PLANET BASEMAPS

PRODUCT SPECIFICATIONS

PLANET.COM

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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 Automated Basemaps have been generated automatically using a proprietary “best scene on top” algorithm that selects the highest quality PlanetScope or RapidEye imagery from Planet’s catalog. By selecting the best images from frequent imaging intervals, Planet is able to create spatially accurate, high-resolution basemaps that minimize the effects of seasonality, cloud, haze, and image misalignments.

Planet Surface Reflectance Basemaps use similar scene selection techniques as Planet Automated Basemaps, except that they are constrained to only use PlanetScope Surface Reflectance assets (analytic_sr asset type).

Planet Basemaps are often used in web mapping applications or 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 it also allows the service to update frequently.

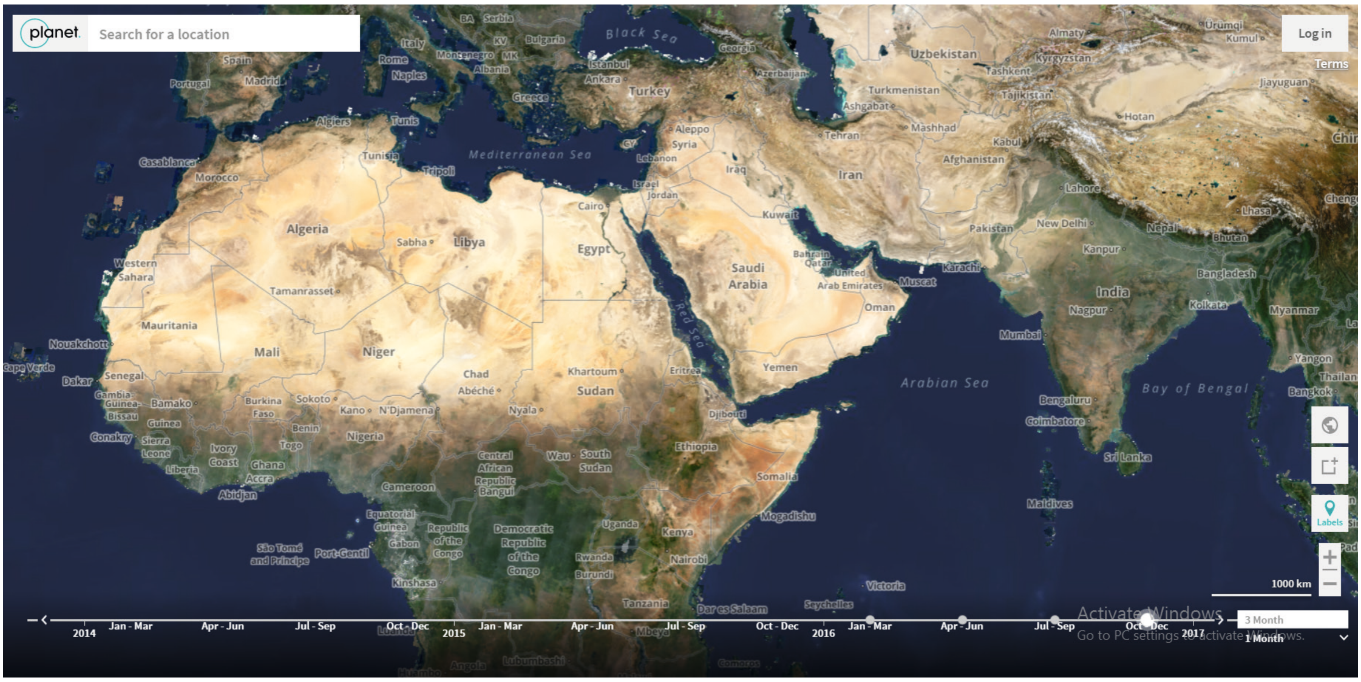

Figure A. Portion of a basemap centered on the Indian Ocean as displayed in Planet Explorer.

2. AUTOMATED TIMELAPSE BASEMAPS PRODUCT SPECIFICATIONS

2.1 RANGE

Planet Automated Basemaps imagery is generated between 60° South and 74° North in order to minimize distortion at the poles. The geographic range of Automated Basemaps may be global, or defined by a custom Area of Interest (AOI). Each basemap also has a specified time range which can either be standard or customized - and all data that is incorporated into the basemap will come from this defined time range.

2.2 SOURCE IMAGERY

The source imagery for Timelapse Basemaps can be PlanetScope (PS) satellites or RapidEye (RE) satellites, or a combination of both. During the basemap generation process, a record of which PlanetScope or RapidEye image each individual scene in the basemap derives from is retained. Since the specifications of PS or RE sensors differ, please see the Planet Imagery Product Specification sheet (Planet Imagery Tools Specification) for details on each type of image.

2.2.1 Imagery

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

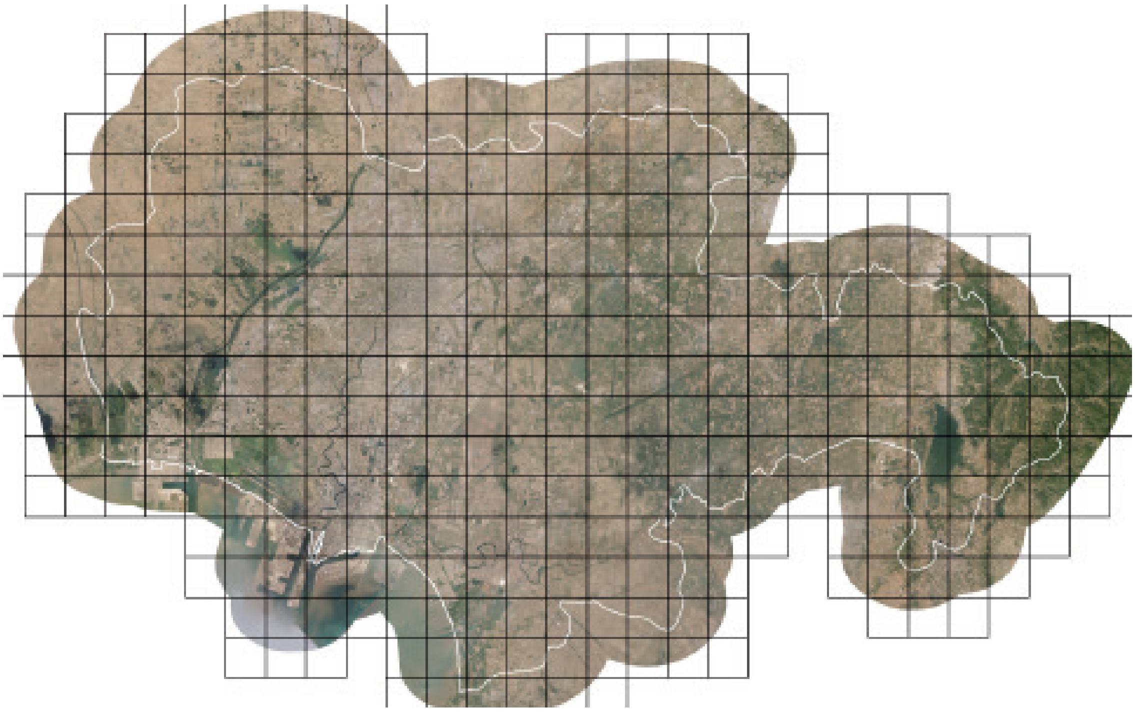

Figure B: Basemap with Quad Boundaries

An individual quad has the following standard specifications:

Table A: Basemap with Quad Boundaries

Individual Quad Specifications

Attribute	Description
Sensors	PlanetScope, RapidEye
Pixel Size (resolution)	4.77 m at the Equator
Image Bit Depth	8 bits per pixel
Bands	Red, Green, Blue, Alpha
Projection	WGS84 Web Mercator (EPSG:3857)
Size	4096 x 4096 pixels
Processing	Geometrically aligned and radiometrically balanced. Seamlines are minimized with tonal balancing.

The projection used in Planet basemaps has been selected to match what is typically used in web mapping applications. All basemaps can be viewed at full resolution within the Planet graphical user interface (up to Zoom Level 15 in the Web Mercator Projection), giving a resolution of 4.77 m at the Equator. The resolution improves at higher and lower latitudes*. The Alpha Mask indicates areas of the quad where there is no imagery data available.

* The precise resolution in meters may be roughly calculated with this formula: $4.77 \times \cos(\text{latitude})$.

Figure C: Single Quad within a Basemap

2.3 AUTOMATED BASEMAPS PRODUCTS

Planet's Automated Basemaps are built using Planet's automated generation techniques described in section 3.

3. AUTOMATED BASEMAP GENERATION TECHNIQUES

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

3.1 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.

The source imagery for mosaics is drawn from the following pool:

- PlanetScope Ortho Scenes
- RapidEye Ortho Tiles

3.2 COLOR BALANCING

In the color balancing step, a histogram matching approach is used to reduce the appearance of seam lines or borders between adjacent images. For each image selected as the best representative, the histogram and cumulative distribution function (CDF) are calculated, as well as the CDF of a reference image data set, which in Planet's case is an enhanced set of seasonal Landsat imagery. Each pixel of the Planet imagery is adjusted using the CDF of the Landsat target. This approach makes the imagery appear consistent and reduces the appearance of seam lines in the basemap. Color balancing is done individually for each basemap tile.

3.3 PACKAGING

Once color balancing has been completed, the imagery is converted into a Web Mercator projection and resampled to a default pixel size of 4.77m. 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.

3.4 QUALITY

The following Quality Statement applies to Planet's Automated and Automated Timelapse Basemaps products.

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.

Timelapse 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.

3.5 TIMELAPSE

Planet Automated Timelapse Basemaps are confined to specific time boundaries from which the source imagery may be used. The following chart describes the target Automated Timelapse Basemaps collection period and delivery schedule. Due to natural variations in cloud cover of the earth's surface, Automated Timelapse basemaps can not be guaranteed to have full, cloud-free coverage of a certain area within a certain timelapse. The longer the timelapse, the better the chances of full cloud free coverage become.

4. PLANET SURFACE REFLECTANCE BASEMAPS

4.1 IMAGE SELECTION

Planet Surface Reflectance Basemaps are generated using the same image selection methodologies for Planet Automated Basemaps, with the additional constraint that only Planetscope Surface Reflectance asset types (PSScene4Band analytic_sr) are allowable inputs. The 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.

Planet Surface Reflectance Basemaps are non-automated products, built to users specified Time of Interest (TOI) and Area of Interest (AOI). No color balancing or color adjustments are applied to the Surface Reflectance Basemaps; preserving the calculated pixel value is vital to these basemaps being analytic ready. Surface Reflectance Basemaps are more likely to contain seam lines and for narrow TOI's are more likely to contain clouds.

Planet Surface Reflectance basemaps are packaged in the same method as Automated Basemaps described in section 3.3. Surface Reflectance overview and web service tiles are available as RBG (default) or as Color Infrared (CIR). Surface reflectance basemaps have slightly different specifications as shown in Table B.

Table B. Individual Quad Specifications

Individual Surface Reflectance Quad Specifications

Attribute	Description
Sensors	PlanetScope. Surface Reflectance Assets Only
Pixel Size (resolution)	4.77 m at the Equator
Image Bit Depth	16 bits per pixel
Bands	Blue, Green, Red, NIR Alpha
Projection	WGS84 Web Mercator (EPSG:3857)
Size	4096 x 4096 pixels
Processing	Geometrically aligned.

5. BASEMAP METADATA

Basemaps and individual quads have metadata associated with them that provides the user with additional details. 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 C. Basema Metadata Schema

Basemap Metadata Schema

Attribute	Description
bbox	A four element array containting 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 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 automated timelapse basemaps this will be describe 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 time that the last input scene was taken in ISO 8601 format
level	Zoom level of available quads, maximum zoom level of tileserver
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

Individual Quad Specifications

Attributes	Description
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 `glevel`, `tilex` and `tiley`
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 D. Mosaic Quad Metadata Schema

Mosaic Quad Metadata Schema

Field	Description
bbox	4 element array describing 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 `L{level}-{X}E-{Y}N`, where level is the the max zoom level for the mosaic, and X and Y are the x and y position of the quad in the grid for that zoom level.

A sample quad ID is L15-1023E-2465N, indicating that this mosaic has a maximum zoom level of 15 (or 4.77m per pixel) and that this particular quad is in the position 1023, 2465 in the two dimensional grid that makes up the basemap.

7. 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 GUI's 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 Dimensions or Capabilities requests from clients. This should have minimal impact to basemaps consumers since Planet is only serving up a single layer and a single dimension and any consuming application should default to these.

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