



Singapore • Mosaic



# PLANET BASEMAPS

## PRODUCT SPECIFICATION

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### Disclaimer

This document is designed as a general guideline for customers interested in acquiring Planet automated basemaps products and services. Planet takes an agile and iterative approach to its technology, and therefore may make changes to the product(s) described in this document.

## GLOSSARY

### **Application Programming Interface (API)**

A set of routines, protocols, and tools for building software applications.

### **Basemap**

A mosaic used as a reference layer in a GIS or other map based application. Also referred to as an imagery basemap.

### **GeoJSON**

A standard for encoding geospatial data using JSON (see JSON below).

### **GeoTIFF**

An image format with geospatial metadata suitable for use in a GIS or other remote sensing software.

### **JavaScript Object Notation (JSON)**

Text-based data interchange format used by the Planet API.

### **Mosaic**

A composite of many individual images into a single layer.

### **Portable Network Graphic (PNG)**

An image format suitable for web use.

### **Quad**

A single square GeoTIFF, many of which together comprise a mosaic.

### **Scene**

Single image captured by a PlanetScope satellite. Many scenes together compose a mosaic.

### **Timelapse**

A discrete block of time with a defined start and end point. For example, a Q1 Timelapse refers to the time period between Jan 1 and March 31.

### **Tile Server**

A server that provides web tiles to clients over the web.

### **Web Tile**

A PNG map image served by a tile server at a variety of zoom levels.

# 1. OVERVIEW OF PLANET BASEMAPS

Planet offers a range of Basemap products, each suited for different applications and use cases. The Global Basemap is best suited for mapping and visual simulation use cases. It is automatically generated annually, covers the entire globe in RGB bands, and has a visual color curve applied.

Select Basemaps are best suited for monitoring and analytics-driven uses cases, where basemaps enable an understanding of change over time. Select Basemaps are generated in accordance with the customer's needs, allowing choice of source imagery, frequency of updates, and delivery.

## 2. GLOBAL BASEMAP

### 2.1. Imagery Selection

Planet's Global Basemap is generated systematically between 74° North and 60° South in order to minimize distortion at the poles, using PlanetScope and/or RapidEye imagery. Planet leverages a proprietary "best scene on top" algorithm that selects the highest quality imagery from our catalog over the normal hemispheric *leaf-on* periods. This is roughly July to September in the northern hemisphere, and January to March in the southern hemisphere, with year-round imagery in the tropics) to create the Global Basemap.

For more detail on image selection, color balancing, and quality thresholds, see the Appendix.

### 2.2. Scene Provenance

During the Basemap generation process, a record of each individual PlanetScope or RapidEye image used is retained. Since the specifications of PlanetScope and RapidEye sensors differ, please see the Planet Imagery Product Specification for details on each type of image.

### 2.3. Cadence

The Global Basemap is generated annually and is available in mid-January.

### 2.4. Delivery

The Global Basemap can be streamed via WMTS for use in web mapping applications or for visualization purposes.

### 3. SELECT BASEMAPS

Planet’s Select Basemaps are generated according to a customer-specified area of interest and are comprised of PlanetScope imagery (visual or surface reflectance).

#### 3.1. Image Selection

##### Select Basemaps – Visual

Select Basemaps are generated using a proprietary “best scene on top” algorithm that selects the highest quality imagery from Planet’s catalog over a specified time range. By selecting the best images, Planet is able to create radiometrically and spatially accurate, high-resolution basemaps that minimize the effects of cloud, haze, and other image variability.

Table A. Select Basemaps – Visual

Source Imagery	Download (GeoTIFF) Bands	Streaming (WMTS) Bands	Monitoring Frequency	Zoom Level	Color Target
PlanetScope Visual product	RGB	RGB	Quarterly Monthly Weekly	15, 16	MODIS

For more detail on image selection, color balancing, and quality thresholds, see the Appendix.

##### Select Basemaps – Surface Reflectance

Select Surface Reflectance Basemaps are generated using the PlanetScope Surface Reflectance asset type (PSScene4Band analytic\_sr) as input. The Select Surface Reflectance product utilizes external sources of data like MODIS for deriving atmospheric parameters. Processing details may be found in the Planet Imagery Specifications document.

Table B. Select Basemaps – Surface Reflectance

Source Imagery	Download (GeoTIFF) Bands	Streaming (WMTS) Bands	Monitoring Frequency	Zoom Level	Normalization
PlanetScope Surface Reflectance product	BGRN	RGB, NRG	Quarterly Monthly Weekly	15, 16	Available if requested

Normalization may be applied to reduce any remaining image-to-image variability due to residual atmospheric correction uncertainties.

### 3.2. Scene Provenance

During the Basemap generation process, a record of each individual PlanetScope image used is retained. All source scenes are traceable through the Planet API and UI.

### 3.3. Cadence

The time period for Select Basemaps start and end at 00:00 UTC. Select Basemaps produced quarterly cover the months of January to March, April to June, July to September, and October to December, respectively. Select Basemaps produced monthly cover all calendar days of the month, including leap days. Select Basemaps produced weekly begin on Monday and end exactly 7 days later, respectively.

### 3.4. Delivery

Select Basemaps can be streamed via WMTS for use in web mapping applications or downloaded via for offline analysis within traditional GIS or imagery tools. To accommodate these use cases, Planet Basemaps are distributed via tile servers as well as individual imagery files. Not only does this allow for convenient and easy integration, but also allows the Basemaps to be updated frequently with the latest imagery. Select Surface Reflectance Basemap WMTS tiles are available as both RGB and Color Infrared (CIR).

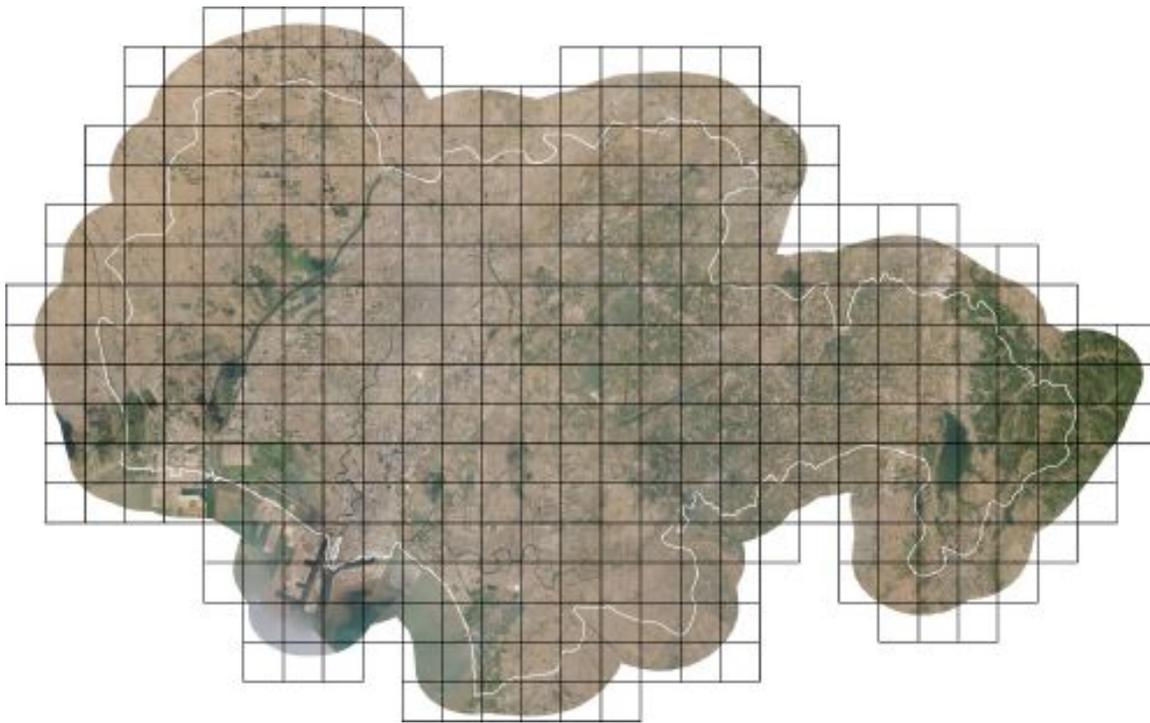
# +

## 4. BASEMAP PRODUCT SPECIFICATION

### 4.1. Basemap Quads

Imagery within Planet Basemaps is distributed as a grid of GeoTIFF files, which are called “basemap quads” or simply “quads.”

Figure A: Basemap with Quad Boundaries



An individual quad has the following standard specifications:

Table B: Individual Quad Specifications

INDIVIDUAL QUAD SPECIFICATIONS	
Attribute	Description
Imagery)	PlanetScope and RapidEye (Visual) PlanetScope (Surface Reflectance)
Pixel Size (resolution) <sup>1</sup>	4.77 m at the Equator for zoom level 15 (PlanetScope and RapidEye) 2.39 m at the Equator for zoom level 16 (PlanetScope and RapidEye)

<sup>1</sup> The precise resolution in meters may be roughly calculated with this formula: Pixel Size at the Equator × cos(latitude).

Image Bit Depth	8 bits per pixel (Visual) 16 bits per pixel (Surface Reflectance)
Bands	Red, Green, Blue, Alpha (Visual) Blue, Green, Red, NIR, Alpha (Surface Reflectance)
Projection	WGS84 Web Mercator (EPSG:3857)
Size	4096 x 4096 pixels
Processing	Atmospheric correction (Surface Reflectance Basemaps only). May be radiometrically balanced. Seamlines may be minimized with tonal balancing. Geometrically aligned.

The projection used in Planet Basemaps has been selected to match what standard web mapping applications (Web Mercator Projection). The Alpha Mask indicates areas of the quad where there is no imagery data available.

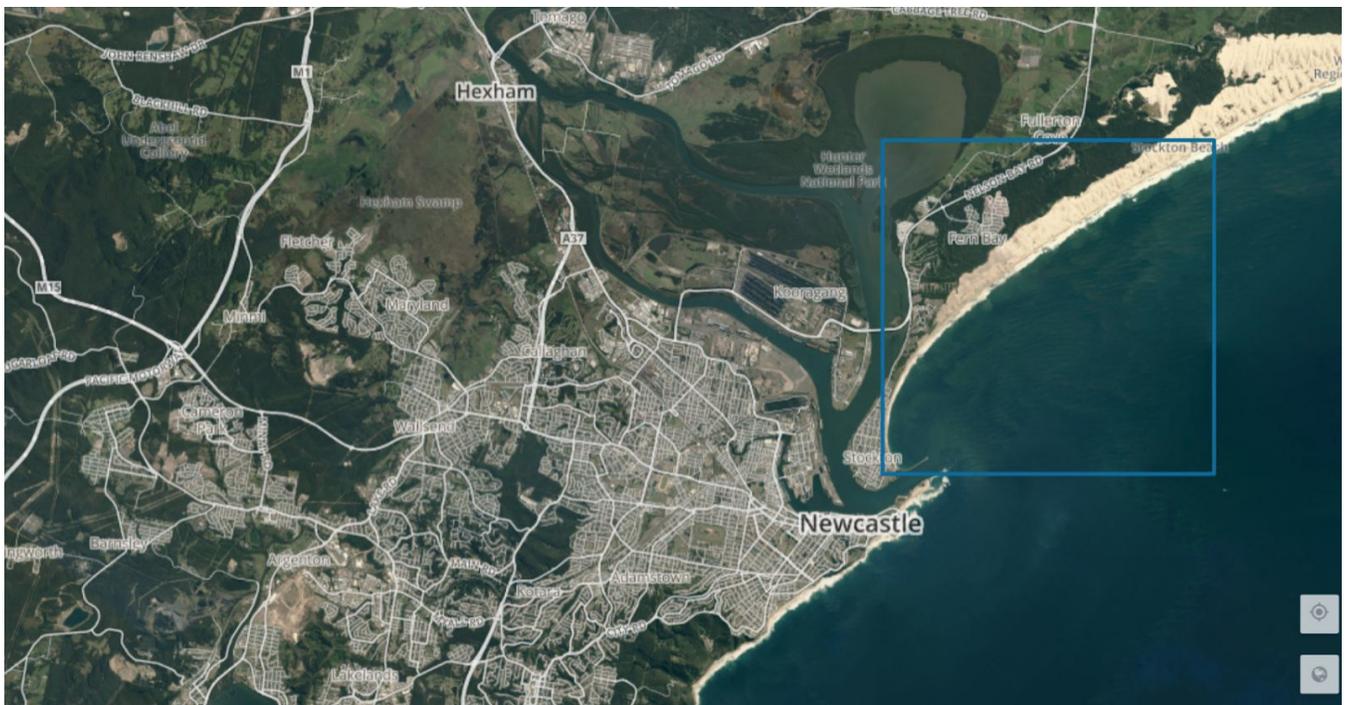


Figure B: Single Quad within a Basemap



## 5. BASEMAP METADATA

Basemaps and individual quads have metadata associated. Metadata is always distributed in JSON format and can be accessed over the Planet API. When there is a spatial component to the metadata, the GeoJSON extension to JSON is used to encode geometries so that they may be read by common GIS and geospatial tools.

### 5.1 BASEMAP METADATA FIELDS FOR MOSAICS API

The following metadata fields are provided for each basemap.

Table D: Basemap Metadata Schema

BASEMAP METADATA SCHEMA	
Field	Description
bbox	A four element array containing the lat long bounding box (lower left and upper right)
coordinate_system	The EPSG code of the coordinate system in which the quad GeoTIFF are projected, i.e. EPSG:3857 or EPSG:4326
datatype	The datatype for each quad GeoTIFF. One of byte, uint16, int16, uint32, int32, float32, float64, cint16, cint32, cfloat32, cfloat64
first_acquired	The UTC date and time that the first input scene was taken in ISO 8601 format
grid	A JSON field including the quad pattern description, the square quad size in pixels, and the pixel resolution in meters (see below)
id	The internal identifier for this basemap
interval	For Select Basemaps, this will provide the time interval (for example, "1 mon"). For other basemaps, this will not be present.
item_types	The type of source scenes used as input to basemap
last_acquired	The UTC date and time that the last input scene was taken in ISO 8601 format
level	Zoom level of available quads, corresponding to mercator grid level.
links.quads	API link to the list of GeoTIFF quads that make up this basemap
links.self	API link to the mosaic resource
links.tiles	API link to the tileserver URL for the basemap
name	The name of the basemap

product_type	The basemap category this represents. For example 'Timelapse' for standard, automated intervals.
quad_pattern	The naming scheme for quads, as a format string with <code>glevel</code> , <code>tilex</code> and <code>tiley</code>
quad_size	The width and height (equivalent) of each quad GeoTIFF in pixels
resolution	The size in meters of pixels in quad GeoTIFFs

## 5.2 BASEMAP QUAD METADATA FIELDS

The following metadata fields are provided for each basemap quad.

Table E: Mosaic Quad Metadata Schema

MOSAIC QUAD METADATA SCHEMA	
Field	Description
bbox	4 element array providing the lower left and upper right coordinates of the bounding box
id	The unique identifier for this quad
links.download	API link to download the GeoTIFF
links.items	RFC 3986 URI representing the canonical location of the items make up the quad.
link.self	RFC 3986 URI representing the canonical location of this object.
links.thumbnail	API link to a thumbnail of this quad
percent_covered	The percentage of the GeoTIFF pixels that are not no-data values
type	Always "Feature" to make dictionary a valid GeoJSON Feature



## 6. PRODUCT NAMING

The naming scheme for quad IDs within each basemap is available in the basemap as the `quad_pattern` property. It is generally `{X}-{Y}`, where X and Y are the x and y position of the quad in the grid.

A sample quad ID is 1023-2465, indicating that this particular quad is in the position 1023, 2465 in the two dimensional grid that makes up the basemap. Additional information on basemap quad naming and access can be found in the Planet API Reference documentation.

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## 7. STREAMING WEB TILES

### 7.1 TILE SERVICE

In addition to downloadable GeoTIFFs, Planet also provides a web tile service that is compatible with OpenStreetMaps (OSM) and commercial basemap providers to display basemaps in web applications or other compatible clients. These GUIs use the Planet tile service to preview basemaps in the browser.

Access to tiles follows the convention used by OSM, with URLs requiring the name of a basemap, the zoom level and an x and y position in the grid. The grid follows the common Web Mercator tiling scheme used in many web mapping applications and libraries.

A sample URL would be:

```
https://tiles.planet.com/basemaps/v1/planet-tiles/global_monthly_2016_05_mosaic/gmap/{z}/{x}/{y}.png?api_key={key}
```

In addition to <https://tiles0.planet.com>, Planet also provides [tiles1](#), [tiles2](#) and [tiles3](#) subdomains. Web tiles returned by this service will be 256 by 256 pixel PNG images. XYZ tile services are typically supported by major proprietary and open-source GIS software.

A full reference for the XYZ tile service can be found in the Planet [documentation](#).

### 7.2 WEB MAPPING TILE SERVICE

The Planet Platform is able to serve basemaps via an OGC Compliant Web Mapping Tile Service (WMTS). The WMTS URL endpoint is provided by Planet and will function with any WMTS client with the proper authentication credentials.

The current implementation of the WMTS has some limitations: it does not support 'GetFeatureInfo' requests from clients.



## APPENDIX

# BASEMAP GENERATION TECHNIQUES

Planet Basemaps are built using highly-automated generation techniques, which employ a scalable processing pipeline with three key steps: image selection, color balancing, and packaging.

### IMAGE SELECTION

To build a basemap, a process is triggered to select the best imagery to represent every part of the coverage area. A number of image quality metrics are used to determine the best imagery from within the time of interest window. The approach determines the best imagery based on cloud cover and acutance (image sharpness), and the imagery that ranks highest in the weighting of these metrics is used in the following color balancing step.

For Select Basemaps, imagery selection is constrained to fall within the specified time of interest (for example, the March 2018 basemap will only have data collected from March 1 to March 31 of 2018). For the Global Basemap, imagery selection is based on the normal hemispheric *leaf-on* periods (roughly July to September in the northern hemisphere, and January to March in the southern hemisphere, with year-round imagery in the tropics).

All source scenes are traceable through Planet API and UI.

### COLOR BALANCING

#### Select Basemaps – Visual

In the color balancing step, scenes are normalized to a monthly MODIS-based surface reflectance target to minimize variability between scenes and reduce atmospheric effects. Each scene is processed with a unique color curve optimized to remove haze and broadly match the colors of the target while still preserving the hue of neutral colors (i.e. clouds/snow stay white). Next, after adjacent scenes have been combined into a mosaic tile, a seamline-reduction algorithm minimizes any remaining local differences between scenes. These approaches makes the imagery appear consistent and seamless.

#### Select Basemaps – Surface Reflectance

Customers may opt for no color balancing or color adjustments to be applied to the Select Surface Reflectance Basemaps, thus preserving the calculated pixel value, which is vital to these basemaps being ready for analysis. Consequently, Select Surface Reflectance Basemaps are more likely to contain seam lines.

## PACKAGING

Once color balancing has been completed for Select Visual Basemaps, the imagery is converted into a Web Mercator projection and resampled to a default pixel size of 4.77 m. The resulting quads are then indexed within the Planet platform so that they may be downloaded for offline use.

In a subsequent step, lower zoom level overviews are created to populate the full stack of web tiles. These feed into the Planet tile servers (see the sections on the web tile service below), which are easily integrated in other applications, serving up only the part of the basemap a user needs.

## QUALITY

Planet's proprietary automated mosaicing process uses a "best scene on top" methodology to select the highest quality scenes for use in a mosaic, preferring, for example, images that contain the lowest fraction of cloud coverage or have the highest acutance (sharpness).

Additional processing techniques are then applied to enhance the visual quality of a basemap, such as color corrections, reducing the effects of atmospheric haze, sharpening, or adjusting pixels near scene boundaries to minimize the effect of scene lines.

Select Basemaps source imagery inputs are restricted to a specific time period, as defined by the contracted Time of Interest (TOI). As such, basemap coverage and quality may be impacted by the source imagery input constraints in the specified TOI; and for smaller TOI's, the likelihood of this impact increases.

Planet cannot guarantee that a basemap will not contain visible scene lines or artifacts resulting from the mosaicing process. Planet's automated techniques are optimized for landmass coverage; therefore basemaps over open water, such as oceans extending from shorelines may exhibit inconsistencies in visual quality.