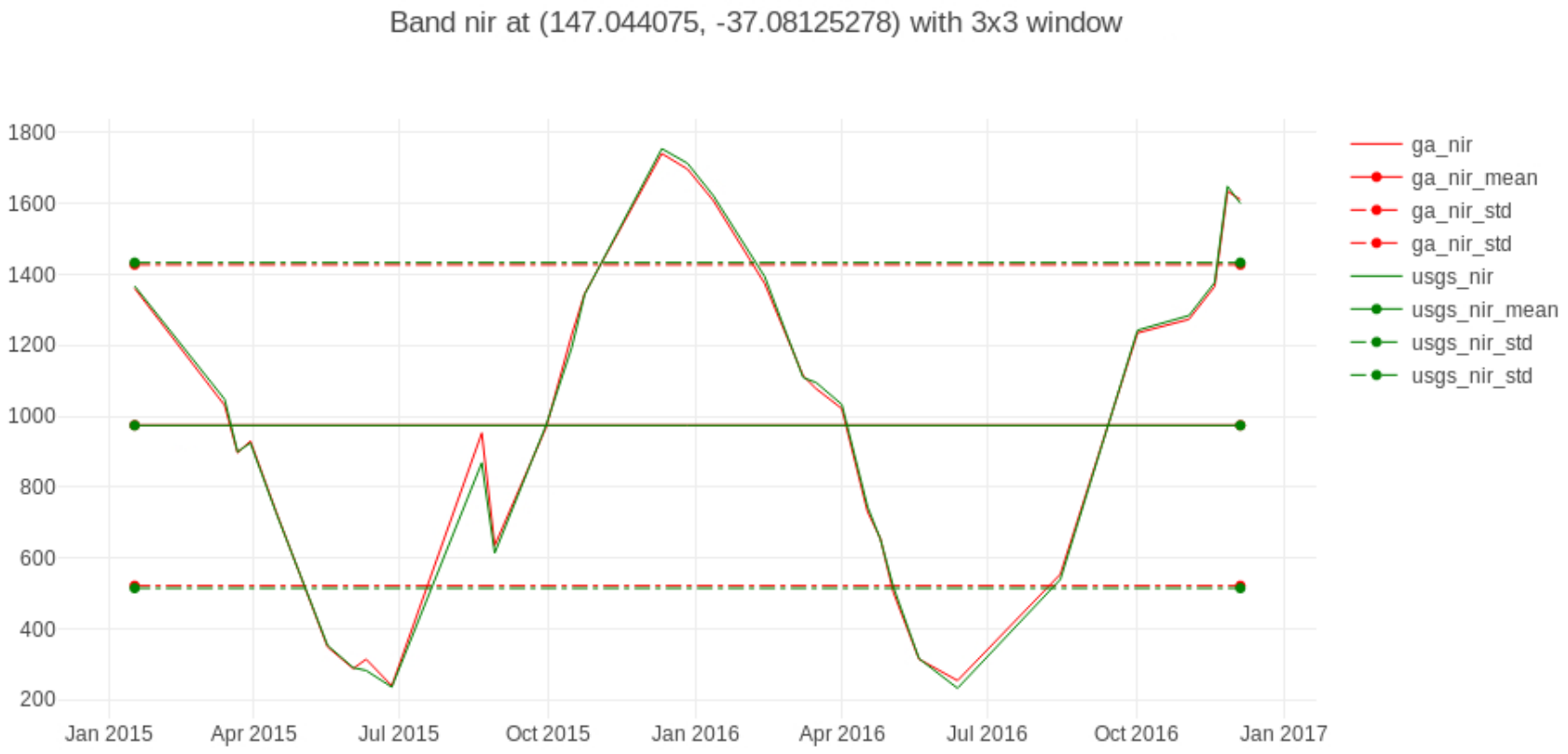
Normalising ratios - NDVI

Thresholds on spectra

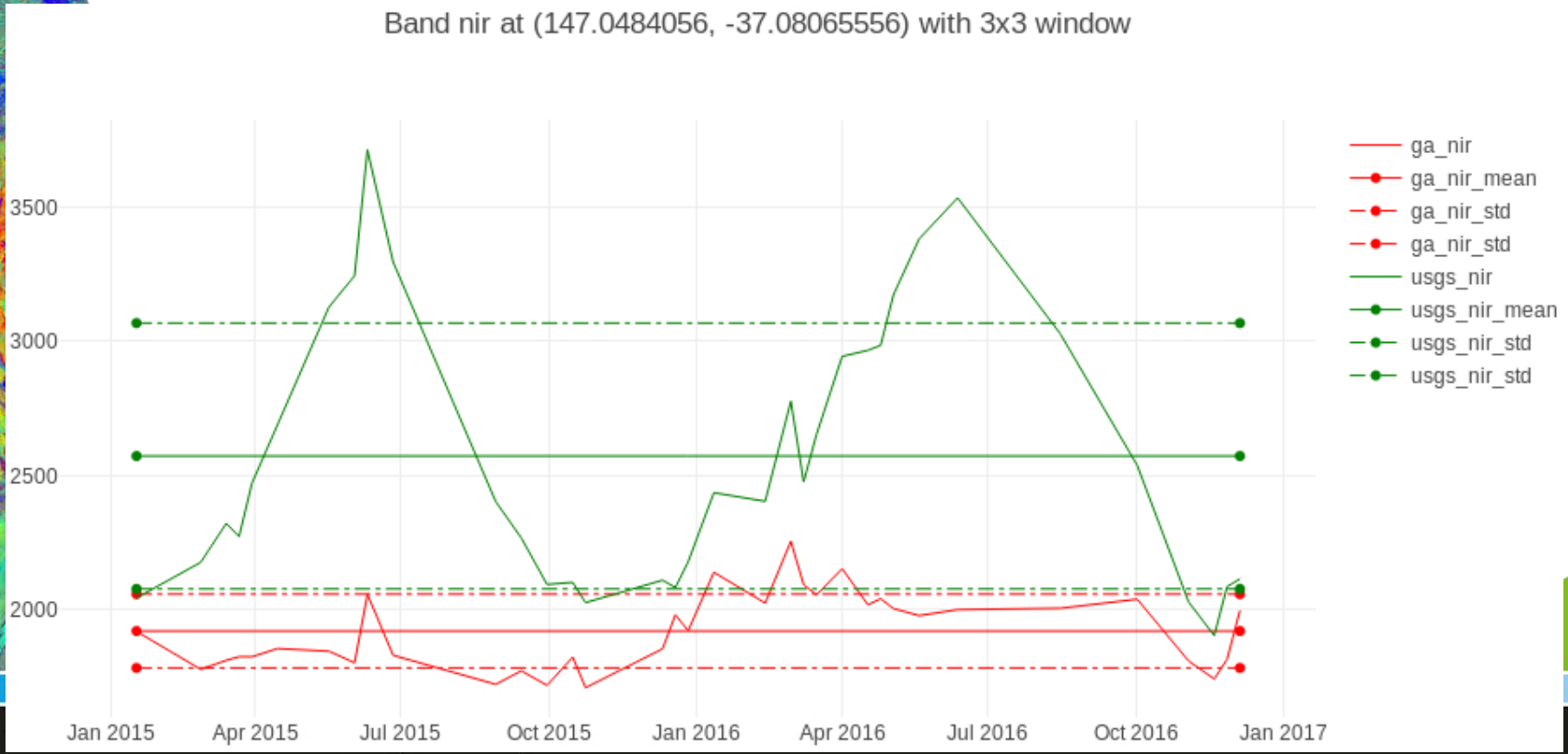


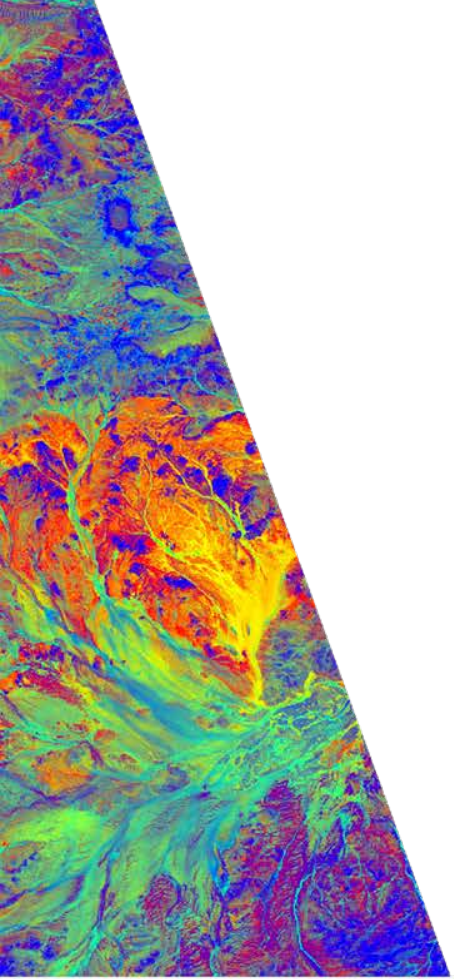
NE and SW Facing hill slope

SW Facing hill slope
USGS and GA Lambertian



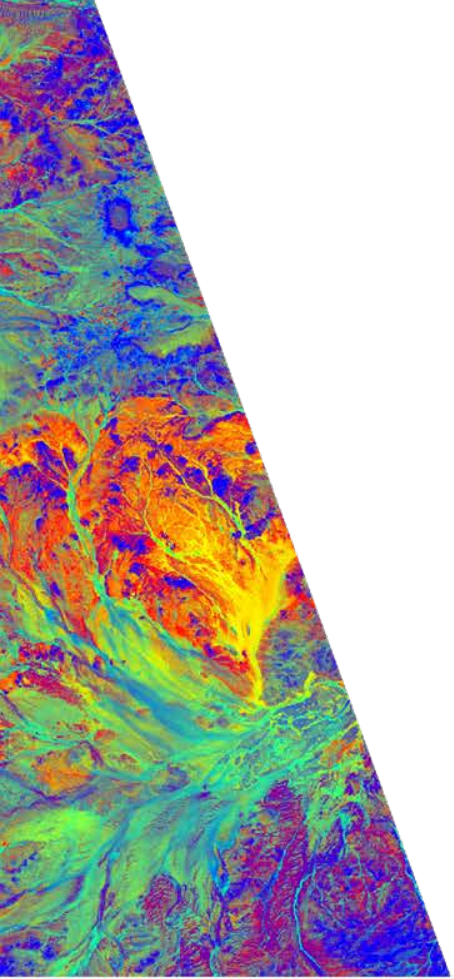
NE Facing hill slope – NIR band
USGS Lambertian - GA NBART





Upcoming features

- Generic sensor support - Landsat, Sentinel-2 or any OpenDataCube product
- Interactive map for query selection
- Optional matching of time-series pairs
- Update tool release - May 2019
- Results of sensitivity and inter-comparison study to be presented at Living Planet Symposium.



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Thanks!

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