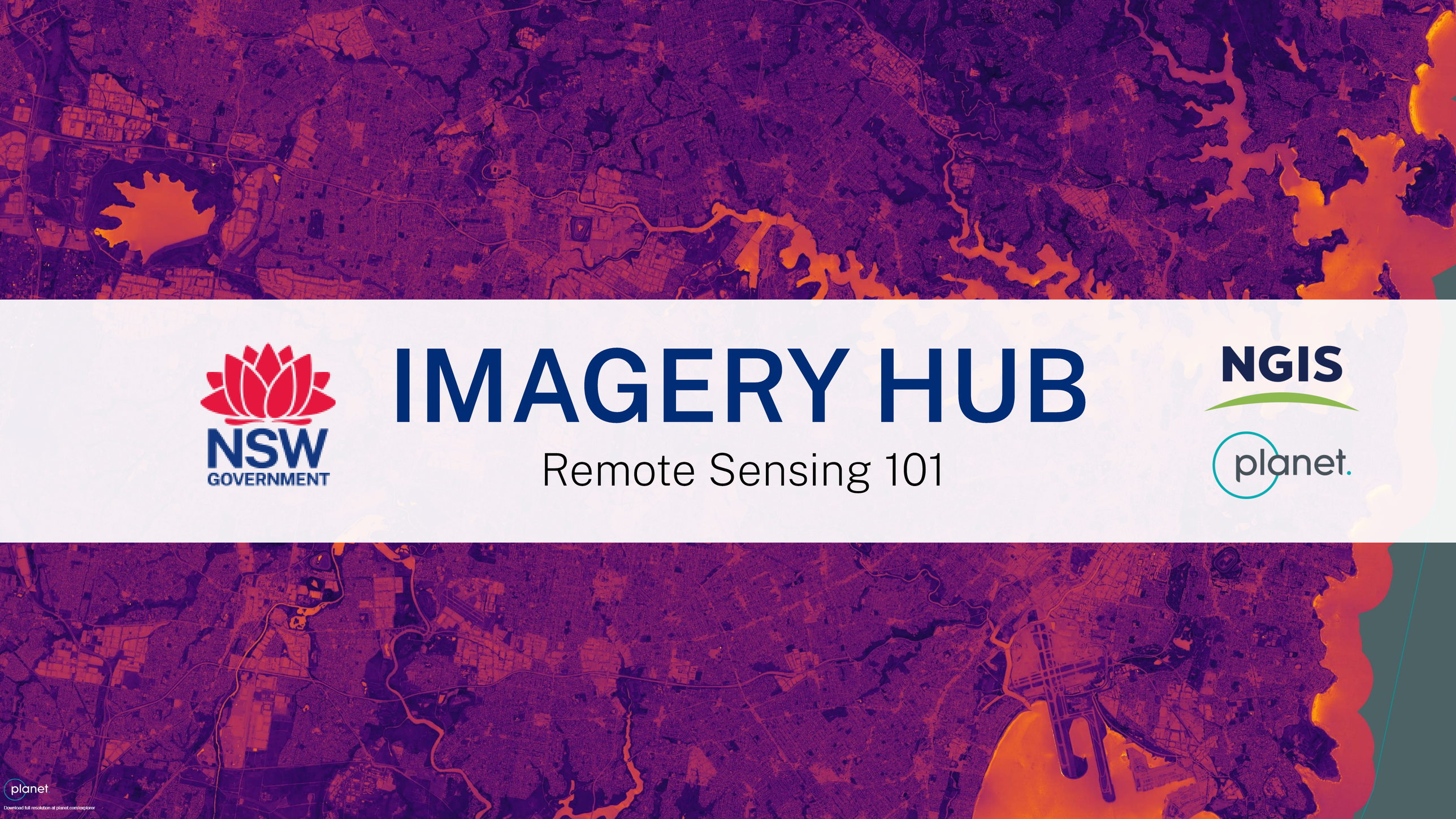
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Remote Sensing 101
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planet.
Download full resolution at planet.com/explorer

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ACKNOWLEDGEMENT

We pay respect to the Traditional Custodians and First Peoples of NSW and acknowledge their continued connection to their country and culture.

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WELCOME

Anthony Young

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CONTENTS

- Welcome
- Workflows
- Visual interpretation
- Spectral analysis
- Downloaded Imagery (GeoTIFFs)
- Q & A

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REQUIREMENTS

- Internet access
- NSW Imagery Hub Planet Account - to request an account please contact: spatial.imagery@environment.nsw.gov.au
- No prerequisites required

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YOU'LL LEARN

- About Remote Sensing and Earth Observation
- Understanding visual and temporal interpretation
- About spectral bands and indices
- Process for acquiring downloaded Planet data
- Analysis of downloaded 8-band PlanetScope and 4-band SkySat GeoTIFFs
- File metadata

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PRESENTERS

Brittany Baker

NGIS

IMAGERY HUB

MEET THE TEAM

Anna Bradney

NSW GOVERNMENT

Ken Gillan

NGIS

David Black

NSW GOVERNMENT

Abby Boulter

planet.

Sue Rea

NSW GOVERNMENT

Mina Tambrchi

NSW GOVERNMENT

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QUESTIONS

- Please place questions in the chat box. We will strive to answer all questions by the end of the webinar in the Q&A.

- This webinar is recorded. The recording will be available after the event on the Planet for NSW Government on Vimeo: https://vimeo.com/channels/dpespatialimagery

- Please contact us for any further queries:

spatial.imagery@environment.nsw.gov.au

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DOCUMENTATION

- Please contact the team if you require training, smaller and targeted sessions are available.

- Please contact us for any further queries:

spatial.imagery@environment.nsw.gov.au

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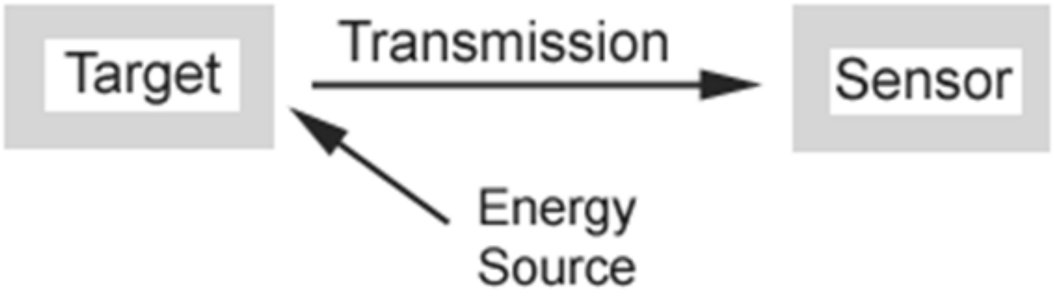
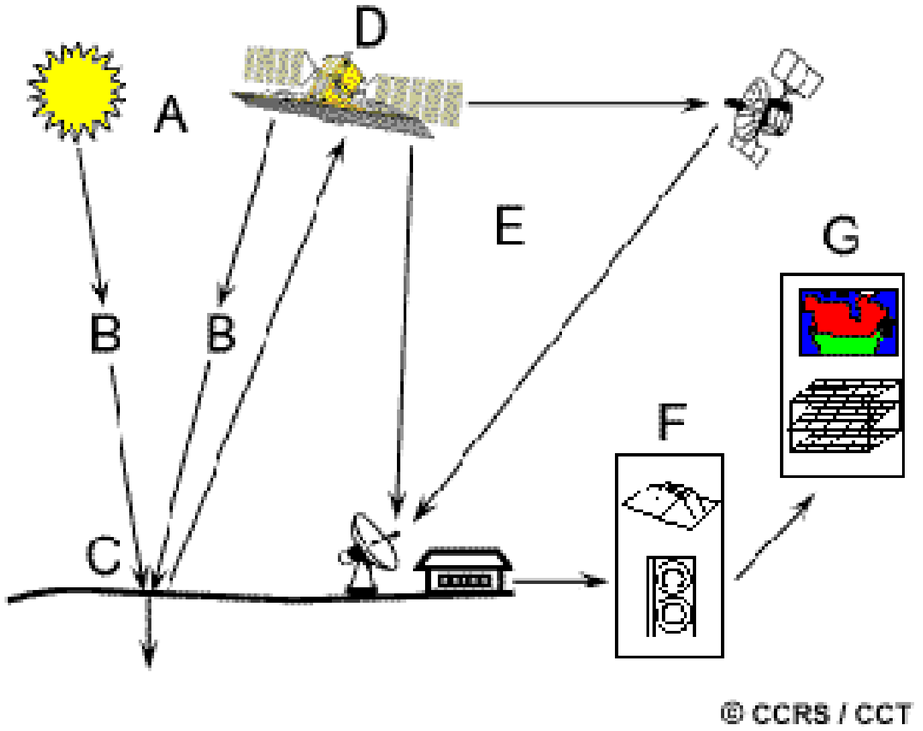
Earth Observation is the gathering of information about Earth using remote sensing technologies, usually involving satellites carrying imaging devices.





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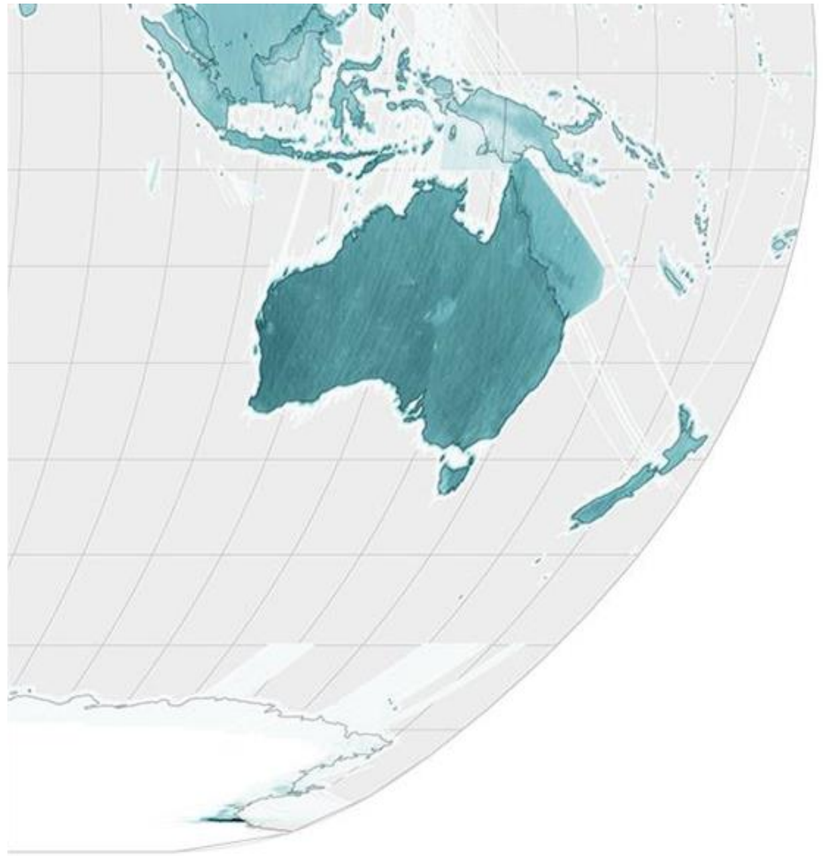
- Petabytes of imagery at any location in NSW
- Deep historical context on your areas of interest and deep imagery stacks for analytics and app development
- View change and assess trends
- Online access to PlanetScope, Landsat, and Sentinel archives, and tasked SkySat, SPOT, (more coming soon)



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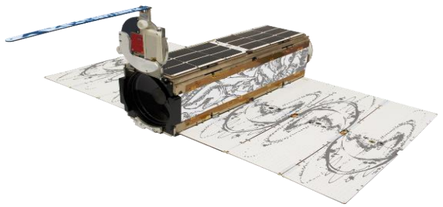
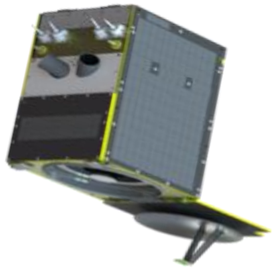


PlanetScope 3.7m (8-bands)

Near-daily NSW monitoring and archive online

Monthly NSW basemap web services

GeoTIFF downloaded & SPOT available **on request**



SkySat 0.5m (4-bands)

Tasking **on request**

Greater Sydney Basemap

Login to Explorer

Please request an account:
spatial.imagery@environment.nsw.gov.au

Navigate to https://planet.com/explorer

Search for imagery

Use the Explorer interface to select a date and browse the catalogue

Use online tools

Measure tools, snapshot, & Planet Stories for timelapse or comparison

Copy ID of imagery

Request download

Contact the team to download physical copy (GeoTIFF): spatial.imagery@environment.nsw.gov.au

Require a basemap? Login to the Viewer

View basemaps in the Basemap viewer:
https://www.planet.com/basemaps/

Use ArcGIS Pro or QGIS integration

Installed Plugin or Add-in:
https://developers.planet.com/integrations/

Login with your account to load a Planet basemap or image

Use WMTS or XYZ

Navigate to Basemap WTMS page:
https://developers.planet.com/docs/basemaps/tile-services/wmts/

Add to ArcMap, ArcGIS Online, or Enterprise Portal

Conducting visual analysis?

Use online tools:
https://planet.com/explorer

Time series analysis?

Use Planet Stories for timelapse:
https://planet.com/stories
Use Slider or Time Animation tools in GIS Integration

Further analysis?

Contact team to download imagery asset:
spatial.imagery@environment.nsw.gov.au
View and use tools in GIS
Pixel difference, spectral indices

AI / ML Classification

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TYPES OF ANALYSIS

- Visual Interpretation
- Temporal / Time Series Analysis
- Pixel Differences
- Spectral Indices
- ML/Classification

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VISUAL INTERPRETATION

Elements:

- Tone
- Shape
- Size
- Pattern
- Texture
- Shadow
- Association

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TONE

Tone refers to the relative brightness or colour of objects in an image.

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SHAPE

Shape refers to the general form, structure, or outline of individual objects.

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SIZE

Size of objects in an image is a function of scale.

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PATTERN

Pattern refers to the spatial arrangement of visibly discernible objects.

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TEXTURE

Texture refers to the arrangement and frequency of tonal variation in particular areas of an image.

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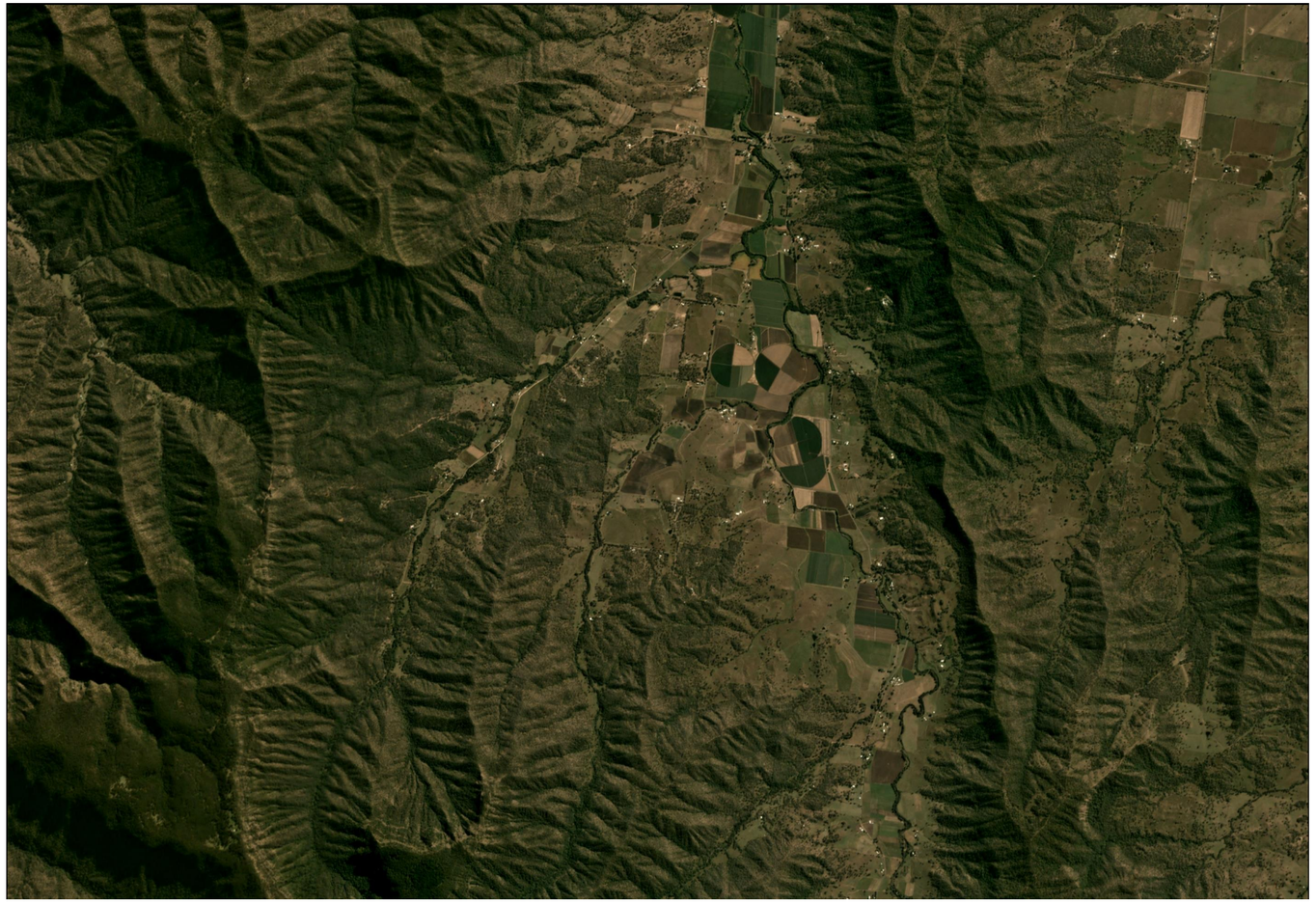
SHADOW



Shadow may provide an idea of the profile, or could eliminate interpretation in an area.

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ASSOCIATION

Association accounts for the relationship between other recognisable objects or features in proximity.

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TEMPORAL ANALYSIS

A time series is a collection of observations over time.

Patterns:

- **Trend**
- **Seasonal**
- **Irregular**

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TREND

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SEASONAL

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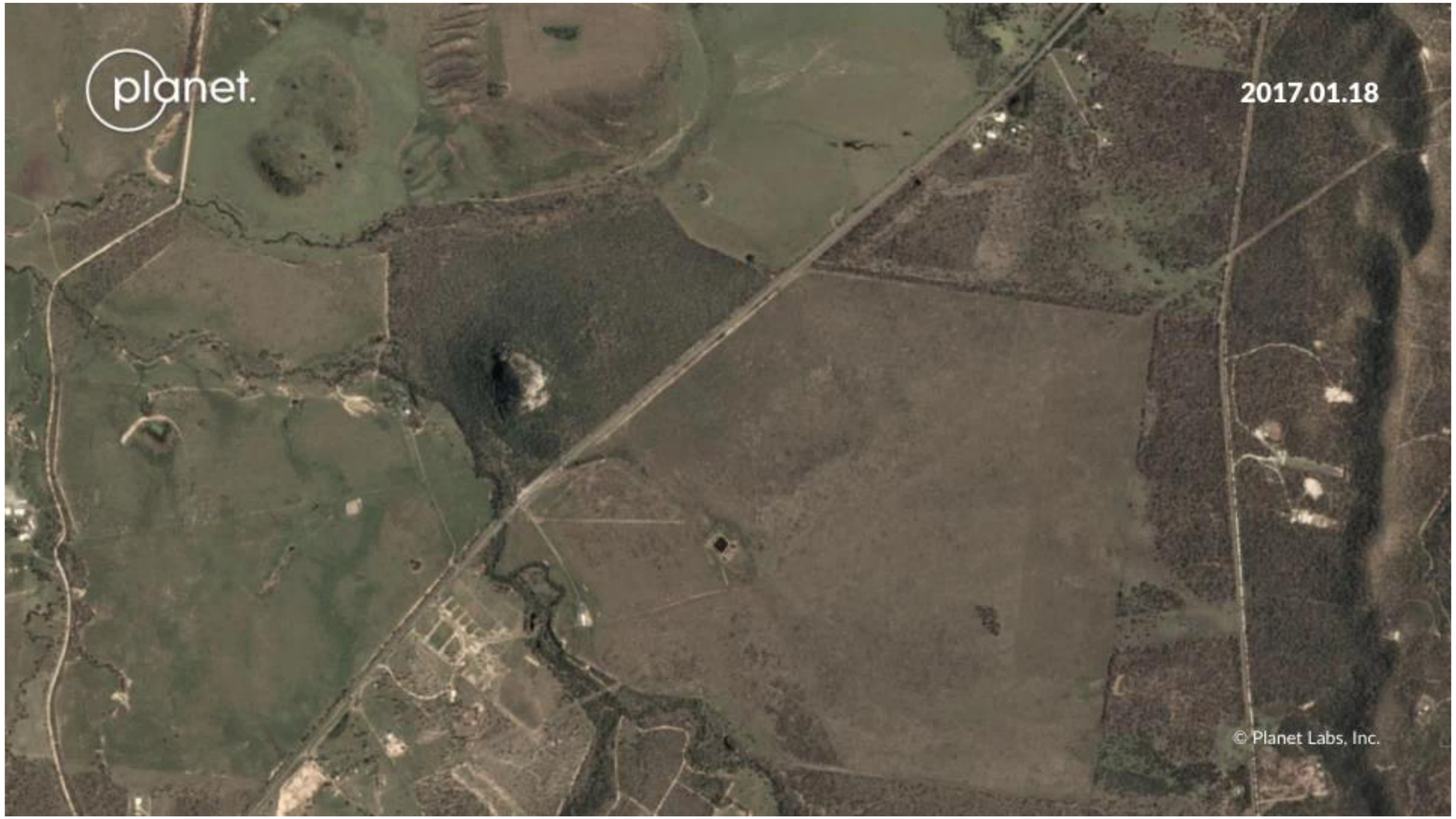
IRREGULAR



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REMOTE SENSING ANALYSIS

- Pixel Differences
- Spectral Indices
- ML/Classification

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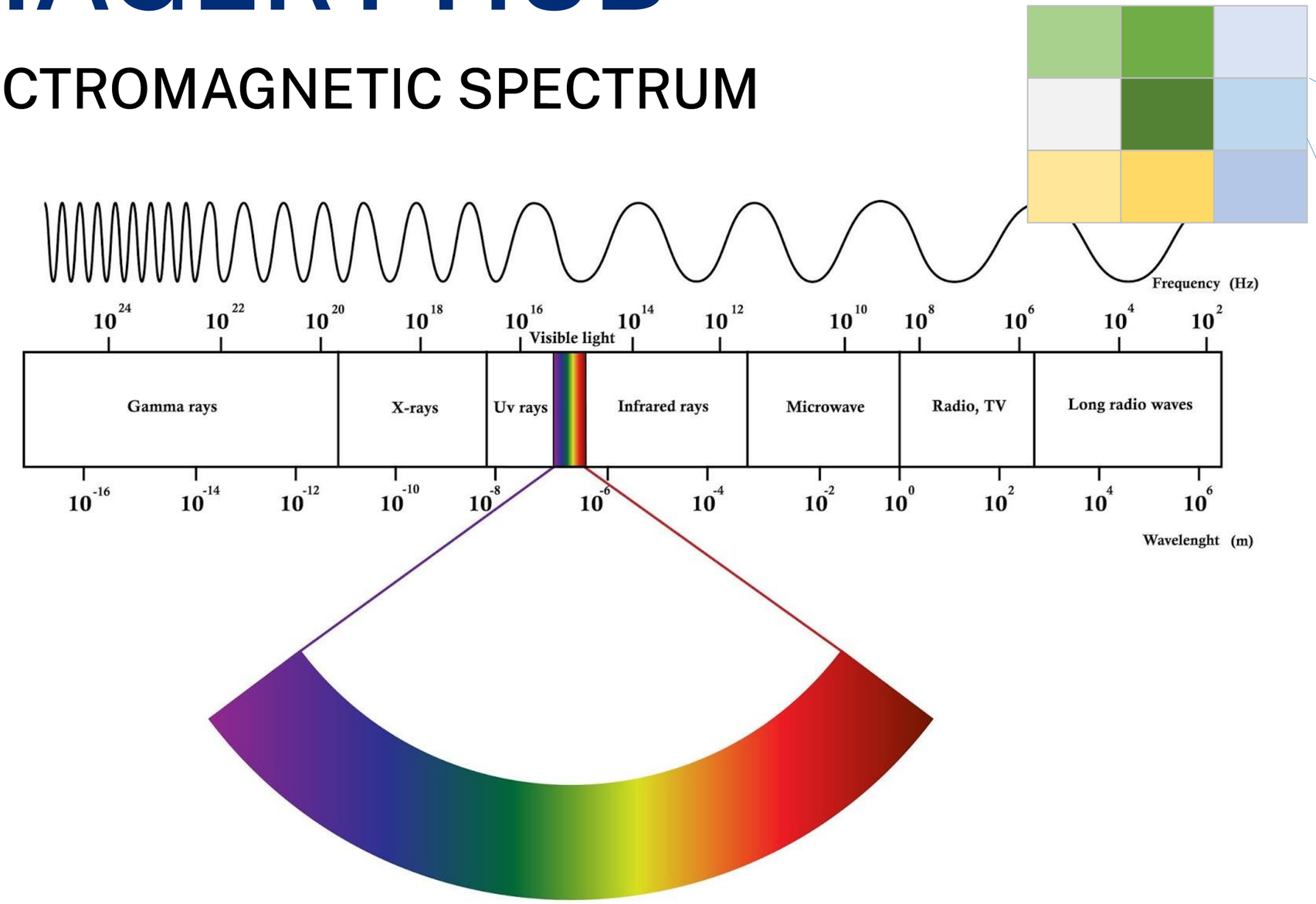
ELECTROMAGNETIC SPECTRUM



G = 3188
B = 2867
R = 1977
N = 0877

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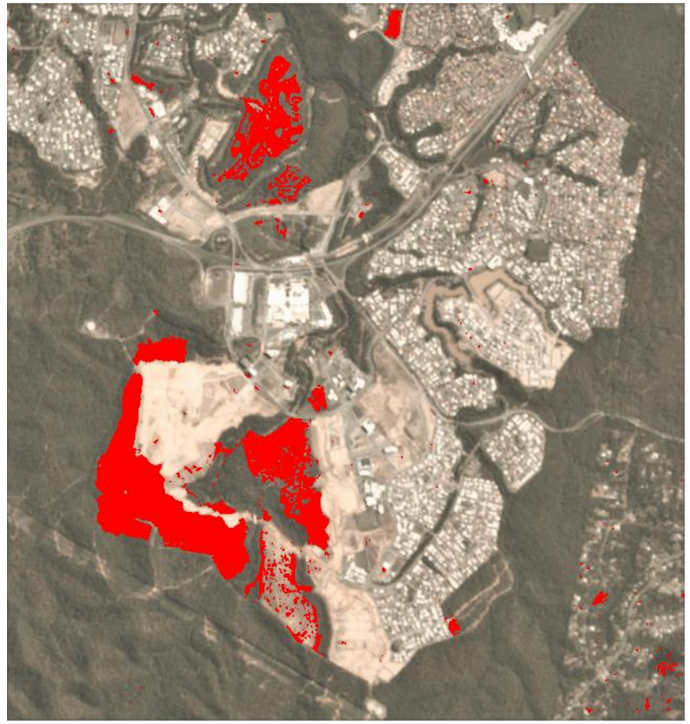
PIXEL DIFFERENCES



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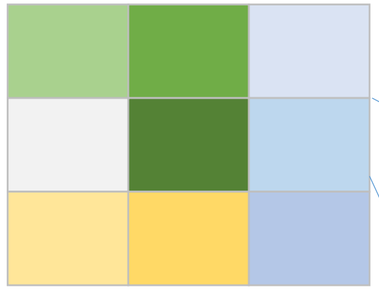
ELECTROMAGNETIC SPECTRUM



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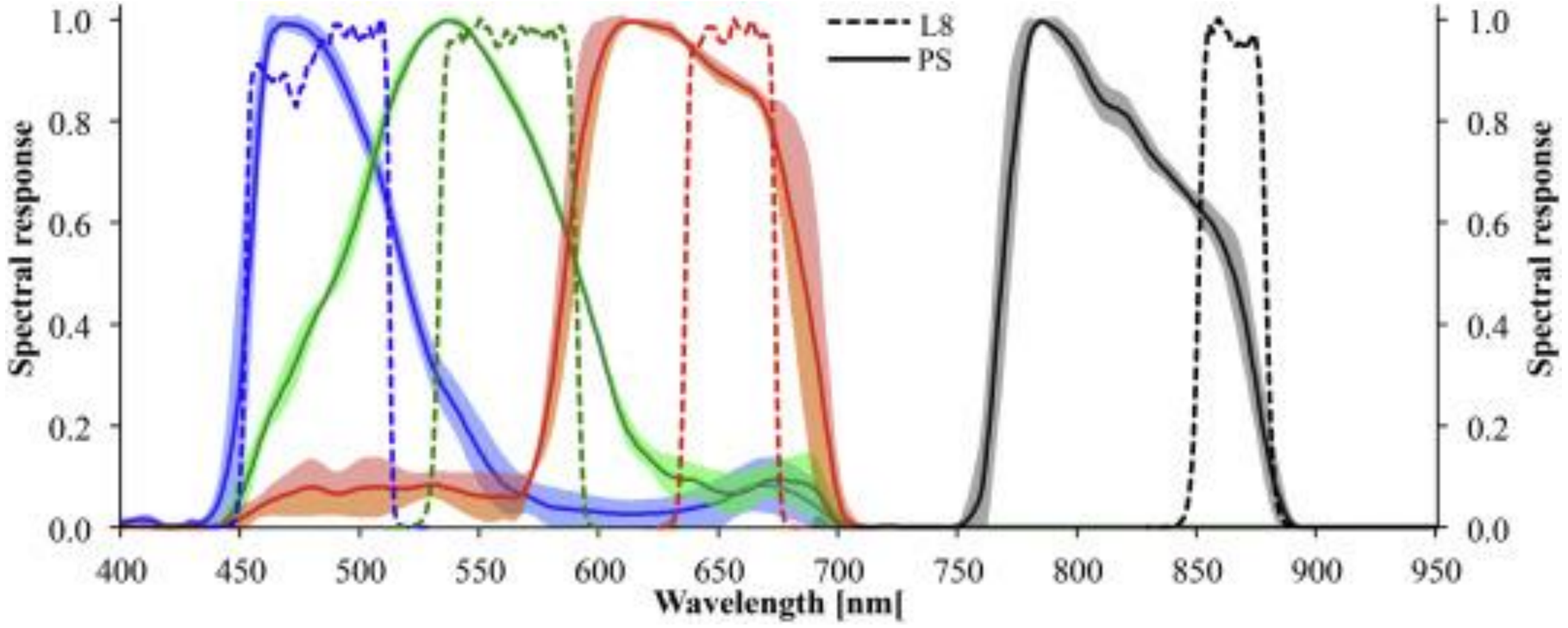
B = 2867
R = 1977
N = 0877



Source: Houberg & McCabe, 2018, Remote Sensing of Environment, 209:211-226

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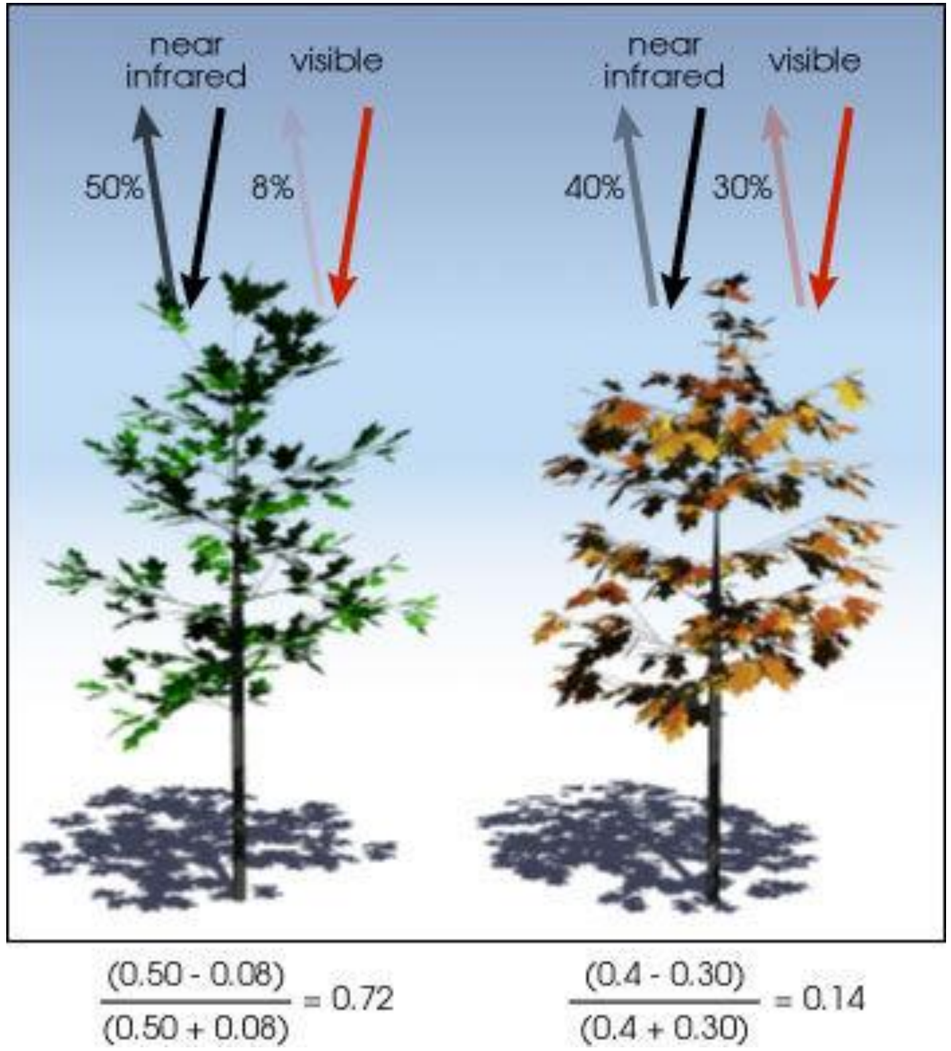
SPECTRAL INDEX

A spectral index is a mathematical equation that is applied on the various spectral bands of an image per pixel.

Normalized Difference Vegetation Index (NDVI)

$$NDVI = \frac{(NIR - Red)}{(NIR + Red)}$$



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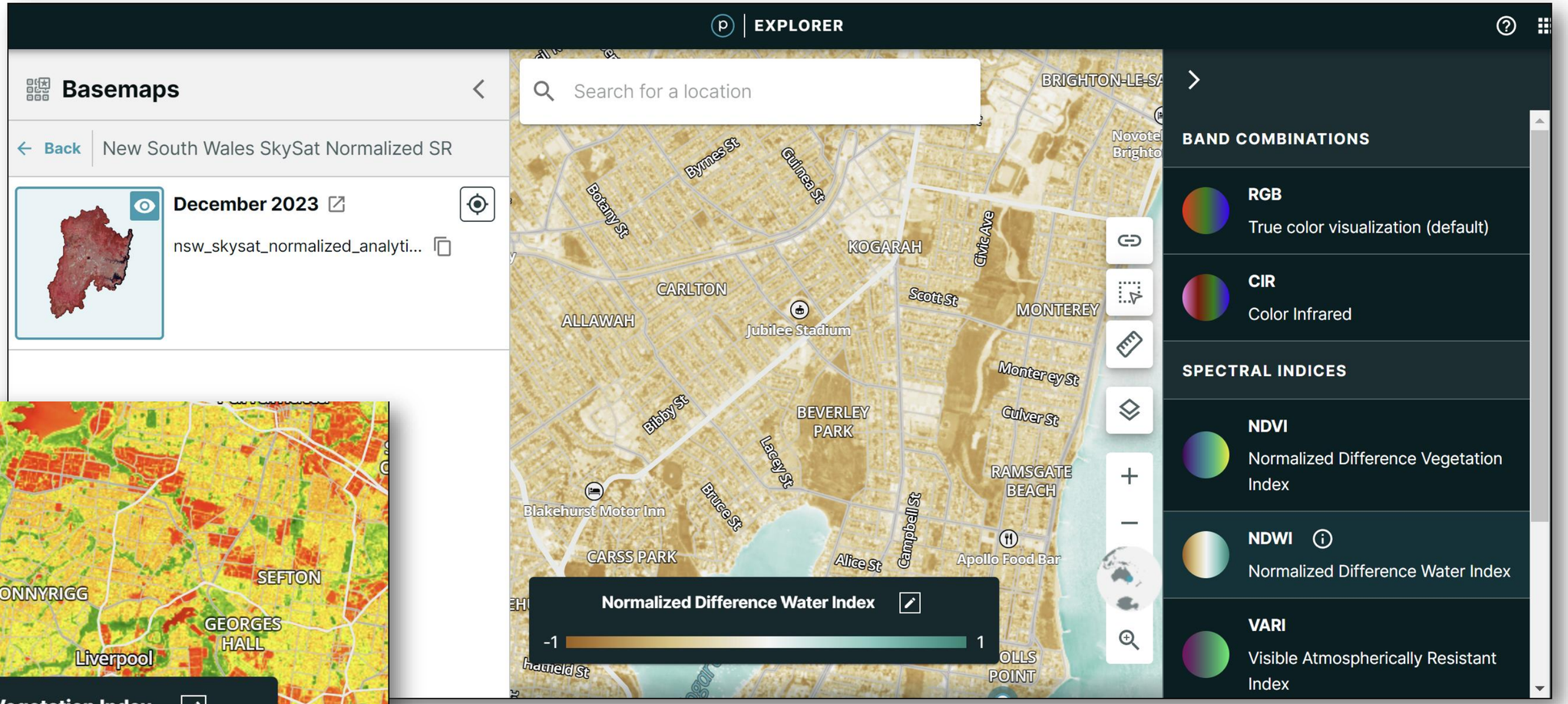
SPECTRAL INDEX



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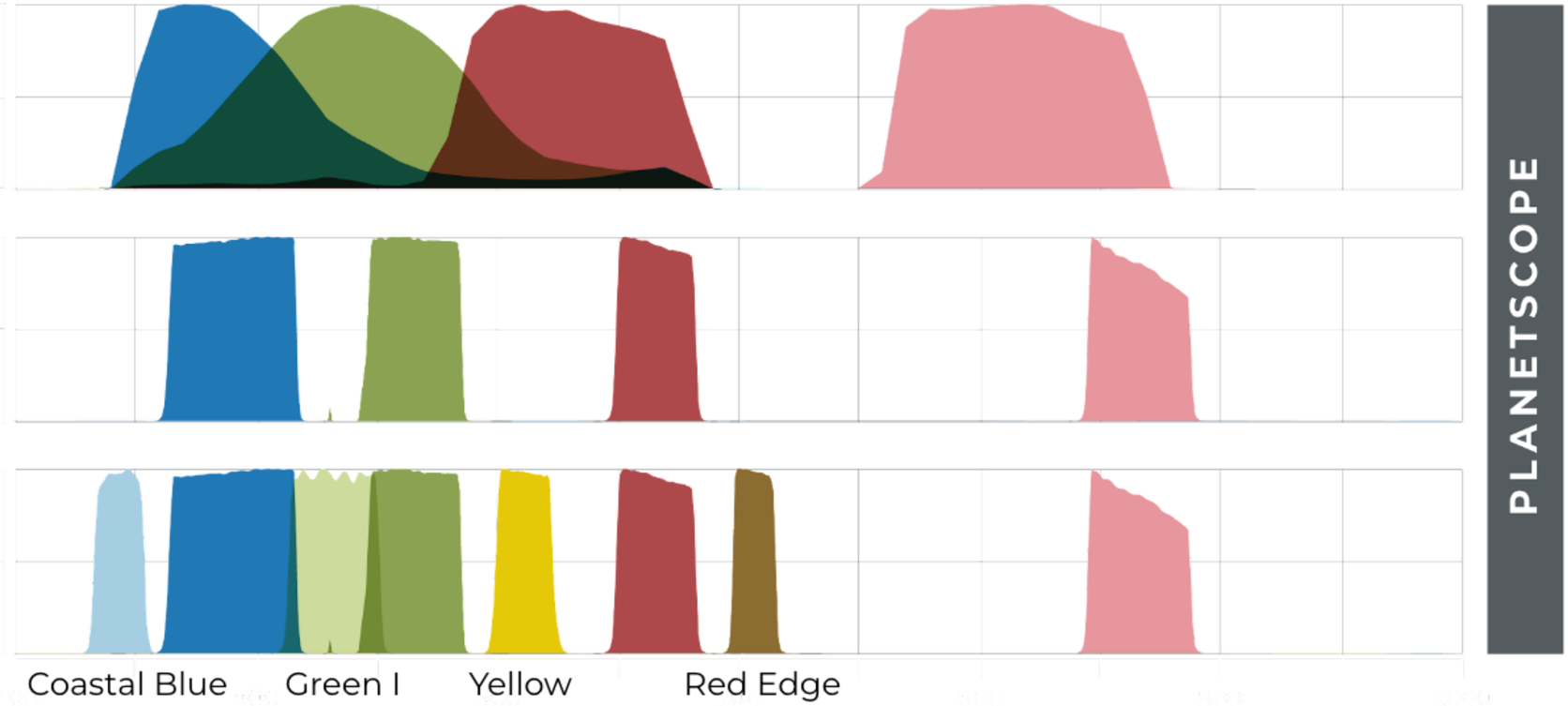
SPECTRAL BANDS



PLANETSCOPE

Dove Classic

Blue: 455 - 515 nm
Green: 500 - 590 nm
Red: 590 - 670 nm
NIR: 780 - 860 nm

Dove-R

Blue: 464 - 517 nm
Green: 547 - 585 nm
Red: 650 - 682 nm
NIR: 846 - 888 nm

SuperDove

Coastal Blue 431-452 nm*
Blue: 465-515 nm
Green I: 513. - 549 nm
Green II: 547. - 583 nm*
Yellow: 600-620 nm*
Red: 650 - 680 nm
Red-Edge: 697 - 713 nm
NIR: 845 - 885 nm

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SPECTRAL BANDS

The following bands is what is included in the 3 bands Visual product:

- **Red, Green, Blue** (RGB)

The following bands is what is included in the 4 bands Analytic or Basic product:

- **Red, Green, Blue** (RGB)
- **Near Infrared** (NIR)

The following is what is included in the 8 bands:

- **Red, Green, Blue** (RGB)
- **Near Infrared** (NIR)
- **Coastal blue** = near-shore bathymetry
- **Red-edge** = vegetation stress & water quality
- **Yellow** = crop and land cover classification
- **Green 1** = plant health

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SPECTRAL CLASSIFICATION

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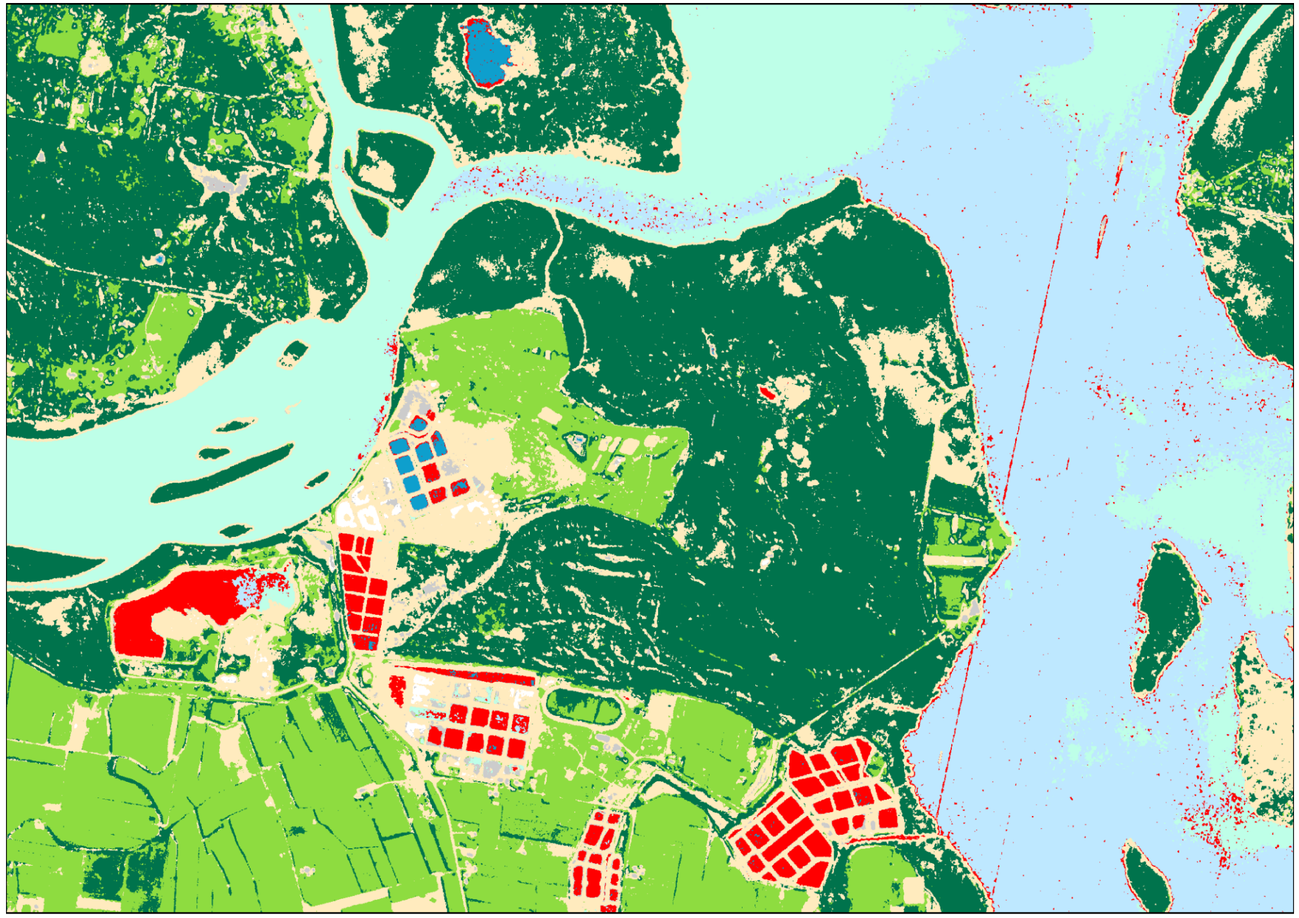
SPECTRAL CLASSIFICATION



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TERMINOLOGY

Visual - orthorectified, colour-corrected, RGB imagery

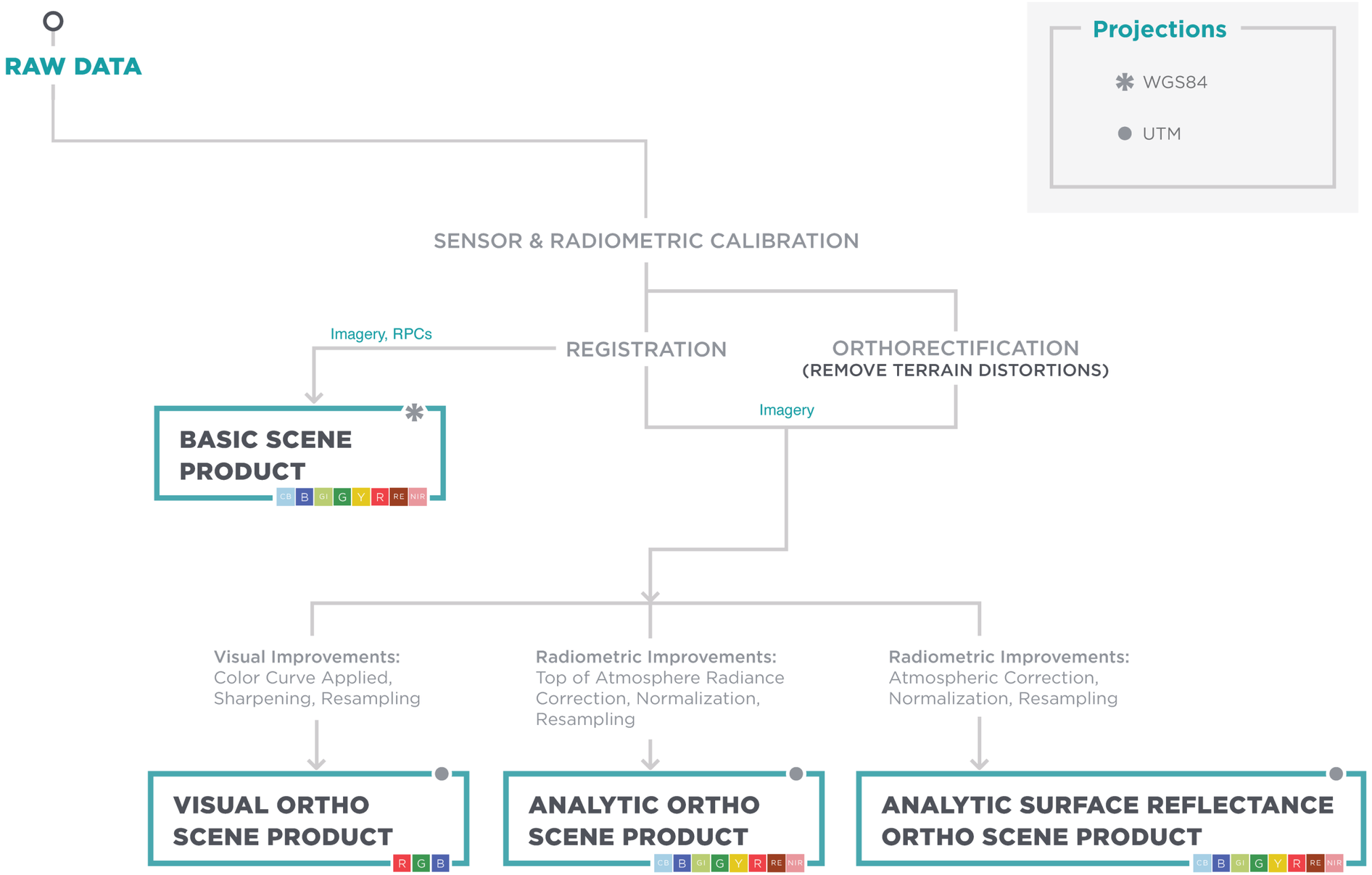
Basic - non-orthorectified, calibrated, multispectral imagery

Analytic - orthorectified, calibrated, multispectral imagery

Surface Reflectance - orthorectified and radiometrically corrected to ensure consistency across localized atmospheric conditions

Harmonisation - allows you to reduce inconsistencies between data across sensors (Dove Classics, Dove-R, SuperDove, Sentinel-2)

IMAGE PROCESSING CHAIN



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FORMAT

GeoTIFF most common format, in zipped folder with metadata json

PlanetScope Scene naming convention:
<acquisition date>_<acquisition time>_<acquisition time seconds hundredths>_<satellite_id>_<productLevel>_<bandProduct>.<extension>

Example: 20200922_183720_11_106a_3B_AnalyticMS.tif

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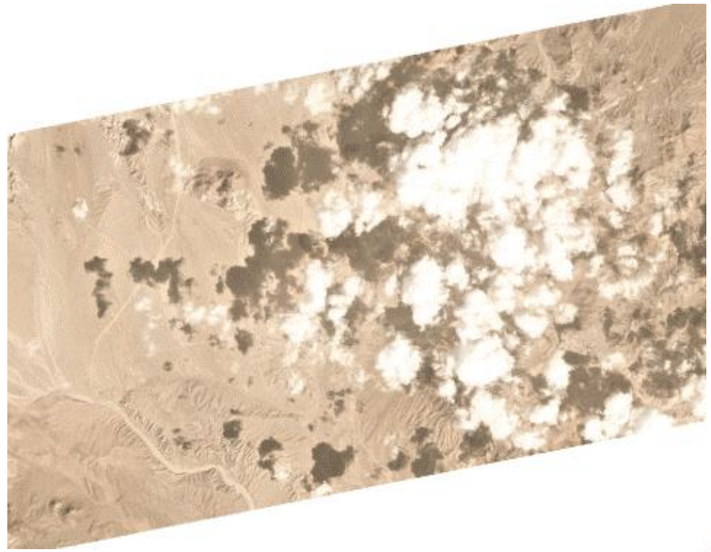
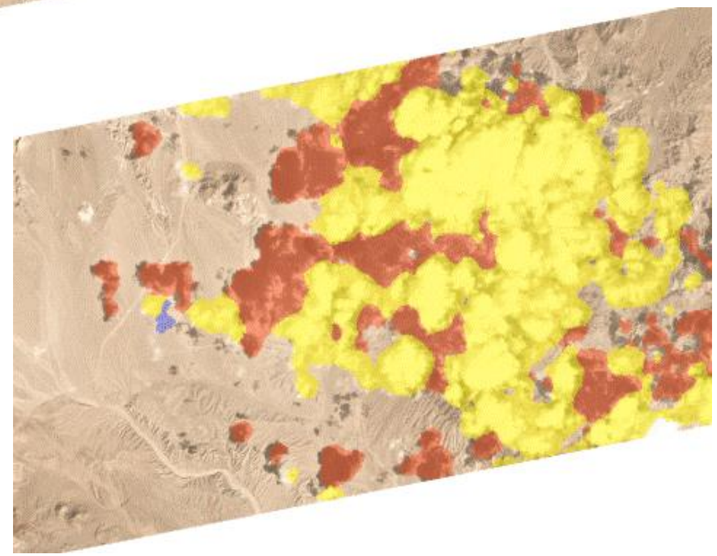
UDM 2.1

A Usable Data Mask (UDM) with every published image.

UDM2.1 is the latest version developed by Planet, and it provides valuable information formatted as an 8-band GeoTIFF format.





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UDM 2.1

Band	Class	Pixel Value Range	Description
1	Clear	0,1	Regions of a scene that are free of cloud, haze, cloud shadow and/or snow
2	Snow	0,1	Regions of a scene that are covered with snow or ice
3	Cloud Shadow	0,1	Shadows caused by clouds or haze and not by mountains, buildings, or other terrain features
4	Light Haze	0,1	Regions of a scene with thin, filamentous clouds, soot, dust, and smoke. You can see ground objects through haze
5	Heavy Haze	0,1	UDM2.1 does not support a heavy haze class, but this class name persists to support functional backwards compatibility with UDM2.0. Pixels will never be classified as Heavy Haze with UDM2.1.
6	Cloud	0,1	Regions of a scene that contain thick clouds. You cannot see ground objects through clouds
7	Confidence	0-100	This is an indication of how confident the model that powers UDM2.1 is that a given pixel's classification is correct
8	Unusable Pixels	–	Equivalent to the UDM asset. For the PlanetScope 8th Band, the bits are as follows. Bit 0: Black fill, Bit 1: Likely cloud, Bit 2: Blue (Band 2) is anomalous, Bit 3: Green (Band 4) is anomalous, Bit 4: Red (Band 6) is anomalous, Bit 5: Red Edge (Band 7) is anomalous, Bit 6: NIR (Band 8) is anomalous, Bit 7: Coastal Aerosol (Band 1) and/or Green-I (Band 3) and/or Yellow (Band 5) is anomalous. See Planet's Imagery Specification for complete details.

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Remote Sensing

Demonstration

spatial.imagery@environment.nsw.gov.au

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Remote Sensing

Thank you

Contact us

spatial.imagery@environment.nsw.gov.au

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Remote Sensing

APPENDIX

Contact us

spatial.imagery@environment.nsw.gov.au

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SENSOR AND RADIOMETRIC CALIBRATION

Darkfield/Offset Correction: Corrects for sensor bias and dark noise. Master offset tables are created by averaging on-orbit darkfield collects across 5-10 degree temperature bins and applied to scenes during processing based on the CCD temperature at acquisition time.

Flat Field Correction: Flat fields are collected for each optical instrument prior to launch. These fields are used to correct image lighting and CCD element effects to match the optimal response area of the sensor. Flat fields are routinely updated on-orbit during the satellite lifetime.

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SENSOR AND RADIOMETRIC CALIBRATION

Camera Acquisition Parameter Correction: Determines a common radiometric response for each image (regardless of exposure time, number of TDI stages, gain, camera temperature and other camera parameters).

Absolute Calibration: As a last step, the spatially and temporally adjusted datasets are transformed from digital number values into physical based radiance values (scaled to $W/(m^2 str \mu m)*100$). For additional technical detail, refer to On-Orbit Radiometric Calibration of the Planet Satellite Fleet.

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ORTHORECTIFICATION

Removes terrain distortions. This process consists of two steps:

1. The rectification tiedown process wherein tie points are identified across the source images and a collection of reference images (ALOS, NAIP, Landsat) and RPCs are generated.

2. The actual orthorectification of the scenes using the RPCs, to remove terrain distortions. The terrain model used for the orthorectification process is derived from multiple sources (Intermap, NED, SRTM and other local elevation datasets) which are periodically updated. Snapshots of the elevation datasets used are archived (helps in identifying the DEM that was used for any given scene at any given point).

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VISUAL PRODUCT PROCESSING

Presents the imagery as natural colour (Red, Green, Blue), optimized as seen by the human eye. This process consists of three steps:

1. Nominalization - Sun angle correction, to account for differences in latitude and time of acquisition. This makes the imagery appear to look like it was acquired at the same sun angle by converting the exposure time to the nominal time (noon).

2. Unsharp mask (sharpening filter) applied before the warp process.

3. Custom colour curve applied post warping.

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SURFACE REFLECTANCE PRODUCT PROCESSING

Removes atmospheric effects. This process consists of three steps:

1. Top of Atmosphere (TOA) reflectance calculation using coefficients supplied with the at-sensor radiance product.

2. Lookup table (LUT) generation using the 6SV2.1 radiative transfer code and MODIS near-real-time data inputs.

3. Conversion of TOA reflectance to surface reflectance for all combinations of selected ranges of physical conditions and for each satellite sensor type using its individual spectral response as well as estimates of the state of the atmosphere.

You can find a detailed white paper on Surface Reflectance Products here.

NGIS

planet.