DigitalGlobe™

Core Imagery Product Guide

v. 2.0

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1 DigitalGlobe Imagery Products

1.1 Overview of This Document

This document provides detailed descriptions of DigitalGlobe's Core Imagery products, including product levels, specifications, available options, new collection levels and delivery methods. It is intended for an external audience and is DigitalGlobe's official product offering.

1.2 Product Overview

DigitalGlobe's Core Imagery products are derived from high-resolution satellite and aerial images. Our core products vary according to processing level and geolocational accuracy. Each product is delivered with a set of support files to assist you in analyzing or further processing the imagery.

All DigitalGlobe products are corrected for radiometric and sensor distortions. Radiometric corrections include relative radiometric response between detectors, non-responsive detector fill, and conversion for absolute radiometry. Sensor corrections include corrections for internal detector geometry, optical distortion, scan distortion, line-rate variations and mis-registration of the multispectral bands where applicable.

Table 1.1 Core Imagery Products Suite

CORE IMAGERY PRODUCTS	ACCURACY (CE90)	PROCESSING			GEOGRAPHIC AVAILABILITY
		RADIOMETRICALLY AND SENSOR-ORRECTED	GEORECTIFIED	ORTHORECTIFIED	
Basic	5 m-23 m[1]	●			Worldwide
Basic Stereo Pair	5 m[1]	●			Worldwide
Standard	5 m – 23 m[1]	●	●		Worldwide
Ortho Ready Standard	5 m – 23 m[1]	●	●		Worldwide
Ortho Ready Standard Stereo	5 m[1]	●	●		Worldwide
Vision Premium Precision Aerial	2.7 m – 5.4 m	●		●	Continental U.S. + Western Europe

[1]Excluding the effects of terrain and up to 30 degrees off-nadir angle

CORE PRODUCTS	ACCURACY (CE90)	PROCESSING			GEOGRAPHIC AVAILABILITY
		RADIOMETRICALLY AND SENSOR-ORRECTED	GEORECTIFIED	ORTHORECTIFIED	
Vision Premium Precision	4.2 m	●		●	Worldwide, limited to fine Digital Elevation model (DEM) coverage (SRTM + USGS NED)
Vision Premium Mapping	10.2 m	●		●	Worldwide, limited to fine DEM coverage (SRTM + USGS NED)
Vision Premium Display	25.4 m	●		●	Worldwide, limited to fine DEM coverage (SRTM + USGS NED)
Vision Precision	4.2 m	●		●	Worldwide, limited to fine DEM coverage (SRTM + USGS NED)
Vision Mapping	10.2 m	●		●	Worldwide, limited to fine DEM coverage (SRTM + USGS NED)
Vision Display	25.4 m	●		●	Worldwide, limited to fine DEM coverage (SRTM + USGS NED)

1.3 Constellation Order Fulfillment

DigitalGlobe offers order fulfillment from the constellation. This means that a given order, ImageLibrary or New Collection, can be sourced from any sensor capable of fulfilling the product requirements. This capability enables faster collection and delivery by using all constellation resources to fulfill the order.

1.4 Imaging Band Options

DigitalGlobe offers four image band options:

- **Panchromatic** - Products include only one band and is black and white.
- **Multispectral** - Products include 4- or 8- multispectral bands.
- **Pan-sharpened** - Products combine the visual information of the multispectral data with the spatial information of the panchromatic data, resulting in a higher ground sample distance (GSD) color product.
- **SWIR** – Products include 8 shortwave infrared bands[2].

1.4.1 Multispectral Products

The band sequence for 4-band and 8-band multispectral products is in order of shortest wavelength to longest wavelength. The band order in a 4-band multispectral product is Blue, Green, Red, and Near Infrared1 (NIR1). The

[2] SWIR availability date TBD

band order in an 8-band multispectral product is Coastal, Blue, Green, Yellow, Red, Red Edge, Near Infrared1 and Near Infrared2 (NIR2). For more information on the specific ranges of the panchromatic and multispectral bands, refer to the section *Satellite Constellation* on page 32.

1.4.2 Pan-sharpened Products

Pan-sharpened products are offered as 3-band and 4-band products. 3-band color products are available in Natural Color (Blue, Green and Red bands) and in Color Infrared (Green, Red and NIR1 bands). The 4-band pan-sharpened product uses the Blue, Green, Red, and Near Infrared1 bands. All pan-sharpened products are tiled due to large file sizes. Pan-sharpened products are available in 30 cm[3], 40 cm, 50 cm and 60 cm GSD and are only available as Standard and Ortho level products.

1.4.3 SWIR Products[4]

SWIR or Shortwave infrared products are offered as 8-band. This includes bands SWIR 1-8. SWIR products are available as 7.5 m GSD and are only available as Basic and Standard level products.

1.4.4 Band Option Summary

Table 1.2 Summary of Product Band Options

PRODUCT TYPE	PIXEL RESOLUTION CLASS	IMAGE BANDS (IN ORDER)
Panchromatic Only	30 cm³, 40 cm, 50 cm, 60 cm	Panchromatic
Multispectral (4-Band)	1.2 m³, 1.6 m, 2.0 m, 2.4 m	Blue, Green, Red, NIR1
Multispectral (8-Band)	1.2 m³, 1.6 m, 2.0 m	Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2
Bundle (Pan + 4-Band)	30 cm³, 40 cm, 50 cm, 60 cm 1.2 m³, 1.6 m, 2.0 m, 2.4 m	Panchromatic Blue Green, Red, NIR1
Bundle (Pan + 8-Band)	30 cm³, 40 cm, 50 cm 1.2 m³, 1.6 m, 2.0 m	Panchromatic Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2
Shortwave infrared (8-band[4]	7.5 m	SWIR 1-8

[3] 30 cm/1.2 m availability date TBD
[4] SWIR availability date TBD

PRODUCT TYPE	PIXEL RESOLUTION CLASS	IMAGE BANDS (IN ORDER)
Natural Color	30 cm[5], 40 cm, 50 cm, 60 cm, 30 cm aerial	Blue, Green, Red
Color Infrared	30 cm[5], 40 cm, 50 cm, 60 cm	Green, Red, NIR1
Pan-sharpened (4-Band)	30 cm[5], 40 cm, 50 cm, 60 cm	Blue, Green, Red, NIR1

Note: It is recommended that selected imagery for 40 cm-class product creation be selected from natively collected <49.9 cm imagery and selected imagery for 30 cm[5]-class product creation be selected from natively collected <39.9 cm imagery.

1.5 Basic Imagery Products

Basic Imagery products are designed for customers with advanced image processing capabilities. These imagery products, when combined with supplied attitude, ephemeris, and camera model information, are suitable for advanced photogrammetric processing (for example, orthorectification).

Each unique image in a Basic Imagery product is processed individually; seamlines will be visible in products requiring multiple images to cover the Area of Interest (AOI). Basic Imagery products are available in panchromatic, multispectral, panchromatic + multispectral bundle and as shortwave infrared (SWIR). Basic Imagery products have an 'as-collected' GSD. The pan-sharpening option is not available with a Basic product.

1.5.1 Processing

Basic Imagery products are radiometrically corrected and sensor corrected, but not projected to a plane using a map projection or datum. The sensor correction blends all pixels from all detectors into the synthetic array to form a single image. The resulting GSD varies over the entire product because the look angle slowly changes during the imaging process.

1.5.2 Accuracy

The Basic Imagery product is in the satellite frame of reference; it is not tied to ground location, and is therefore a geometrically raw product with no implied accuracy. However, when the data is processed with the supplied refined Image Support Data (ISD), a horizontal geolocational accuracy of 5 m CE90[6], excluding terrain and off-nadir effects, can be achieved at less than 30° off-nadir. The shortwave infrared (SWIR) Basic Imagery product has a geolocational accuracy of 7.5 m CE90.

1.5.3 Physical Structure

Basic Imagery products are delivered as scenes. Scenes are approximately full swath width, cut into consistent lengths. Depending on area ordered, the length of the last piece of imagery used to fulfill the Area of Interest (AOI) could be less than the length specified below. There will be at least 1.8 km overlap between scenes of the same strip.

- QuickBird Scene-framed products are approximately 14.9 km x 14 km at nadir (at 400km altitude).

[5] 30 cm/1.2 m availability date TBD
[6] For Panchromatic + 8-band multispectral products

- WorldView-1 Scene-framed products are approximately 17.6 km x 14 km at nadir.
- WorldView-2 Scene-framed products are approximately 16.4 km x 14 km at nadir.
- GeoEye-1 Scene-framed products are approximately 17.3 km x 14 km at nadir.
- WorldView-3 Scene-framed products are approximately 13.1 km x 14 km at nadir.
- WorldView-3 SWIR Scene-framed products will be approximately 10.8 km 14 km at nadir.

1.5.4 Specification Table for Basic Imagery (panchromatic + 8-band multispectral)

The following table lists the processing specifications, product and delivery parameters, and delivered Image Support Data (ISD) Files for Basic Imagery Products.

Table 1.3 Specifications for Basic Imagery Products

PHYSICAL CHARACTERISTICS – BASIC IMAGERY	
Minimal orderable area	Single Scene 183 km² – 246 km² (sensor dependent)
Product Framing	Scene-based
Pan Strip Width (km, approx. at nadir)	13.1 km – 17.6 km (sensor dependent)
PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy (nadir)	Geometrically raw. With supplied Image Support Data (ISD) imagery can be processed to 5 m CE90 (WorldView-1, WorldView-2, GeoEye-1, WorldView-3) or 23 m CE90 (QuickBird) at less than 30° off-nadir, excluding terrain effects.
PRODUCT PARAMETERS	
Product Options	Panchromatic, 4-Band MS, 8-Band MS, Pan + 4-Band MS Bundle, Pan + 8-Band MS Bundle
Number of Bits per Pixel in Delivered Product	8 or 16
Digital Scaling Method (applies to 8-bit only)	Linear with a maximum value set to 255
Resampling Option	4x4 Cubic Convolution, MTF kernel, Nearest Neighbor
Output Pixel Spacing	As collected (pixels may be resampled based on selected minimum GSD)
Cloud Cover	0-15% default, other options available upon request
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
Image Data Format Options	GeoTIFF, NITF 2.0, NITF 2.1

IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, ephemeris file; attitude file; geometric calibration file; RPC00B file; license text file; tile map file.
Spacecraft Telemetry	Refined attitude/ephemeris (supplied with ISD).

1.5.5 Specification Table for Basic Imagery SWIR products

The following table lists the processing specifications, product and delivery parameters, and delivered Image Support Data (ISD) Files for Basic Imagery SWIR products.

Table 1.4 Specifications for Basic Imagery SWIR Products

PHYSICAL CHARACTERISTICS – BASIC SWIR IMAGERY	
Minimal orderable area	Single Scene ~150 km²
Product Framing	Scene-based
Pan Strip Width (km, approx. at nadir)	10.8 km
PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy (nadir)	Geometrically raw. With supplied Image Support Data (ISD) imagery can be processed to 7.5 m CE90 (WorldView-3) at less than 30° off-nadir, excluding terrain effects.
PRODUCT PARAMETERS	
Product Options	8-band SWIR (SWIR 1-8)
Number of Bits per Pixel in Delivered Product	8 or 16 (collected at 14)
Resampling Option	4x4 Cubic Convolution
Output Pixel Spacing	As collected (pixels may be resampled based on required minimum GSD)
Cloud Cover	0-15% default, other options available upon request
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
Image Data Format Options	GeoTIFF

IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, ephemeris file; attitude file; geometric calibration file; RPC00B file; license text file; tile map file.
Spacecraft Telemetry	Refined attitude/ephemeris (supplied with ISD).

1.6 Basic Stereo Pair Imagery Products

Basic Stereo Pair Imagery products are suitable for customers with a high level of image expertise and who have software that is capable of ingesting, processing, and/or displaying stereo imagery. Basic Stereo Pair Imagery products are typically used to create Digital Elevation Models or for three-dimensional feature extraction.

Basic Stereo Pair Imagery products are comprised of one or more pairs of Basic Images with 100% overlap over the customer's Area of Interest (AOI). Stereo mates are collected on the same satellite orbit and with specific look angles in order to attain imagery appropriate for stereo viewing. Basic Stereo Pair Imagery is available in panchromatic, 4-band multispectral, panchromatic + 4-band multispectral bundle or shortwave infrared products. Basic Stereo Pair Imagery products have an 'as-collected' GSD.

1.6.1 Processing

Basic Stereo Pair Imagery products are radiometrically-corrected and sensor-corrected, but not projected to a plane using a map projection or datum. The sensor correction blends all pixels from all detectors into the synthetic array to form a single image. The resulting GSD varies over the entire product because the attitude & ephemeris slowly change during the imaging process.

1.6.2 Accuracy

The Basic Stereo Pair Imagery product is in the satellite frame of reference. It is not tied to ground location, and is therefore a geometrically raw product with no implied accuracy. However, when the data is processed with the supplied refined Image Support Data (ISD), a horizontal geolocational accuracy of 5 m CE90, excluding terrain and off-nadir effects, can be achieved at less than 30° off-nadir. Vertical accuracy is 5 m LE90 at less than 30° off-nadir.

1.6.3 Physical Structure

The minimum order size for Basic Stereo Pair Imagery products is 15 km wide x 14 km long up to a maximum of a one degree cell (approximately 110 km x 110 km) for WorldView-1, WorldView-2 and WorldView-3. It is 17.3 km wide x 14 km long for GeoEye-1. Basic Stereo Pair Imagery products are full-width framed delivered at full swath width which is 17.6 km at nadir for WorldView-1 Imagery, 16.4 km for WorldView-2, 17.3 km for GeoEye-1 and 13.1 km for WorldView-3. Due to file size constraints, Stereo products often must be divided into smaller image segments. They can be segmented in two different ways: cut up into 14 km lengths or, for larger areas, the length of the image strip can be divided into equal parts along the image strip.

Products cut up into 14 km lengths will be delivered in 14 km increments, except for the last increment in the strip, which may be a fractional increment. Products that are divided into equal segments can be divided by 1, 2, 4, or 7 parts. Customers who require small, manageable files sizes or who are interested in achieving higher processing speeds should opt to divide the strips into more parts by selecting a larger number of parts. Those users who can manage large file sizes and desire a fewer number of images to cover the Area of Interest (AOI) should select smaller number of parts. For either method of division, there will be at least 1 km overlap between adjacent stereo pairs.

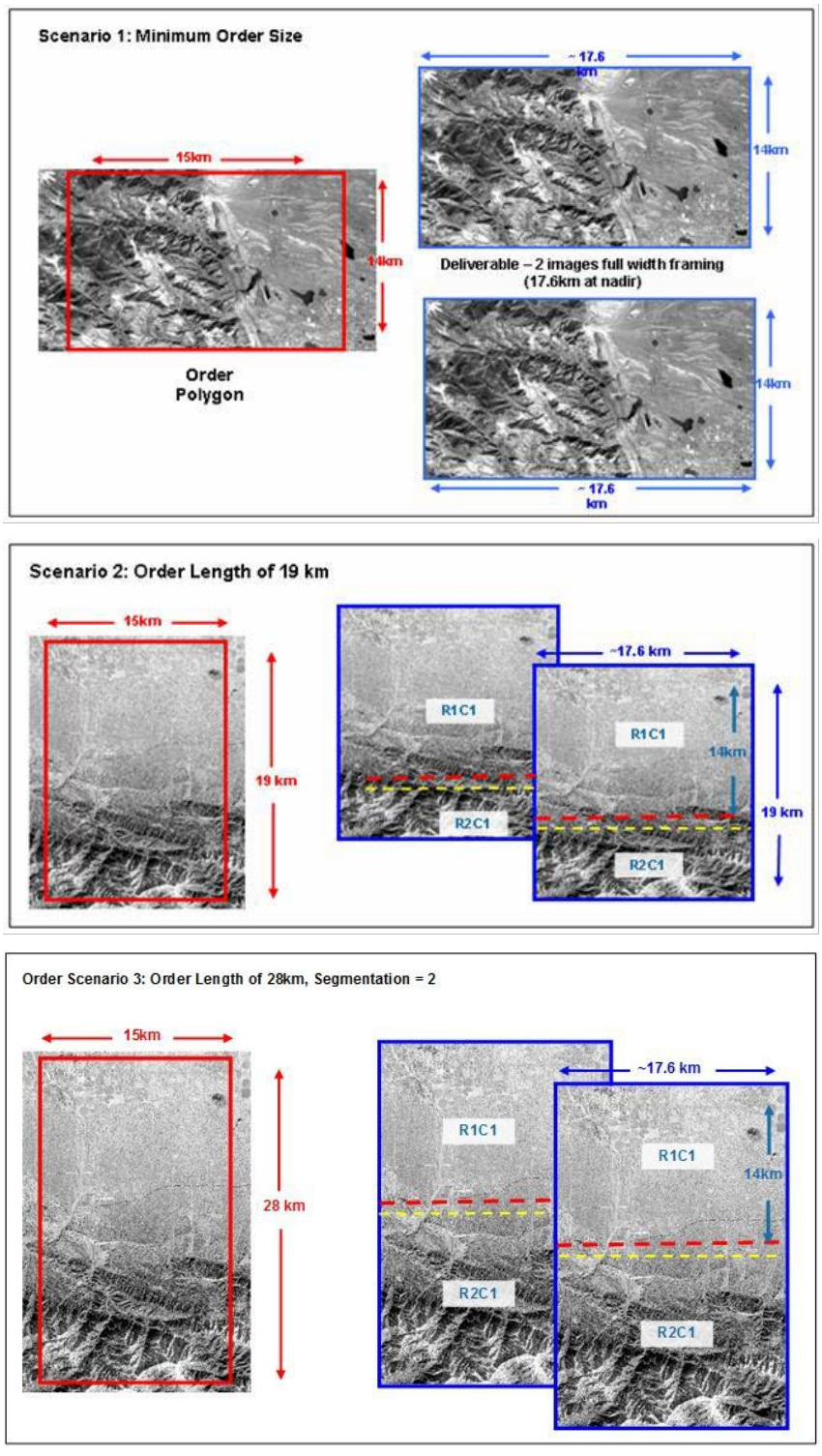


Figure 1.1 Three Ordering Scenarios 14 KM Length Stereo Imagery

1.6.4 Specification Table for Basic Stereo Pair Imagery (panchromatic + 8-band multispectral)

The following table lists the processing specifications, product and delivery parameters, and delivered Image Support Data (ISD) files for Basic Stereo Pair Imagery products.

Note the stereo collection angles will constrain the off-nadir and azimuth angles.

Table 1.5 Specifications for Basic Stereo Pair Imagery Products

PHYSICAL CHARACTERISTICS – BASIC STEREO IMAGERY	
Minimal orderable area	WorldView-1 & WorldView-2: 210 km^2 (15 km x 14 km) GeoEye-1: 242.2 km^2 (17.3 km x 14 km) WorldView-3: 183 km^2 (13.1 km x 14 km)
Product Framing	Full-width
Pan strip width (km, approximate at nadir)	WorldView-1: 17.6 km WorldView-2: 16.4 km GeoEye-1: 17.3 km WorldView-3: 13.1 km
PROCESSING SPECIFICATIONS	
Absolute geolocation accuracy (nadir)	Geometrically raw. With supplied Image Support Data (ISD) imagery can be processed to 5 m CE90 at less than 30° off-nadir, excluding terrain effects.
Absolute Vertical Accuracy	5 m LE90 at less than 30° off-nadir
PRODUCT PARAMETERS	
Product Options	Panchromatic, 4-Band MS, Panchromatic + 4-Band MS Bundle
Number of bits per pixel in deliverable image	8 or 16
Digital Scaling Method (applies to 8-bit only)	Linear with a maximum value set to 255
Resampling Option	4x4 Cubic Convolution, MTF kernel, Nearest Neighbor
Output Pixel Spacing	As collected; no worse than 75 cm
Overlap of AOI	100%
Convergence Angle C	30-60
Bisector Elevation Angle (BIE)	60-90
Asymmetry	< 20 degrees

DELIVERY PARAMETERS	
Output product delivery media options	FTP (pull), DVD, External Hard Drive
File Format Options	GeoTIFF, NITF 2.0, NITF 2.1
IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, ephemeris file; attitude file; geometric calibration file; RPC00B file; license text file; tile map file, stereo file
Spacecraft Telemetry	Refined attitude/ephemeris (supplied with ISD)

1.7 Standard Imagery Products

Standard Imagery products are suitable for users requiring modest absolute accuracy and/or large area coverage. Users of Standard Imagery products usually possess sufficient image processing tools and knowledge to manipulate and exploit the imagery for a wide variety of applications.

1.7.1 Processing

Standard Imagery products are radiometrically corrected, sensor corrected, and projected to a plane using the map projection and datum of the customer's choice. Standard Imagery products are available in panchromatic at 30 cm[7], 40 cm, 50 cm or 60 cm GSD, pan-sharpened at 30 cm[7], 40 cm, 50 cm or 60 cm GSD, multispectral at 1.2 m[7], 1.6 m, 2.0 m or 2.4 m GSD depending on the sensor or shortwave infrared (SWIR) at 7.5 m[8]. All Standard Imagery products can have a uniform GSD throughout the entire product or have satellite-standard GSD.

The radiometric corrections applied to this product include: relative radiometric response between detectors, non-responsive detector fill, and a conversion for absolute radiometry. The sensor corrections account for internal detector geometry, optical distortion, scan distortion, any line-rate variations, and registration of the panchromatic and multispectral bands. Geometric corrections remove spacecraft orbit position and attitude uncertainty, Earth rotation and curvature, and panoramic distortion.

Standard Imagery comes in two varieties:

- **Standard Imagery:** Standard Imagery has a coarse Digital Elevation Model (DEM) applied to it, which is used to normalize for topographic relief with respect to the reference ellipsoid. The degree of normalization is relatively small, so while this product has terrain corrections, it is not considered orthorectified.
- **Ortho Ready Standard Imagery:** Ortho Ready Standard Imagery has no topographic relief applied with respect to the reference ellipsoid, making it suitable for orthorectification. Ortho Ready Standard Imagery is projected to a constant base elevation, which is calculated on the average terrain elevation per order polygon or can be supplied by the customer.

[7] 30 cm/1.2 m availability date TBD
[8] SWIR availability date TBD

1.7.2 Accuracy

Standard and Ortho Ready Standard Imagery product accuracies vary by sensor. For QuickBird imagery, the geolocation accuracy specification is 23 m CE90. The WorldView-1, WorldView-2, GeoEye-1 and WorldView-3 accuracy specification is 5 m CE90[9] at less than 30° off-nadir. The shortwave infrared (SWIR) product has a geolocational accuracy of 7.5 m CE90. These accuracies are excluding any topographic displacement and off-nadir viewing angle. Ground location is derived from refined satellite attitude and ephemeris information without requiring the use of Ground Control Points (GCPs). When Ortho Ready Standard Imagery is processed using supplied Rational Polynomial Coefficients (RPCs), a high quality Digital Elevation Model (DEM) (e.g. DTED Level 2) and sub-meter GCPs, accuracies in the range of 4 m CE90[9] may be achieved.

1.7.3 Physical Structure

With the exception of lack of terrain correction, Ortho Ready Standard Imagery products have all the same specifications as Standard Imagery products. All the specifications in this section apply to both Standard Imagery products and Ortho Ready Standard Imagery products.

If the order polygon crosses more than one strip, one product is made for each image strip that is used to fulfill the order. As the Standard Product is not mosaicked, one product will be delivered for each strip the order polygon intersects. The delivered area for Standard Products is the order polygon, black-filled to the Minimum Bounding Rectangle (MBR). The following figures show the final product structure for order polygons that fall within a single strip, and that cross multiple strips.

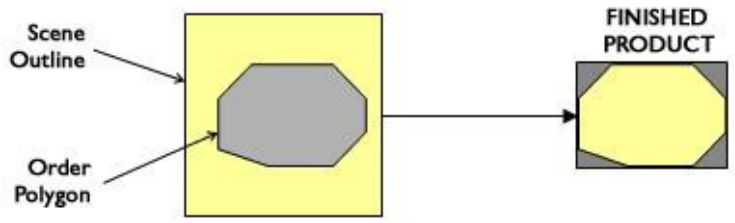


Figure 1.2 Product Structure for Standard and Orthorectified Imagery Products within a Single Strip

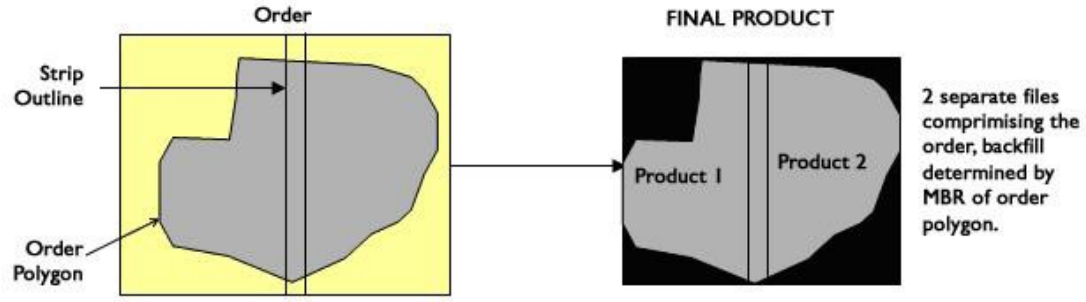


Figure 1.3 Product Structure for Projected Multi-Strip Products

Standard Imagery products are delivered as one image file for each strip the order polygon intersects. If the order polygon intersects more than one strip, the imagery in each strip will be delivered as separate files, will not be mosaicked together to form a single image, and will not be radiometrically balanced.

[9] For Panchromatic + 8-band multispectral products

1.7.4 Specification Table for Standard Imagery Products (panchromatic + 8-band multispectral)

The following table lists the processing specifications, product and delivery parameters, and delivered Image Support Data (ISD) files for Standard Imagery products.

Table 1.6 Specifications for Standard Imagery Products

PHYSICAL CHARACTERISTICS – STANDARD AND ORTHO READY STANDARD IMAGERY	
Minimum Orderable Area	25 km^2 (ImageLibrary); new collection subject to minimum price for level selected, not less than 100 km^2
Product Framing	Area-based
PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy	Geolocation accuracy specification of 5 m CE90 (WorldView-1, WorldView-2, GeoEye-1, WorldView-3) or 23 m CE90 (QuickBird) at less than 30° off-nadir, excluding terrain effects.
Geometric Corrections Applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion; terrain elevation (coarse)
Geolocation Information Applied	Ephemeris and attitude; rotation and alignment to map projection
Applied Terrain Information	Average base elevation or customer specified elevation (Ortho Ready Standard); coarse DEM (Standard)
PRODUCT PARAMETERS	
Product Options	Panchromatic, 4-Band MS, 8-Band MS, Pan + 4-Band MS Bundle, Pan + 8-Band MS Bundle, 3-Band Pan-sharpened as Natural Color or Color Infrared, 4-band Pan-sharpened
Number of Bits per Pixel in Delivered Image	8 or 16
Digital Scaling Method (applies to 8-bit only)	Linear with a maximum value set to 255 (if highest digital number is ≤ 255, no scaling is applied)
Resampling Option	4x4 Cubic Convolution, Nearest Neighbor, MTF kernel, Enhanced kernel, Pan-sharpening
Dynamic Range Adjustment (DRA) Option	Color correction and contrast enhancement (8-bit only)

PRODUCT PARAMETERS (CONT.)	
Output Tile Size Options	None; 8k x 8k pixels; 14k x14k; 16k x 16k pixels; Map-based
Output Pixel Spacing	Panchromatic: 30 cm[10], 40 cm, 50 cm or 60 cm Pan-sharpened: 30 cm[10], 40 cm, 50 cm or 60 cm Multispectral: 1.2 m[10], 1.6 m, 2.0 m or 2.4 m
Output Alignment	Rotated to Map North Up
Cloud Cover	0-15% Default, other options available upon request
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
Image Data Format Options	GeoTIFF, NITF 2.0, NITF 2.1
IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, RPC00B file; license text file; tile map file
Spacecraft Telemetry	Refined attitude/ephemeris (used to create the product)

1.7.5 Specification Table for Standard Imagery SWIR Products

The following table lists the processing specifications, product and delivery parameters, and delivered Image Support Data (ISD) files for Standard Imagery products.

Table 1.7 Specifications for Standard Imagery SWIR Products

PHYSICAL CHARACTERISTICS – STANDARD AND ORTHO READY STANDARD SWIR IMAGERY	
Minimum Orderable Area	25 km^2 (ImageLibrary); new collection subject to minimum price for level selected, not less than 100 km^2
Product Framing	Area-based
PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy	Geolocation accuracy specification of 7.5 m CE90 (WorldView-3) at less than 30° off-nadir, excluding terrain effects.
Geometric Corrections Applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion; terrain elevation (coarse)

[10] 30 cm/1.2 m availability date TBD

PROCESSING SPECIFICATIONS (CONT.)	
Geolocation Information Applied	Ephemeris and attitude; rotation and alignment to map projection
Applied Terrain Information	Average base elevation or customer specified elevation (Ortho Ready Standard); coarse DEM (Standard)
PRODUCT PARAMETERS	
Product Options	8-band SWIR (SWIR 1-8)
Number of Bits per Pixel in Delivered Image	8 or 16 (collected as 14)
Digital Scaling Method (applies to 8-bit only)	Linear with a maximum value set to 255 (if highest digital number is ≤ 255, no scaling is applied)
Resampling Option	4x4 Cubic Convolution
Dynamic Range Adjustment (DRA) Option	n/a
Output Tile Size Options	None
Output Pixel Spacing	7.5 m
Output Alignment	Rotated to Map North Up
Cloud Cover	0-15% Default, other options available upon request
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
Image Data Format Options	GeoTIFF
IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, RPC00B file; license text file; tile map file
Spacecraft Telemetry	Refined attitude/ephemeris (used to create the product)

1.8 Ortho Ready Stereo Imagery Products

Ortho Ready Standard Stereo Imagery products are suitable for customers with a high level of image expertise and software that is capable of ingesting, processing and/or displaying stereo imagery. They are typically used to create Digital Elevation Models or for three dimensional feature extraction. Customers ordering stereo products who require a small Area of Interest (AOI) should order the Ortho Ready Standard Stereo product while customers requiring large area coverage should opt for the Basic Stereo Pair Imagery product.

1.8.1 Processing

Ortho Ready Stereo Imagery is map projected but has no topographic relief applied with respect to the reference ellipsoid, making it suitable for orthorectification. Ortho Ready Stereo Imagery is projected to a constant base elevation, which is calculated on the average terrain elevation per order polygon or can be supplied by the customer.

The Ortho Ready Stereo product takes on all of the same stereo collection angle specifications as the Basic Stereo Pair Imagery products, however are available for customers who either prefer a map corrected stereo product or require a smaller minimum Area of Interest.

1.8.2 Accuracy

Ortho Ready Imagery product accuracies vary by sensor. The WorldView-1, WorldView-2, GeoEye-1 and WorldView-3 accuracy specification is 5 m CE90 at less than 30° off-nadir. These accuracies are excluding any topographic displacement and off-nadir viewing angle. Ground location is derived from refined satellite attitude and ephemeris information without requiring the use of Ground Control Points (GCPs). Vertical accuracy is 5 m LE90 at less than 30° off-nadir.

1.8.3 Physical Structure

Ortho Ready Stereo Imagery products offer 100% stereo coverage over the Area of Interest (AOI). The minimum AOI size for this product is 100 km^2. These products have the same physical structure as Ortho Ready Standard Imagery products. Refer to *1.7.3 1.7.3* Physical Structure on page 18 for details.

1.8.4 Specification Table for Ortho Ready Standard Stereo Imagery Products

The following table lists the processing specifications, product parameters, and delivered Image Support Data (ISD) files for Ortho Ready Standard Stereo Imagery products.

Table 1.8 Specifications for Ortho Ready Standard Stereo Imagery Products

PHYSICAL CHARACTERISTICS –ORTHO READY STANDARD STEREO IMAGERY	
Minimum Order Size	100 km^2 (10 km x 10 km)
Maximum Order Size	110 km^2 x 110 km^2
Product Framing	Area-Based
Final Product Physical Structure	Product Tiling Available
Pan Strip Width (km, approximate at nadir)	WorldView-1: 17.6 km WorldView-2: 16.4 km GeoEye-1: 17.3 km WorldView-3: 13.1 km

PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy	Geolocation accuracy specification of 5 m CE90 (WorldView-1, WorldView-2, GeoEye-1 and WorldView-3) at less than 30° off-nadir, excluding terrain effects.
Geometric Corrections Applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion
Geolocation Information Applied	Ephemeris and attitude; rotation and alignment to map projection
Applied Terrain Information	Average base elevation or customer-specified
PRODUCT PARAMETERS	
Product Options	Panchromatic, 4-Band MS, 8-Band MS, Pan + 4-Band MS Bundle, Pan + 8-Band MS Bundle, 3-Band Pan-sharpened as Natural Color or Color Infrared, 4-band Pan-sharpened
Number of Bits per Pixel in Delivered Image	8 or 16
Digital Scaling Method (applies to 8-bit only)	Linear with a maximum value set to 255
Resampling Option	4x4 Cubic Convolution, Nearest Neighbor, MTF kernel, Enhanced kernel, Pan-sharpening
Dynamic Range Adjustment (DRA) Option	Color correction and contrast enhancement (8-bit only)
Output Tile Size Options	None; 8k x 8k pixels; 14k x14k; 16k x 16k pixels; Map-based
Output Pixel Spacing	Panchromatic: 30 cm[11], 40 cm, 50 cm or 60 cm Pan-sharpened: 30 cm[11], 40 cm, 50 cm or 60 cm Multispectral: 1.2 m[11], 1.6 m, 2.0 m or 2.4 m
Output Alignment	Rotated to Map North Up
Cloud Cover	0-15% Default, other options available upon request
Map Projections	Geographic (Lat/Lon), UTM, State Plane
Ellipsoids and Datums	NAD27, NAD83, WGS84
Convergence Angle	30-60
Bisector Elevation Angle (BIE)	60-90

[11] 30 cm/1.2 m availability date TBD

PRODUCT PARAMETERS (CONT.)	
Asymmetry	< 20 degrees
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
File Format Options	GeoTIFF, NITF 2.0, NITF 2.1
IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file; RPC00B file; license text file; tile map file, stereo file

1.9 Advanced Ortho Series

Advanced Ortho Series products are orthorectified, fully processed and ready to be integrated into your GIS workflow. The Advanced Ortho Series provides an ideal base for creating and revising mapping and GIS databases, or for registering existing feature layers. Advanced Ortho Series products can also be used for change detection and other analytical applications that require a high degree of absolute accuracy.

DigitalGlobe offers the Advanced Ortho Series for customers who require fully processed imagery with clearly defined aesthetic and accuracy specifications, which are described in greater detail in *Table 1.9*.

If the customer wishes to utilize their own data, such as a Digital Elevation Model (DEM) or Ground Control Points (GCPs), Custom Orthorectified products are available. Refer to *1.9.6 Custom Orthorectified* Products on page 26 for details. If the customer requires orthorectified imagery that does not conform to the standardized options of the Advanced Ortho Series, Map Scale Orthorectified products are available. Refer to *1.9.7 Map Scale Orthorectified* Products on page 27. Options for Map Scale Orthorectified products are the same as the Advanced Ortho Series except where noted in *Table 1.12*.

Table 1.9 Advanced Ortho Series Imagery Products and Associated Accuracies

ACCURACY TYPE	ACCURACY CE90	ACCURACY RMSE	VISION PREMIUM	VISION
Precision Aerial	2.7 m – 5.3 m	1.8 m – 3.5 m	Superior aesthetics with high touch services Virtually cloud and haze free Tonally balanced 3-5 day delivery[12]	N/A
Precision	4.2 m	2.8 m		Standard aesthetics with automated production 2-3 day delivery[12]
Mapping	10.2 m	6.6 m		
Display	25.4 m	16.5 m		

[12]Satellite delivery times based on areas smaller than 1500 km^2. Larger areas will be delivered within 5 days for Ortho Vision; within 10 days for Ortho Vision Premium.

1.9.1 Processing

Advanced Ortho Series satellite imagery products are radiometrically-corrected, sensor-corrected, and orthorectified with a fine Digital Elevation Model (DEM). This is performed using the map projection and datum requested by the customer. Orthorectified imagery products require DEMs to remove relief displacement. Ground Control Points (GCPs) can also be used to improve the absolute accuracy. Before an order for an Orthorectified Imagery product is accepted, DigitalGlobe will determine whether it has the appropriate support data to make the desired product. The accuracy of the DEMs and/or GCPs required to make each product depends on the Orthorectified Imagery product ordered. Quotes for the support data will be provided on request (for locations where GCPs can be collected). *Table 1.10* summarizes the processing parameters used for Vision Premium and Vision Ortho products.

1.9.2 Block Adjusted Multi-Image Orthorectified Products

Block Adjusted Multi-Image Orthorectified products are generated from more than one image strip. Common features in overlapping image strips are identified, and are used to tie the images into a block of data. The component image strips are orthorectified so that each image strip can be maintained as its own product part, each with associated metadata.

1.9.3 Mosaic Products

Orthorectified mosaic products are comprised of Block-Adjusted image strips that are mosaicked into a single image layer. Orthorectified mosaic products are area-framed and oriented North Up.

1.9.4 Tonal Balancing

Tonal balancing, available for multi-image mosaics, adjusts pixels in adjacent images to the same color, brightness, and contrast for a seamless appearance.

Differences due to seasons, viewing geometry and ascending/descending orbits, lighting and aerosol content differences, etc., may not be accommodated. Products that have been tonally balanced are not suitable for multispectral analysis.

Table 1.10 Vision and Vision Premium Processing Parameters

PROCESSING	VISION PREMIUM	VISION
Product Options	Naturla Color (3-Band Pan-sharpened) is the default. Other options available.	
Spatial Resolution	30 cm[13], 40 cm, 50 cm, 60 cm	30 cm[13], 40 cm, 50 cm, 60 cm, 30 cm aerial
Customer Framing	Area-Based	
Bit Depth	8 bits per pixel	
Resampling Kernel	Enhanced kernel for Pan-sharpened, MTF kernel for panchromatic	
File Format	GeoTIFF is default, other options may be available. See *4.2.1 File* Formats on page 48.	
Mosaic	Available for all sensors.	

[13] 30 cm availability date TBD

PROCESSING	VISION PREMIUM	VISION
Radiometric Balancing	General balancing required for mosaics	Precise balancing required for mosaics
DRA	On	
Datum/Projection/Units	Default is UTM WGS84 (m), other supported options are available. See *4.2 Projections and Datums* on page 52.	
Tiling	8k x 8k, 14k x 14k, 16k x 16k pixels	
Delivery	FTP (pull), DVD, External Hard Drive	

1.9.5 Aesthetics

The Advanced Ortho Series offers two aesthetic specifications: Vision Premium and Vision. Vision Premium aesthetics are of the highest quality, with more rigorous specifications for cloud, haze, snow, geometric breaks and cutline placement. Vision aesthetics are very good quality but have less rigorous specifications for cloud, haze, snow, geometric breaks and cutline placement than Vision Premium. Vision products are less manually intensive and can be generated more quickly and at larger scale. Table 1.11 describes the specifications for Vision Premium and Vision products in detail.

Table 1.11 Aesthetic Quality Specifications

QUALITY TYPE	VISION PREMIUM	VISION
Cloud Cover	< 10%	< 20%
Haze, Pollution, and Fog	Minimized	Allowable
Snow	Only persistent allowed	Allowable
Tonal Balancing	Required; input imagery is seasonally consistent	Optional; If requested, optimal results may not be achieved
Geometric Breaks	Minimized	Allowable up to one half the product CE 90
Cutline Placement	Seamless	Automated, visible radiometric breaks are allowable

1.9.6 Custom Orthorectified Products

Customers may provide their own Digital Elevation Models (DEMs) or Ground Control Points (GCPs) when ordering Custom Orthorectified products. There is no stated accuracy associated with Custom Orthorectified products because the quality and accuracy of the finished product is directly dependent upon the quality and accuracy of the support data. Please contact DigitalGlobe for a complete list of acceptable types of support data and formats.

1.9.7 Map Scale Orthorectified Products

Map Scale Orthorectified products are available with the same accuracy specifications as listed in *Table 1.9*, but are also available without Dynamic Range Adjustment (DRA) and in both 8- or 16-bits per pixel. The only aesthetic

specification supported by Map Scale Orthorectified products is a 15% cloud cover for the Area of Interest (AOI). No aesthetic specifications as identified in *Table 1.11* are supported.

1.9.8 Specification Table for Map Scale Orthorectified Products (panchromatic + 8-band multispectral)

Table 1.12 Map Scale Orthorectified Product Specifications

PHYSICAL CHARACTERISTICS – ORTHO IMAGERY	
Minimal Orderable Area	100 km^2
Maximum Orderable Area	10,000 km^2
Product Framing	Area-based
PROCESSING SPECIFICATIONS	
Absolute Geolocation Accuracy	4.2 m – 25.4 m CE90
Geometric Corrections Applied	Spacecraft orbit position and attitude uncertainty; Earth rotation; Earth curvature; panoramic distortion; terrain elevation (fine)
Geolocation Information Applied	Refined ephemeris and attitude; rotation and alignment to map projection
Applied Terrain Information	Fine DEM
Spatial Mosaicking	Images mosaicked to minimize seamlines – optional
Tonal Balance	Contiguous tonal balancing across multi-image mosaics - optional
PRODUCT PARAMETERS	
Product Options	Panchromatic, 4-Band MS, 8-Band MS, Pan + 4-Band MS Bundle, Pan + 8-Band MS Bundle, 3-Band Pan-sharpened as Natural Color or Color Infrared, 4-band Pan-sharpened
Number of Bits per Pixel in Delivered Product	8 or 16
Digital Scaling Method (applies to 8 bit only)	Linear with maximum value set to 255 (if highest DN is <= 255, no scaling is applied)
Resampling Option	Nearest Neighbor, 4x4 Cubic Convolution, MTF kernel, Enhanced kernel, Pan-sharpening
Dynamic Range Adjustment (DRA)	On or Off available
Output Tile Size Options	None; 8k x 8k pixels; 14k x14k; 16k x 16k pixels Product Units-customer specified (mosaics only)

PRODUCT PARAMETERS (CONT.)	
Output Pixel Spacing	Panchromatic: 30 cm[14], 40 cm, 50 cm or 60 cm Pan-sharpened: 30 cm[14], 40 cm, 50 cm or 60 cm Multispectral: 1.2 m[14], 1.6 m, 2.0 m or 2.4 m
Map Projections, Ellipsoids and Datums	See *Table 4.2 Projections and Datums* on page 52.
Output Alignment	Rotated to Map North up
Cloud Cover	15%
DELIVERY PARAMETERS	
Output Product Delivery Media Options	FTP (pull), DVD, External Hard Drive
Image Data Format Options	GeoTIFF, NITF 2.0, NITF 2.1
IMAGE SUPPORT DATA	
ISD Files Supplied to Customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, license text file; tile map file
Spacecraft Telemetry	Refined attitude/ephemeris (used to create the product)

1.10 Precision Aerial

The Precision Aerial product is a Premium Precision Ortho. However, it has a number of specifications that differ from the satellite-derived Advanced Ortho Series products. The Advanced Ortho Aerial program is a joint effort with Microsoft to produce the first wall-to-wall 30 cm Natural Color and 60 cm Color Infrared orthomosaics of the contiguous United States and Western Europe.

1.10.1 Collection Program

The Advanced Ortho Aerial program imagery is collected in 1 degree by 1 degree Region Tiles (~10,000 km^2) in a grid pattern for complete country coverage. Additionally, individual Metros, which are irregular polygons generously drawn around the major cities and population centers, are collected and processed as a complete product to ensure high quality within the populated areas. Processing a Metro contiguously ensures that seasonality, color balancing, and mosaicking are maintained for a whole Metro regardless of how that metro falls along the 1 degree x 1 degree Region Tile boundaries. Each Region Tile is categorized into High Value, Standard Value, and Remote Value groups. These categories dictate collection priority. Metros are always High Value. Collection priority is placed on highly populated Metro areas, then select Standard Value region tiles, which will be followed by Remote Value region tiles.

[14] 30 cm/1.2 m availability date TBD

1.10.2 Physical Structure

Vision Premium Precision Aerial products are delivered in full Region Tiles or Metro areas and are tiled in 25,000 by 25,000 pixels for Natural Color (RGB) and 12,500 by 12,500 pixels for Color Infrared (CIR).

1.10.3 Processing

Precision Aerial products are orthomosaics that are color balanced within the Region Tiles. Color differences between the frames that make up a mosaic will be minimized. Specifically, individual image frames will be adjusted for side-to-side shading, contrast variations, time-of-day, sun-angle, atmospheric conditions like haze, and the use of multiple cameras over multiple days. Whenever adjacent Region Tiles are available, an overlapping strip of images will be used in color balancing of a new Region Tile, however adjacent Region Tiles and Metros will not be color balanced to each other. Seamlines are minimized by routing through irregular paths through the images to avoid above-ground man-made structures. Seam-lines between images from adjacent flight strips may be noticeable in vegetated or built-up areas. To minimize any potential geometric errors between adjacent Region Tiles, flying patterns will be adjusted such that there always is a flight line centered on the region tile boundary.

The following table defines the characteristics of the Vision Premium Precision Aerial product. DigitalGlobe makes a best effort to abide by the quality specifications; however, under rare circumstances we may allow slight variations. These products are all produced to the following specification and available off the shelf. Custom Orthomosaic processing is not available for this product.

1.10.4 Specification Table for Vision Premium Precision Aerial Products

Table 1.13 Specifications for Vision Premium Precision Aerial Products

PROCESSING PARAMETER	HIGH VALUE	STANDARD BLOCK	REMOTE BLOCK
Sensor	Microsoft UltraCam G		
Maximum Off-Nadir Angle	+/- 42.4° ONA CrossTrack +/- 6.8° ONA LongTrack		
Cloud Cover Restrictions	< 1%	< 1%	1%
Sun Elevation	30°	20°	20°
Maximum Accuracy Tolerance (CE90)	2.67 m or 4.01 m	4.01 m	4.01 m or 5.34 m
MOSAICKING AND COLOR BALANCING			
Color Balancing	Yes within complete 1° x 1° region tile, or metro AOI		
Mosaicking	Yes, within Region Tiles and Metros		

PRODUCTION PARAMETERS			
Processing	Orthorectified Aerial Imagery		
Bits per Pixel	8 bits		
Spatial Resolution	Natural Color (RGB): 30 cm; Color Infrared (CIR): 60 cm		
Dynamic Range Adjustment (DRA)	Yes		
Resampling Kernel	Cubic Convolution		
Spectral Bands	Natural Color: RGB; Color sharpened Infrared: NRG		
Projection, Datum, Units	UTM, WGS84, meters		
Tile Size	RGB: 25,000 x 25,000 pixels, CIR: 12,500 x 12,500 pixels		
File Format and Associated Parameters	GeoTIFF		
Naming	**Region products:** <RGB or CIR>_<LL_LAT_LL_LON>_<yyyy>_<mm>_<dd>_ISO.XML Eg. RGB_N40W105_2010_04_30_ISO.XML **Metro products:** <RGB or CIR>_<Metro Name>_<yyyy>_<mm>_<dd>_ISO.XML Eg. CIR_USA-CO-Denver_2010_04_30_ISO.XML		
Metadata	Metadata: IS0 19115		
ENVIRONMENTAL CONDITIONS			
Cloud and Shadow Restrictions	0%	< 2%	< 3%
	Must not be black and detail is clearly visible		
Haze	0%	< 2%	< 3%
	Must not be white and detail is clearly visible		
Standing Water	0%	0%	< 1%
Seasonality	Leaf-Off	N/A	N/A
Snow	Permanent Snow	Above Treeline	< 3%

1.11 Geo and GeoStereo Products

Geo and GeoStereo products are available only with the IKONOS satellite. Functionally equivalent to Ortho Ready Standard and Ortho Ready Stereo products, Geo and GeoStereo products conform to a different technical specification. Please refer to DigitalGlobe's Geo/GeoStereo Product Guide.

2 Satellite Constellation

The DigitalGlobe Constellation consists of six high-resolution satellites (native collection ability):

IKONOS - 82 cm Panchromatic, 3.28 m 4-Band Multispectral
QuickBird – 55 cm Panchromatic, 2.16 m 4-Band Multispectral (at 400km altitude)
WorldView-1 – 50 cm Panchromatic
WorldView-2 – 46 cm Panchromatic, 1.85 m 8-Band Multispectral
GeoEye-1 – 41 cm Panchromatic, 1.65 m 4-Band Multispectral
WorldView-3 – 31 cm Panchromatic, 1.24 m 8-Band Multispectral, 3.7 m 8-Band SWIR

Due to different capabilities of each satellite, they are able to deliver different items from the core product list. IKONOS is only available as Geo and GeoStereo products. Please refer to DigitalGlobe's Geo/GeoStereo Product Guide.

Table 2.1 Product Availability by Satellite

	IKONOS	QUICKBIRD	WORLDVIEW-1	WORLDVIEW-2	GEOEYE-1	WORLDVIEW-3
Available Products	Geo, GeoStereo	Basic, Standard, Ortho Ready Standard and AOS	Basic, Basic Stereo, Standard, Ortho Ready Standard/Stereo and AOS	Basic, Basic Stereo, Standard, Ortho Ready Standard/Stereo and AOS	Basic, Basic Stereo, Standard, Ortho Ready Standard/Stereo and AOS	Basic, Basic Stereo, Standard, Ortho Ready Standard/Stereo and AOS
Product Spatial Resolution	80 cm or 1 m Pan 3.2 m or 4 m MS	60 cm Pan 2.4 m MS	50 cm Pan	40 cm, 50 cm Pan 1.6 m, 2.0 m MS	40 cm,50 cm Pan 1.6 m, 2.0 m MS	30 cm[15], 40 cm, 50 cm Pan 1.2 m[15], 1.6 m, 2.0 m MS 7.5 m SWIR[15]
Multispectral Bands	Red, Green, Blue, Near-Infrared 1	Red, Green, Blue, Near-Infrared 1	N/A	Coastal, Blue, Green, Yellow, Red, Red Edge, Near-Infrared 1, and Near-Infrared 2	Red, Green, Blue, Near-Infrared 1	Coastal, Blue, Green, Yellow, Red, Red Edge, Near-Infrared 1, and Near-Infrared 2
Native Accuracy (at nadir on flat terrain)	15 m CE90	23 m CE90	5 m CE90	5 m CE90	5 m CE90	5 m CE90 7.5 m CE90 (SWIR)

Please see Spectral Response for DigitalGlobe Earth Imaging Instruments for details on sensor band values.

[15] 30 cm/1.2 m and SWIR availability date TBD

The following sections outline the capabilities of each satellite.

2.1 IKONOS Satellite

Launched on 24 September 1999, IKONOS collects 82-centimeter panchromatic and 3.28-meter multispectral data at a rate of over 240,000 square kilometers per day or over 87 million square kilometers per year. IKONOS orbits the Earth every 98 minutes at an altitude of approximately 681 kilometers or 423 miles. The satellite travels a sun-synchronous orbit, always crossing the equator at approximately 10:30 a.m. local time.

Table 2.2 IKONOS Satellite Characteristics

CHARACTERISTIC	DETAIL
Launch Information	Date: September 24, 1999 Launch Vehicle: Delta II 7920 Launch Site: Vandenberg Air Force Base
Orbit	Altitude: 681 kilometers Type: Sun synchronous, 10:30 am descending node Period: 98 minutes
Sensor Bands	Panchromatic: 450 - 520
	Multispectral:
	Blue: 450-550 nm Green: 520-600 nm Red: 630-690 nm Near-IR1: 760-900 nm
Sensor Resolution (GSD = Ground Sample Distance)	0.82 meters GSD at nadir panchromatic 3.28 meters GSD at nadir multispectral 0.91 meters GSD at 20° off-nadir panchromatic 3.64 meters GSD at 20° off-nadir multispectral
NIIRS Equivalency	NIIRS potential of > 5.0
Dynamic Range	11-bits per pixel
Swath Width	11 kilometers at nadir
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below
Retargeting Agility	Acceleration: 1.43 deg/s/s Rate: 3.86 deg/sec Time to slew 200 kilometers: 10 seconds
Pan Point Target Rate (50 km spacing)	4 points/min
Onboard Storage	2199 gigabits solid state with EDAC

CHARACTERISTIC	DETAIL
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1651 km wide swath Higher angles selectively available
Per Orbit Collection	524 gigabits
Daily Collection (km^2)	240,000 km^2
Max Contiguous Area Collected in a Single Pass	138 x 112 km mono 63 x 112 km stereo
Nominal Scene Size	121 km^2
Revisit Frequency to target at 40° N latitude	1.1 days at 1 meter GSD 3.7 days at 20° off-nadir or less (0.52 GSD)
Revisit Time	3 days at 40° latitude with elevation > 60°
Geolocation Accuracy (CE90)	Specification of 15 meters CE90 at less than 30° off-nadir excluding terrain and off-nadir effects. With registration to GCPs in image: 2 meters.

2.2 QuickBird Satellite

DigitalGlobe's QuickBird satellite provides high resolution panchromatic and multispectral imagery. Its large swath width, combined with ample on-board storage and geolocational accuracy, allows it to efficiently and accurately image large areas of the globe.

Table 2.3 QuickBird Satellite Characteristics

CHARACTERISTIC	DETAIL	
	ALTITUDE 400 KM	ALTITUDE 300 KM
Launch Information	Date: October 18, 2001 Launch Vehicle: Delta II Launch Site: Vandenberg Air Force Base	
Orbit	Altitude: 400 kilometers Type: Sun synchronous, 10:00 am descending node Period: 92.4 minutes	Altitude: 300 kilometers Type: Sun synchronous, 10:25 am descending node Period: 90.4 minutes

CHARACTERISTIC	DETAIL	
	ALTITUDE 400 KM	ALTITUDE 300 KM
Sensor Bands	Panchromatic: 405-1053	Multispectral: Blue: 430 - 545 Green: 466 – 620 Red: 590 – 710 NIR1: 715 - 918
Sensor Resolution (GSD = Ground Sample Distance)	0.55 meters GSD at nadir panchromatic 2.16 meters GSD at nadir multispectral	0.41 meteres GSD at nadir panchromatic 1.63 meters GSD at nadir multispectral
NIIRS Equivalency	NIIRS potential of 4.9	
Dynamic Range	11-bits per pixel	
Swath Width	14.9 kilometers at nadir	11.2 kilometers at nadir
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below	
Retargeting Agility	Acceleration: .086 deg/s/s Rate: 2.4 deg/sec Time to slew 200 kilometers: 38 seconds	Time to slew 200 kilometers: 44 seconds
Onboard Storage	128 gigabits capacity	
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1005 km wide swath Higher angles selectively available	
Per Orbit Collection	331 gigabits	
Max Contiguous Area Collected in a Single Pass	14.9 x 360 km mono	11.2 x 360 km mono
Revisit Frequency to target at 40° N latitude	Revisit time may vary from 2 to 12 days depnding on target location as the orbit decays.	
Geolocation Accuracy (CE90)	Geolocation Accuracy specification of 23 meters CE90 excluding terrain and off-nadir effects. Demonstrated 17 meters LE90 (without ground control).	

2.3 WorldView-1 Satellite

WorldView-1 is the first of our next-generation equipped with state-of-the-art control moment gyros (CMGs), which provide stunning agility, rapid retargeting and efficient in-track stereo collection. The WorldView-1 satellite is capable of collecting up to 1,000,000 square kilometers of 50 cm resolution panchromatic imagery per day.

Table 2.4 WorldView-1 Satellite Characteristics

CHARACTERISTIC	DETAIL	
Launch Information	Date: September 18, 2007 Launch Vehicle: Delta II 7920 Launch Site: Vandenberg Air Force Base	
Orbit	Altitude: 496 kilometers Type: Sun synchronous, 10:30 am descending node Period: 95 minutes	Altitude: 496 kilometers Type: Sun synchronous, 1:30 pm descending node Period: 95 minutes
Sensor Bands	Panchromatic 397-905	
Sensor Resolution (GSD = Ground Sample Distance)	0.50 meters GSD at nadir 0.55 meters GSD at 20° off-nadir	
NIIRS Equivalency	NIIRS potential of > 5.0	
Dynamic Range	11-bits per pixel	
Swath Width	17.7 kilometers at nadir	
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below	
Retargeting Agility	Acceleration: 2.29 deg/s/s Rate: 4.45 deg/sec Time to slew 200 kilometers: 10 seconds	
Onboard Storage	2199 gigabits solid state with EDAC	
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1035 km wide swath Higher angles selectively available	
Per Orbit Collection	331 gigabits	
Max Contiguous Area Collected in a Single Pass	111 x 112 km mono 51 x 112 km stereo	
Revisit Frequency to target at 40° N latitude	1.7 days at 1 meter GSD or less 5.4 days at 20° off-nadir or less (0.55 meter GSD)	
Geolocation Accuracy (CE90)	Geolocation Accuracy specification of 5 meters CE90 at less than 30° off-nadir, with actual accuracy in the range of 4.0 – 5.5 meters CE90 at nadir, excluding terrain and off-nadir effects. With registration of GCPs in image: 2 meters.	

2.4 WorldView-2 Satellite

WorldView-2 is the first commercially available 8-band multispectral satellite equipped with state-of-the-art control moment gyros. It has high agility, rapid retargeting and efficient in-track stereo collection, plus with its higher elevation, it provides faster revisit times around the globe. The WorldView-2 satellite is capable of collecting up to 1,000,000 square kilometers of 46 cm panchromatic and 1.85 m 8-band multispectral imagery per day.

Table 2.5 WorldView-2 Satellite Characteristics

CHARACTERISTIC	DETAIL	
Launch Information	Date: October 8, 2009 Launch Vehicle: Delta II 7920 Launch Site: Vandenberg Air Force Base	
Orbit	Altitude: 770 kilometers Type: Sun synchronous, 10:30 am descending node Period: 100 minutes	
Sensor Bands	Panchromatic: 447 - 808	
	Multispectral:	
	Coastal Blue: 396-458 nm Blue: 442-515 nm Green: 506-586 nm Yellow: 584-663 nm	Red: 624-694 nm Red Edge: 699-749 nm Near-IR1: 765-901 nm Near IR2: 856-1043 nm
Sensor Resolution (GSD = Ground Sample Distance)	0.46 meters GSD at nadir panchromatic 1.85 meters GSD at nadir multispectral 0.52 meters GSD at 20° off-nadir panchromatic 2.07 meters GSD at 20° off-nadir multispectral	
NIIRS Equivalency	NIIRS potential of > 5.0	
Dynamic Range	11-bits per pixel	
Swath Width	16.4 kilometers at nadir	
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below	
Retargeting Agility	Acceleration: 1.43 deg/s/s Rate: 3.86 deg/sec Time to slew 200 kilometers: 10 seconds	
Onboard Storage	2199 gigabits solid state with EDAC	
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1651 km wide swath Higher angles selectively available	

CHARACTERISTIC	DETAIL
Per Orbit Collection	524 gigabits
Max Contiguous Area Collected in a Single Pass	138 x 112 km mono 63 x 112 km stereo
Revisit Frequency to target at 40° N latitude	1.1 days at 1 meter GSD 3.7 days at 20° off-nadir or less (0.52 GSD)
Geolocation Accuracy (CE90)	Specification of 5 meters CE90 at less than 30° off-nadir excluding terrain and off- nadir effects. With registration to GCPs in image: 2 meters.

2.5 GeoEye-1 Satellite

GeoEye-1 is able to collect images at 0.41-meter panchromatic and 1.65-meter multispectral resolution. The satellite is able to collect up to 700,000 square kilometers of panchromatic (and up to 350,000 square kilometers of multispectral) imagery per day. This capability is ideal for large scale mapping projects. GeoEye-1 is able to revisit any point on Earth once every three days or sooner.

Please note that GeoEye-1 images in two collection modes: Enhanced Line Rate which is a collection mode that increases the collection capacity and allows for larger areas to be fulfilled more quickly and Standard Line Rate. Image acquisition in Enhanced Line Rate mode results in 32 panchromatic pixels collected for every 1 multispectral pixel as compared to the Standard Line Rate which results in 16 panchromatic pixels for every 1 multispectral pixel. The resulting products are the same in format and comparable in their quality.

Table 2.6 GeoEye-1 Satellite Characteristics

CHARACTERISTIC	DETAIL
Launch Information	Date: September 6, 2008 Launch Vehicle: Delta II Launch Site: Vandenberg Air Force Base
Orbit	Altitude: 681 kilometers Type: Sun-synchronous, 10:30am descending node Period: 98 minutes
Sensor Bands	Panchromatic Black&White: 450-800 nm
	Multispectral: Blue: 450-510 nm Green: 510-580 nm Red: 655-690 nm Near-IR: 780-920 nm
Sensor Resolution (GSD = Ground Sample Distance)	0.41 meters GSD at nadir panchromatic 1.65 meters GSD at nadir multispectral

CHARACTERISTIC	DETAIL
NIIRS Equivalency	NIIRS potential of > 5.0
Dynamic Range	11-bits per pixel
Swath Width	Nominal swath width: 15.3 at nadir
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below
Retargeting Agility	Time to slew 200km: 20 seconds
Onboard Storage	1 Tbit
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1651 km wide swath Higher angles selectively available
Per Orbit Collection	524 gigabits
Max Contiguous Area Collected in a Single Pass	138 x 112 km mono 63 x 112 km stereo
Revisit Frequency to target at 40° N latitude	2.6 days at 30° off nadir
Geolocation Accuracy (CE90)	Specification of 5 meters CE90, 3 meters CE90 (measured)

2.6 WorldView-3 Satellite

WorldView-3 is the first multi-payload, super-spectral, high resolution commercial satellite. With an average revisit time of <1 day and the capability to collect up to 680,000KM2 per day, WorldView-3 further enhances DigitalGlobe's ability for rapid and reliable collection.

Table 2.7 WorldView-3 Satellite Characteristics

CHARACTERISTIC	DETAIL
Launch Information	Date: August 13, 2014 Launch Vehicle: Atlas V Launch Site: Vandenberg Air Force Base
Orbit	Altitude: 617 kilometers Type: Sun synchronous, 10:30 am descending node Period: 97 minutes
Sensor Bands	Panchromatic: 445 – 808 nm
	Multispectral:

CHARACTERISTIC	DETAIL	
	Coastal Blue: 397-454 nm Blue: 445-517 nm Green: 507-586 nm Yellow: 580-629 nm	Red: 626-696 nm Red Edge: 698-749 nm Near-IR1: 765-899 nm Near-IR2: 857-1039 nm
	Shorwave Infrared (SWIR):	
	SWIR-1: 1184-1235 nm SWIR-2: 1546-1598 nm SWIR-3: 1636-1686 nm SWIR-4: 1702-1759 nm	SWIR-5: 2137-2191 nm SWIR-6: 2174-2232 nm SWIR-7: 2228-2292 nm SWIR-8: 2285-2373 nm
	CAVIS:	
	Desert Clouds: 405-420 nm Aerosol-1: 459-509 nm Green: 525-585 nm Aerosol-2: 635-685 nm Water-1: 845-885 nm Water-2: 897-927 nm	Water-3: 930-965 nm NDVI-SWIR: 1220-1252 nm Cirrus: 1365-1405 nm Snow: 1620-1680 nm Aerosol-1: 2105-2245 nm Aerosol-2: 2105-2245 nm
Sensor Resolution (GSD = Ground Sample Distance)	Panchromatic: 0.31 meters GSD at nadir 0.36 meters GSD at 20°off nadir Multispectral: 1.24 meters GSD at nadir 1.38 meters GSD at 20° off-nadir Shortwave Infrared (SWIR): 3.70 meters GSD at nadir 4.12 meters GSD at 20° off nadir Available commmercially at 7.5 m CAVIS: 30 meters GSD at nadir 33 meters GSD at 20° off nadir	
NIIRS Equivalency	NIIRS potential of > 5.0	
Dynamic Range	11-bits per pixel panchromatic and multispectral; 14-bits per pixel shortwave infrared	
Swath Width	13.1 kilometers at nadir 10.8 kilometers at nadir – SWIR 14.8 kilometers at nadir - CAVIS	
Pointing Accuracy & Knowledge	Accuracy: < 500 meters at image start and stop Knowledge: Supports geolocation accuracy below	

CHARACTERISTIC	DETAIL
Retargeting Agility	Time to slew 200 kilometers: 12 seconds
Onboard Storage	2199 gigabits solid state with EDAC
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1651 kilometers wide swath Higher angles selectively available
Per Orbit Collection	524 gigabits
Max Contiguous Area Collected in a Single Pass @ 30° off-nadir	66.5 x 112 kilometers mono 26.6 x 112 kilometers stereo
Revisit Frequency to target at 40° N latitude	<1 day at 1 meter GSD 4.5 days at 20° off-nadir or less
Geolocation Accuracy (CE90)	Specification of 5 meters CE90 at less than 30° off-nadir excluding terrain and off-nadir effects. Predicted <3.5 meters without ground control. Specification of 10 meters CE90 – SWIR Specification of 30 meters CE90 - CAVIS

3 Imagery Acquisition

3.1 New Collection

There are three New Collection options for DigitalGlobe Core Imagery products: Select, Select Plus and Single Shot Tasking. Each option offers a different level of service to the customer, and offers different benefits, so the customer should choose the option which aligns best with their needs in terms of collection window, cloud protection, and price. New collection orders have single or multiple acquisition opportunities and different customer-defined tasking parameters, depending on the New Collection type selected.

For Select and Select Plus collection, DigitalGlobe offers a 0-15% default cloud cover. Clouds are defined as pixels through which ground features are obscured either partially or in their entirety due to atmospheric conditions; to be considered cloud cover, a definite boundary between the affected pixels and the unaffected pixels must be visible. All acquired image strips are assessed for cloud cover. Cloud shadows are not accounted for in assessment.

When preparing its collection plan, DigitalGlobe creates the best plan for every pass, which maximizes the benefit to our customer base while adhering to the parameters associated with each New Collection option. Several factors are considered in the collection plan, including New Collection option, date an order was received, the customer-specified collection window, and the cloud cover forecast. In rare instances, DigitalGlobe may pre-empt some orders due to collection efficiency and/or satellite calibration and maintenance.

Select, Select Plus, and Single Shot Tasking is also available from the IKONOS satellite and available as Geo and GeoStereo products. Please refer to DigitalGlobe's Geo/GeoStereo Product Guide.

3.1.1 How New Collection Works

1. An order is placed with the following configurable parameters: New Collection level, Collection date range, Off nadir angle, and Product and Band Options.
2. A feasibility of collection is completed with suggested collection time frames. Collection time frames are provided to a high level of confidence based on current market conditions.
3. Once an order is confirmed the New Collection is scheduled.

3.1.2 Collection Feasibility

DigitalGlobe performs two feasibility studies on all New Collection orders prior to acceptance of the order:

Physical Feasibility assesses the number of times that the satellites have physical access to your target based upon the parameters you provide. Items that affect physical feasibility include off-nadir angle (wider angles will have more accesses than narrow angles), latitude, and collection windows (the larger the collection window, the more access the satellites will have).

Competitive Feasibility assesses DigitalGlobe's ability to collect your order based upon other orders already on the tasking deck.

The output of the feasibility studies will be shown on the customer's order quotation and confirmation form as the DigitalGlobe Suggested End Collect Date and it will vary depending on the New Collection level selected (see below for more detail). The DigitalGlobe Suggested End Collect Date is a probability; not a guarantee. The feasibility is based on conditions on the day it is submitted.

3.1.3 Limitations to New Collection

3.1.3.1 Off nadir impact to re-visit frequency

Due to the orbital track, each satellite has a different re-visit frequency. The exact time will vary based on the target off-nadir (ONA) in addition to latitude and elevation angle; with shorter revisit times for lower elevation angles and higher latitudes. Widening the off nadir angle will allow for additional collection opportunities.

Depending on which product you order (i.e. panchromatic, multispectral, stereo) there may only be limited opportunity for collection for smaller off nadir angles.

- Orthorectified products are restricted to 0-30 degrees ONA (0-25 degrees for QuickBird).
- 45 degree maximum ONA for Core Imagery products

3.1.3.2 Cloud cover

The probability of collecting an image with <20% cloud coverage is less than 50% for the globe. DigitalGlobe uses multiple data inputs to predict weather including a cloud cover forecast 36 hour view which is updated every 30 minutes and historical cloud cover averages by day.

Of the available collection windows, those opportunities are narrowed further by the cloud cover. Even more so for collection requiring less than 15% cloud cover. The timeline for collection may lengthen due to cloud cover. Note that some areas have persistent cloud coverage i.e. the equatorial cloud belt.

3.1.3.3 Sun elevation

Your product choice will impact the sun elevation angle.

- 30 degree minimum sun elevation for pan-sharpened products
- 15 degree minimum sun elevation for panchromatic products

In addition, the globe is subject to sun elevation blackout periods. Based on latitude, there are specific time periods of the year when minimum sun elevation cannot be supported. Blackout periods, when no collection can occur, can be up to 5 months out of a year. As a result, areas of higher latitude will have higher competition due to the smaller collection seasons.

3.1.3.4 New Collection order priority

Priority is driven by the New Collection responsiveness level. Other factors impacting priority include:

- Constraints
- Competition
- Maneuverability
- Overall pass optimization

3.1.3.4 Demand

Even with the combined constellation there are still areas which are constrained due to high demand or due to weather. Competition is high in:

- Areas of high global interest
- Areas with less available collection days per years (due to sun elevation)
- Areas with persistent cloud cover

This means some areas of the globe will continue to have longer collection timelines.

3.1.3.6 Additional constraints

- Stereo collection, with the need to be collected on same pass, introduces additional constraints on collection.
- Specific satellite requests further lowers the collection capability by restricting access.
- Target Azimuth requests introduce additional constraints on collection when restricted.
- Larger areas are more efficient to collect than multiple small areas but may take multiple passes to complete entire AOI. We encourage the acceptance of partial deliveries for larger AOIs.

3.1.4 Select New Collection

- DigitalGlobe's entry-level new collection.
- Select offers flexibility to the customer to set their own collection window or to go with DigitalGlobe's suggested window.
- Customer may specify length of collection window that they are interested in, up to 365 days.
- DigitalGlobe will perform a feasibility study and will supply to the customer a suggested end date for collection. The customer may confirm the order with their original requested collection window, or DigitalGlobe's suggested collection window, understanding that DigitalGlobe's suggested window will give the best likelihood of success.
- DigitalGlobe's feasibility assesses physical and competitive feasibility at the time of order placement; factors may change after order confirmation which affects DigitalGlobe's ability to fulfill a Select new collection order. In the case that DigitalGlobe is unable to collect a Select new collection order in the original new collection window, the customer will be given the option to extend the collection window, cancel remaining collection of unfulfilled area, or take delivery of the partial collect.

Table 3.1 Select New Collection Parameters

SELECT NEW COLLECTION PARAMETERS		CUSTOMER-SELECTED
Minimum Collection Area	Basic Imagery – Single Scene 183 km²-246 km² (sensor dependent) Basic Stereo – 183 km² - 242 km² (sensor dependent) Standard Imagery, Ortho Ready Stereo, Orthorectified Imagery - subject to minimum price, not < 100 km²	Yes
Start Collection Date	Customer-requested	Yes
End Collection Date	Customer-requested number of days from Start Collection Date, up to 365 days from Start Collect OR DigitalGlobe's Suggested End Collect Date	Yes
Maximum Cloud Cover	15%	Yes

SELECT NEW COLLECTION PARAMETERS		CUSTOMER-SELECTED
End Collection Date	Customer-requested number of days from Start Collection Date, up to 365 days from Start Collect OR DigitalGlobe's Suggested End Collect Date	Yes
Maximum Cloud Cover	15%	Yes
Off-Nadir Angle	0° - 45° Basic, Standard, and Ortho Ready Standard Imagery, selectable in 10° increments[16] 0° - 30° Orthorectified Imagery (0° - 15° may be required in areas of rugged terrain)	Yes
Sun Elevation	≥ 15° (as collected); ≥ 30° for Pan-sharpened products	
Sun Azimuth	0° - 360° (as collected)	
Sensor Azimuth	0° - 360° (as collected) - default, selectable in 45° increments	Yes

Note: 30 cm/40 cm products may require constrained off nadir collection.

3.1.5 Select Plus New Collection

- Select Plus New Collection offers a higher level of service to customers than offered for Select New Collection. Customers will see shorter collection windows for Select Plus new collection, as opposed to Select new collection, in areas of high competition.
- Select Plus new collection offers flexibility to the customer to set their own collection window, or to go with DigitalGlobe's suggested window, if different.
- Customer may specify length of collection window that they are interested in, up to 365 days.
- DigitalGlobe will perform feasibility and will supply to the customer a suggested end date for collection. The customer may confirm the order with their original requested collection window, or DigitalGlobe's suggested collection window, understanding that DigitalGlobe's suggested window will provide the best likelihood of a success.
- DigitalGlobe's feasibility assesses physical and competitive feasibility at the time of order placement; factors may change after order confirmation which affects DigitalGlobe's ability to fulfill a Select Plus new collection order. In the case that DigitalGlobe is unable to collect a Select Plus new collection order in the original new collection window, the customer will be given the option to extend the collection window, cancel remaining collection of unfulfilled area, or take delivery of the partial collect.

[16] Less than or equal to 15 degrees may be subject to additional pricing considerations.

Table 3.2 Select Plus New Collection Parameters

SELECT PLUS NEW COLLECION PARAMETERS		CUSTOMER-SELECTED
Minimum Collection Area	Basic Imagery – Single Scene 183 km²-246 km² (sensor dependent) Basic Stereo – 183 km² - 242 km² (sensor dependent) Standard Imagery, Ortho Ready Stereo, Orthorectified Imagery - subject to minimum price, not < 100 km²	Yes
Start Collection Date	Customer requested	Yes
End Collection Date	Customer requested number of days from Start Collection Date, up to 365 days from Start Collect OR DigitalGlobe's Suggested End Collect Date	Yes
Maximum Cloud Cover	15%	Yes
Off-Nadir Angle	0° - 45° Basic, Standard, and Ortho Ready Standard Imagery, selectable in 10° increments[17] 0° - 30° Orthorectified Imagery (0° - 15° may be required in areas of rugged terrain)	Yes
Sun Elevation	≥ 15° (as collected); ≥ 30° for pan-sharpened products	
Sun Azimuth	0° - 360° (as collected)	
Sensor Azimuth	0° - 360° (as collected) - default, selectable in 45° increments	Yes

Note: 30 cm/40 cm products may require constrained off nadir collection.

3.1.6 Single Shot Tasking

- Single Shot Tasking should be used when customers have an immediate need for new imagery, and when customers need a guarantee that imagery will be collected on or near a specific date.
- A single collection attempt.
- An initial collection window of 1 - 14 days may be provided by the customer. DigitalGlobe will perform a feasibility and report back to the customer with the first feasible access date within the customer's requested window.
- Order is guaranteed[18] to be shot once confirmed by DigitalGlobe.
- There is no cloud cover protection for the Single Shot Tasking order. The delivered image could contain up to 100% cloud cover.
- Offered for Basic and Standard Imagery, in panchromatic and 4-band multispectral options.
- Requests must be submitted a minimum of 24 hours in advance of acquisition window for QuickBird and 36 hours in advance for GeoEye-1 and IKONOS orders.
- Orders can start tasking as soon as six hours after order confirmation. Order confirmation is subject to DigitalGlobe business hours. Since Single Shot Tasking orders are planned on a first come, first served basis, it is to the advantage of the customer to place and confirm Single Shot Tasking orders as early as possible prior to the desired collection date to ensure collection.
- Single Shot Tasking is available on QuickBird, IKONOS and GeoEye-1.

[17] Less than or equal to 15 degrees may be subject to additional pricing considerations.
[18] Subject to sensor availability.

- Constellation order fulfillment is not available for Single Shot Tasking; the complete Area of Interest (AOI) must be collected by a single satellite.

Table 3.3 Single Shot Tasking Parameters

SINGLE SHOT TASKING PARAMETERS		CUSTOMER-SELECTED
Minimum Collection Area	Basic Imagery – 100 km² - 242 km^2 (sensor dependent) Standard Imagery - subject to minimum price, not < 100 km^2	Yes
Maximum Collection Area	QuickBird: 17 km wide x 360 km long GeoEye-1: 15 km wide x 360 km long (must be able to collect in a single pass)	
Start Collection Date	As soon as 6 hours after order confirmation[19]	Yes
End Collection Date	1 - 14 days after Start Collection Date	Yes
Maximum Cloud Cover	100%	
Off-Nadir Angle	0° - 45° selectable in 10° increments[20]	Yes
Maximum Number of Acquisition Attempts	1	
Sun Elevation	≥ 15° (as collected); ≥ 30° for pan-sharpened products	
Sun Azimuth	0° - 360° (as collected)	
Sensor Azimuth	0° - 360° (as collected) - default, selectable in 45° increments	Yes

[19] Order confirmation is subject to DigitalGlobe business hours.
[20] Less than or equal to 15 degrees may be subject to additional pricing considerations.

4 ImageLibrary

DigitalGlobe's high-resolution satellite constellation has an annual collection capacity of close to 1 billion km^2. The ImageLibrary is populated with proactive collections of targeted regions, countries, and metropolitan areas as well as project areas worldwide.

The advantage of having an expansive ImageLibrary allows you quick access to all of the imagery you need to complete your project, whether it involves change detection, feature or Digital Elevation Model extraction, base mapping or site planning.

You can search DigitalGlobe's ImageLibrary for and assess numerous images from multiple satellites based on band options, seasonal, atmospheric and temporal considerations to determine which will best meet your project requirements.

When you find the imagery you need in our library, simply place an order, specify your Area of Interest (AOI) and the level of processing you need. For delivery timelines, see Table 4.6.

4.1 Area of Interest/Order Polygon Guidelines

Each order, whether New Collection or an ImageLibrary order, scene-based or area-based, is defined by an Area of Interest (also known as an Order Polygon). An Area of Interest (AOI) must be:

- Closed
- UTM WGS84-compliant
- Decimal Degrees
- One single polygon per shapefile
- Contain no holes
- A minimum of 5km wide
- Contain between 4 and 1,000 vertices

There are 4 options for submitting an Area of Interest (AOI):

- Attach shapefile
- Submit center point and AOI height & width
- Submit corner coordinates
- Submit CAT ID to order entire footprint

The minimum and maximum size for an order polygon depends on the order type and the product selected. Refer to Table 1.3 through Table 1.10 for order polygon restrictions by product type. Note that a minimum of 5 km is required for the length and width of the polygon.

4.2 Product Delivery

DigitalGlobe provides its Core Imagery products to customers on a variety of industry standard image formats and media. In addition to the imagery products, DigitalGlobe also delivers the Image Support Data files as defined in the DigitalGlobe Imagery Support Data document.

4.2.1 File Formats

Core Imagery products are available in three image formats:

- GeoTIFF 1.0
- NITF 2.0
- NITF 2.1

4.2.2 Delivery Options

DigitalGlobe provides a variety of direct and timely delivery options for delivering Core Imagery products: via File Transfer Protocol (FTP) or via express courier for physical media (DHL, FedEx, or UPS). If the order is shipped via FTP, an email will be sent with the details for download. If shipped by courier, DigitalGlobe selects the most reliable and quickest service based upon customer location.

4.2.3 Media

DigitalGlobe supports delivery on DVD and External Hard Drives for its Core Imagery products. Those customers who select electronic delivery via FTP (pull) will not receive imagery on media.

4.5 Tiling

Because some Core Imagery products cannot fit in their entirety on all available media types or may be cumbersome to work with due to their large size, DigitalGlobe offers you the option to break up imagery into smaller pieces called tiles. Tiles may be defined by pixel based grids or by map based coordinates. Pixel based tiles may be defined by approximately 8,192 pixels by 8,192 pixels (8k x 8k), 14,336 pixels by 14,336 pixels (14k x 14k), or 16,384 by 16,384 pixels (16k x16k). Map based tiles are based on map coordinates in product units (meters or feet) and are defined by tile size and tile overlap. Customers who do not wish to tile their imagery may change their media type to one that will accommodate the full size of their product, but should understand that large data files may be difficult to import into some software packages. Please note that most image processing, GIS, and cartographic applications cannot open files over 2 GB in size. Also note that file formats have size restrictions as well. For example, the size restriction for GeoTIFF 1.0 is 4GB.

Tiling is an option for all products, except Basic Imagery.

If an order polygon crosses strip boundaries, then the imagery product will be divided into product components, denoted as P001, P002, etc. When an individual product component exceeds the size limit for the media selected, it is tiled. Each tile, regardless of the tiling option (pixel based or map based) is then given a number corresponding to its position in rows and columns. (See Figure 4.1).

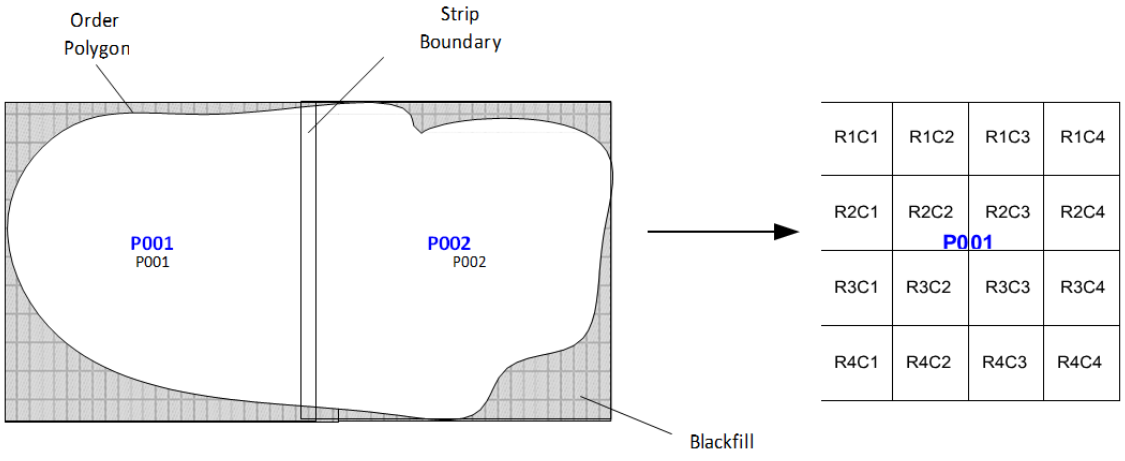


Figure 4.1 Tile Naming

A tile map file (.til) is delivered with every product to help place the tiles in product coordinates. For more information on the tile map file and more technical information on tiling, see the DigitalGlobe Imagery Support Data document.

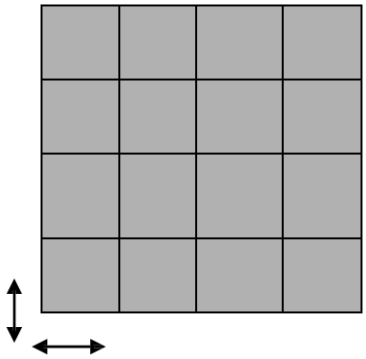


Figure 4.2 Tile Map Naming Example

4.5.1 Pixel-Based Tiling

DigitalGlobe tiles imagery based on pixel grids by first drawing a minimum-bounding rectangle (MBR) around the image-oriented map. That MBR is then divided into tiles, which are sized according to the tiling option selected. Three pixel-based tiling options are available, enabling you to specify the amount of data in each tile. These are as follows: 8k x8k, 14k x14k, and 16k x16k.

8k x 8k - 8k x 8k tiles have exactly 8,192 pixels by 8,192 pixels per tile. This tiling option may be easily read by commercial off-the-shelf (COTS) software products.

When the 8k option is selected, DigitalGlobe starts at the upper left corner of the MBR and counts 8000 x 8000 pixels to create the first tile. (The tiles are actually 8 multiplied by 1024 due to internal blocking, so the first tile would be composed of 8,192 by 8,192 pixels for a panchromatic product. Divide by 4 for a multispectral product.) The next tile is generated starting where the first tile ends (pixel 8192, 0), and pixels are counted down and across. (This same process is applied to 14k x 14k and 16k x 16k tiling, although 1024 is multiplied by 14 or 16, respectively, for these options.)

If the amount of imagery in a tile is fewer than 8192 x 8192 pixels, then the tile is cut off at the edge of the imagery. Some padding, or blackfill, pixels may be included to complete the block. A block is comprised of 1024 panchromatic pixels or 256 multispectral pixels.

14k x 14k -14k x14k tiles have exactly 14,336 by 14,336 pixels per tile.

16k x 16k -16k x16k tiles have exactly 16,384 X 16,384 pixels per tile.

4.5.2 Map-Based Tiling

Map-based tiling is available for all projections except Geographic and defined by product units (meters or feet). With this tiling option, the customer defines the tile size and tile overlap. The default tiling origin is the upper left corner of the minimum bounding rectangle for area based products and the upper left corner of the scene for scene based products. In order to define the tiling layout, the customer will specify length and width of the tiles in the product units. In addition, the amount of overlap is customizable between adjacent tiles. Although this tiling option allows for more custom tiling, tile sizes will be limited by the file size restrictions defined in *4.5.3 No* Tiling on page 45.

4.5.3 No Tiling

DigitalGlobe strives to respect the wishes of its customers in regards to tile size selection. However individual image size, file size, and media type may determine whether an image requires tiling, regardless of the option selected. An

order polygon whose boundaries intersect multiple images may need to have individual images tiled. An individual image will be tiled if it is larger than 4 GB for any available media choice.

4.6 Resampling Kernels

Resampling is necessary to align the pixels in an image to a coordinate grid. DigitalGlobe offers the following resampling options:

Table 4.1 DigitalGlobe Resampling Kernels

RESAMPLING KERNEL	DESCRIPTION	BASIC/BASIC STEREO	STANDARD/ORTHOREADY STANDARD	BASIC / STANDARD SWIR	ORTHOREADY STEREO	AOS	MAP SCALE ORTHOS
Nearest Neighbor	Selects the radiance value from the nearest pixel in the input image; does not alter the radiance values of the original image. This method can result in a blocky or disjointed image because no averaging is performed.	Y	Y	N	Y	N	Y
4x4 Cubic Convolution	Considers nearest 16 pixels synthesizing digital numbers using a polynomial calculation. This method produces a smoother appearance than nearest neighbor method while providing slightly sharper edge detail.	Y	Y	Y	Y	N	Y
MTF	Uses an 8 by 8 pixel window to determine the value of the destination pixel. Based on an empirical modeling of the optical and electronic properties of the sensors. The method produces the sharpest edge detail of all of the methods. Not available with pan-sharpend products. The MTF resampling kernel is recommended for panchromatic and bundled products.	Y	Y	N	Y	Y (Pan only)	Y
Pan-sharpening	DigitalGlobe proprietary method designed for pan-sharpened products. This kernel is only available with pan-sharpened products.	N	Y	N	Y	N	Y
Enhanced	The Enhanced Kernel uses a high pass Laplacian filter applied to the panchromatic data as a pre-processing step before pan-sharpening. The result is an image with very fine detail and excellent color balance. This option is only available for pan-sharpened products. The Enhanced resampling kernel is recommended for pan-sharpened products.	N	Y	N	Y	Y	Y

NOTE: Nearest Neighbor resampling can result with artifacts and patterns especially when resolution is down-sampled. The effect translates to vertical discontinuities in stereo imagery and therefore is not recommended.

NOTE: Use of 4x4 Cubic Convolution is discouraged for pan-sharpened products.

4.7 Projections and Datums

DigitalGlobe supports the following map projections, ellipsoids, and datums:

Table 4.2 DigitalGlobe Supported Map Projections, Ellipsoids, and Datums

MAP PROJECTIONS	ELLIPSOIDS AND DATUMS SUPPORTED
Geographic (Lat/Long)	GDA 94 NAD 27 NAD 83 WGS 84
Japanese 19	Tokyo Mean
UTM	NAD 27 NAD 83 WGS 84
State Plane	NAD 27 NAD 83

4.8 Delivery Timelines

Delivery time for products depends on the product and product options that a customer selects. Table 4.6 establishes the average timetables for product delivery. Times in this table indicate the number of business days to shipment, after DigitalGlobe receives all of the necessary support data to process an order. For ImageLibrary products, this time is number of days after order confirmation. Your product is delivered immediately upon completion of processing. For Basic and Standard New Collection Imagery, this is after imagery acquisition. For Orthorectified New Collection Imagery, this is after imagery acquisition, and the collection of appropriate Digital Elevation Models (DEMs) and Ground Control Points (GCPs).

Processing time for Basic and Standard level products is 1-3 days; for Orthomosaic products, the processing time depends on the area of the order. Precision Aerial Orthos are quoted on a project-by-project basis.

If you need your ImageLibrary imagery as soon as possible, a Rush ImageLibrary option is available for Basic and Standard level products. With the Rush option, the processing time is 24-48 hours, depending on the level of processing selected.

Table 4.3 Expected Delivery Times, By Product Type and New Collection Type

PRODUCT LEVEL[21]	SELECT/ SELECT PLUS	SINGLE SHOT TASKING	IMAGELIBRARY	RUSH IMAGELIBRARY
Basic	3 days	24 hours	1-3 days	24 hours
Standard	3 days	24 hours	1-3 days	24 hours
Standard – pan-sharpened	3 days	24 hours	1-3 days	48 hours
Vision Premium				
Orthorectified	2 days	N/A	2 days	N/A
Orthomosaic – less than 1500 km^2	5 days	N/A	5 days	N/A
Orthomosaic – more than 1500 km^2	10 days	N/A	10 days	N/A
Precision Aerial – 1 Region Tile/Metro	N/A	N/A	3 days	N/A
Precision Aerial – up to 10 Region Tile/Metros	N/A	N/A	10 days	N/A
Precision Aerial – more than 10 Region Tile/Metros	N/A	N/A	Call for quote	N/A
Vision				
Orthorectified	2 days	N/A	2 days	N/A
Orthomosaic – less than 1500 km^2	3 days	N/A	3 days	N/A
Orthomosaic – more than 1500 km^2	5 days	N/A	5 days	N/A

[21] All timelines based on business days (Monday-Friday). Processing assumes one image. Additional contiguous images in a single order will add a nominal number of days.

5 Frequently Asked Questions (FAQ)

What products are in the Core Imagery product series?

Basic (1B) Imagery is the least processed of the Core Imagery product series and is corrected for radiometric distortions, internal sensor geometry, optical distortions, and sensor distortions. Basic Imagery is neither geo-referenced nor mapped to a cartographic projection. Basic Imagery is provided with sensor models and is intended for sophisticated photogrammetric processing such as orthorectification. Basic Imagery is a scene-based product.

Standard (2A) Imagery products are radiometrically corrected, sensor corrected, and projected to a plane using the map projection and datum of the customer's choice. Standard Imagery also has a coarse Digital Elevation Model (DEM) applied to it, which is used to normalize for topographic relief with respect to the reference ellipsoid. The degree of normalization is relatively small, so while this product has terrain corrections, it is not considered orthorectified. All Standard Imagery products have uniform ground sample distance (GSD) throughout the entire product.

Ortho Ready Standard (2A) Imagery contains all the characteristics of the Standard (2A) product, however, Ortho Ready Standard Imagery has no topographic relief (DEM) applied with respect to the reference ellipsoid, making it suitable for orthorectification. Ortho Ready Standard Imagery is projected to a constant base elevation, which is calculated on the average terrain elevation per order polygon or can be supplied by the customer.

Basic (1B) Stereo Imagery contains all the characteristics of the Basic 1B product; however, two images are delivered with 100% overlap over the Area of Interest (AOI). Stereo pairs are collected on the same satellite orbit and with specific look angles in order to attain imagery appropriate for stereo viewing. In addition to the standard metadata files of a Basic product, a .STE file is delivered to orient the stereo pairs in photogrammetric software packages for further analysis and elevation extraction.

Ortho Ready (2A) Stereo Imagery products have the same physical structure as Ortho Ready Standard Imagery products. Ortho Ready Stereo Imagery products offer 100% stereo coverage over the AOI. In addition to the standard metadata files of an Ortho Ready 2A product, a .STE file is delivered to orient the stereo pairs in photogrammetric software packages for further analysis and elevation extraction.

What is the difference between Standard Imagery (2A) and Ortho Ready Standard Imagery (OR2A)?

Standard Imagery has a coarse DEM applied to it, which is used to normalize for topographic relief with respect to the reference ellipsoid. The degree of normalization is relatively small, so while this product has terrain corrections, it is not considered orthorectified. Because Standard Imagery has terrain corrections applied, it is not suitable for orthorectification by the customer. Ortho Ready Standard Imagery has no topographic corrections. This product is mapped to the average base elevation of the terrain covered by each individual satellite scene. Other than the lack of terrain correction, Ortho Ready Standard Imagery products have all the same specifications as Standard Imagery products. Ortho Ready Standard Imagery can be orthorectified using commercial photogrammetric software such as ERDAS IMAGINE, PCI Geomatica, ENVI, and SOCET GXP.

How do I know whether I need Standard Imagery (2A) or Ortho Ready Standard Imagery (OR2A)?

If you are not going to orthorectify your imagery, then a Standard Imagery product will provide a better absolute horizontal accuracy than an Ortho Ready Standard Imagery product. A coarse DEM is applied to Standard Imagery in an effort to minimize the effect of terrain distortions. Because Ortho Ready Standard Imagery is mapped to an average base elevation, the absolute horizontal accuracy may shift from its true location, especially in areas of high relief, if the user does not apply terrain corrections. This will be especially noticeable when comparing a Standard Image with an Ortho Ready Standard Image of the same area. Please note that Standard Imagery and Ortho Ready Standard Imagery both have the same absolute accuracy specification of 23 m (QuickBird satellite) and 5 m[23] (WorldView-1, WorldView-2, GeoEye-1 and WorldView-3 satellites), excluding viewing angle and topographic displacement. If your goal is to orthorectify your imagery, then Ortho Ready Standard Imagery is recommended.

[23] For panchromatic + 8-band multispectral products

Is it better to orthorectify using Basic Imagery or Ortho Ready Standard Imagery?[24]
When using Rational Polynomial Coefficients (RPCs) for orthorectification, both Basic Imagery and Ortho Ready Standard Imagery produce comparable results. When processed using commercial photogrammetric software, RPCs, high quality DEM (e.g. DTED Level 2), and sub-meter GCPs, accuracies up to 3 m RMSE can be expected with QuickBird, WorldView-1, WorldView-2, GeoEye-1 and WorldView-3 data. Slightly better results, up to 2 m RMSE, may be obtained using Basic Imagery and the QuickBird and WorldView Sensor Models with high quality DEMs and sub-meter GCPs. Ortho Ready Standard Imagery enables area-based orthorectification. Basic Imagery requires that an entire scene be orthorectified.

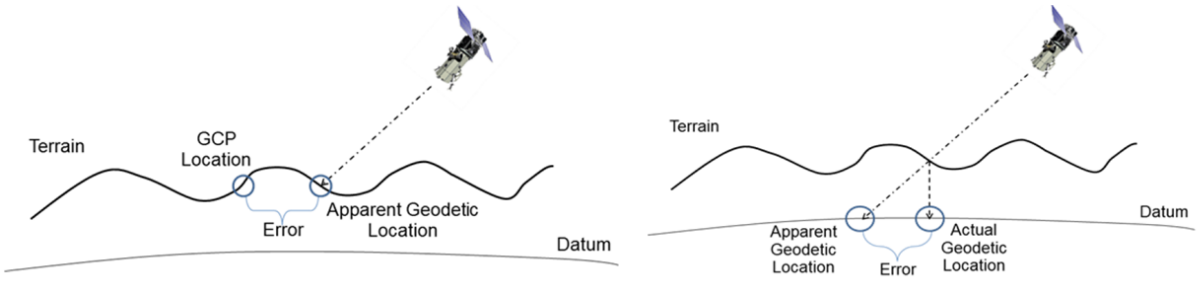
NOTE: Ortho Ready Standard Imagery products that are tiled must be mosaicked back together prior to orthorectification because the metadata files are associated with the entire delivered image.

What is an RPC?
RPC's or Rational Polynomial Coefficients are simpler empirical mathematical models relating image space (line and column position) to latitude, longitude, and surface elevation. Using the Ortho Ready Standard image, its rational polynomial coefficients, and a DEM to supply the elevation values end users can produce an orthorectified image using commercial photogrammetric software such as ERDAS IMAGINE, PCI Geomatica, ENVI, and SOCET GXP.

What are the geolocational accuracies of the Core Imagery product series?[25]
Basic Imagery product accuracy is 5 m CE90 for WorldView 1&2&3 & GeoEye-1 and 23 m CE90 for QuickBird.
Basic Imagery SWIR product accuracy is 7.5 m CE90 for WorldView-3.
Basic Stereo product accuracy is 5 m CE90 (WorldView 1&2&3 and GeoEye-1only)
Standard/Ortho Ready Standard accuracy is 5 m CE90 for WorldView 1&2&3 & GeoEye-1 and 23 m CE90 for QuickBird.
Standard/Ortho Ready Standard SWIR product accuracy is 7.5 m CE90 for WorldView-3.
Ortho Ready Stereo accuracy is 5 m CE90 (WorldView 1&2&3 and GeoEye-1 only)

Why is the Core Imagery Product accuracy better than Ortho Image accuracy?
Absolute geolocation accuracy is a measure of the location of an object, as it appears in a product, with respect to its true location on the Earth. It is determined by comparing a known, surveyed location (typically a ground control point), to the corresponding photo-identifiable feature in an image product. DigitalGlobe specifies geolocation accuracy using the CE90 and LE90 standards. Basic, Standard and Ortho Ready Standard products are not corrected for terrain-induced offsets, and therefore exclude terrain-induced offsets when calculating horizontal accuracy. An example of how accuracy is measured in Basic and Standard products is depicted in Figure 5.1 (in the left image). However, Advanced Ortho Series and Map Scale Ortho products are terrain corrected and therefore the accuracy assessment does include terrain-induced offsets, depicted in Figure 5.1 (in the right image). The geolocation error for orthos is higher because it is calculated by summing the pixel error and the error introduced by the terrain model while the accuracy of Basic and Standard products only uses the pixel error.

[24] For Panchromatic + 8-band multispectral products
[25] Excluding the effects of terrain and up to 30 degrees off-nadir angle.



Accuracy with no terrain correction

Accuracy check with Terrain Correction

Figure 5.1 Visual Comparison of Image Accuracy

What are the different color options that I can purchase from DigitalGlobe?
DigitalGlobe offers four image band options:

- **Panchromatic.** Products include only one band and are black and white.
- **Multispectral.** Products include 4 or 8 multispectral bands.
- **Pan-sharpened.** Products combine the visual information of the multispectral data with the spatial information of the pan data, resulting in a higher GSD color product. DigitalGlobe offers three options for pan-sharpened products; 4-band pan-sharpened, 3-band Natural Color and 3-band False Color.
- **SWIR.** Products include 8 shortwave infrared bands.[26]

What color bands do I get with a Multispectral Product?
The band sequence for 4-band and 8-band multispectral products is in order of shortest wavelength to longest wavelength. The band order in a 4-band multispectral product is Blue, Green, Red, and NIR1. The band order in an 8-band multispectral product is Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2.

What are the different band combinations that I can order?
Refer to Table 5.1 for band combinations.

Table 5.1 Summary of Product Band Options

PRODUCT TYPE	PIXEL RESOLUTION CLASS	IMAGE BANDS (IN ORDER)
Panchromatic Only	30 cm[27], 40 cm, 50 cm, 60 cm	Panchromatic
Multispectral (4-Band)	1.2 m[27], 1.6 m, 2.0 m, 2.4 m	Blue, Green, Red, NIR1
Multispectral (8-Band)	1.2 m[27], 1.6 m, 2.0 m	Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2

[26] SWIR availability date TBD
[27] 30 cm/1.2 m availability date TBD

PRODUCT TYPE	PIXEL RESOLUTION CLASS	IMAGE BANDS (IN ORDER)
Bundle (Pan + 4-Band)	30 cm[28], 4 0cm, 50 cm, 60 cm 1.2 m[28], 1.6 m, 2.0 m, 2.4 m	Panchromatic Blue Green, Red, NIR1
Bundle (Pan + 8-Band)	30 cm[28], 40cm, 50 cm 1.2 m[28], 1.6 m, 2.0 m	Panchromatic Coastal, Blue, Green, Yellow, Red, Red Edge, NIR1, NIR2
Shortwave infrared (8-band[29]	7.5 m	SWIR 1-8
Natural Color	30 cm[28], 40 cm, 50 cm, 60 cm, 30 cm aerial	Blue, Green, Red
Color Infrared	30 cm[28], 40 cm, 50 cm, 60 cm	Green, Red, NIR1
Pan-sharpened (4-Band)	30 cm[28], 40 cm, 50 cm, 60 cm	Blue, Green, Red, NIR1

Note: It is recommended that selected imagery for 40 cm-class product creation be selected from natively collected <49.9 cm imagery and selected imagery for 30 cm-class[28] product creation be selected from natively collected <39.9 cm imagery.

What is Pan-sharpening?
Pan-sharpening combines the visual information of the multispectral data with the spatial information of the panchromatic data, resulting in a higher GSD color product.

What Core Imagery Products can I get Pan-sharpened and what bands can I get?
Pan-sharpened products are offered as 3-band and 4-band products. 3-band Color products are available in Natural Color (Blue, Green and Red bands) and in Color Infrared (Green, Red and NIR1 bands). The 4-band pan-sharpened product uses the Blue, Green, Red, and NIR1 bands. Most pan-sharpened products are tiled due to large file sizes. Pan-sharpened products are available in 30 cm[28], 40 cm, 50 cm and 60 cm GSD and are only available as Standard (2A) and Ortho Ready Standard (2A).

What are the minimum order sizes for the Core Imagery product series?
Basic (1B) minimum order size is 183 km² - 272 km^2 (sensor dependent).
Basic (1B) Stereo Pair minimum order size is 183 km² - 210 km^2 (sensor dependent).
Standard (2A) and Ortho Ready Standard (2A) minimum order size is 25 km^2 (ImageLibrary) (NOTE: New collections are subject to minimum price for the new collection level selected, not less than 100km^2).
Ortho Ready (2A) Stereo minimum order size is 100 km^2 (300 km^2 max).

Why should I get a Tiled product? What are the options?
Because some Imagery Products cannot fit in their entirety on all available media types or may be cumbersome to work with due to their large size, DigitalGlobe offers you the option to break up imagery into smaller pieces called tiles. Tiles may be defined by pixel based grids or by map based coordinates. Pixel based tiles may be defined by the following tiling schemes: 8k x 8k (8,192 pixels by 8,192 pixels), 14k x 14k (14,336 pixels by 14,336 pixels), or 16k x 16k (16,384 by 16,384 pixels). Map based tiles are based on map coordinates in product units (meters or feet) and are defined by tile size and tile

[28] 30 cm/1.2 m availability date TBD
[29] SWIR availability date TBD

overlap. Imagery orders that will be greater than 2 GB in file size are required to be tiled. Additionally 4-band pan-sharpened products are recommended to be tiled at 14k x 14k or smaller due to file size.

(Ortho Ready Stereo vs. Basic Stereo) what is the benefit of one over the other?
Ortho Ready Stereo provides the end user with a product that is map corrected and application ready. It also allows the customer to order a smaller area of interest (minimum 100 km^2) as compared to Basic Stereo. Basic Stereo is geared towards the end user who has a higher level of image expertise and desires a large area for stereo applications.

I have ordered a Stereo product and I see a .STE file in the file folder. What is this file for?
The .STE file identifies the strip ID for both pairs in the stereo mate. It also contains the geometry for collection angles (convergence angle, bisector elevation angel and asymmetry angle) to help orient the stereo pair within commercial photogrammetry software packages. The .STE file comes with both the Basic Stereo product and Ortho Ready Standard Stereo product.

What is resampling?
When a satellite image is acquired, the pixels do not line up with any regular grid. Resampling takes those pixels from the satellite image and aligns them to the grid. When an image is resampled the coordinates of each pixel or the original image are transformed to their new corresponding location in the new regular coordinate system (grid). A pixel in the new grid will not generally overlay a pixel in the original grid. Therefore, the intensity value, or Digital Number (DN), assigned to a cell in the output grid is determined by using the pixel values that surround its position in the original grid. This is resampling.

What are the resampling options?

Nearest Neighbor: This method selects the radiance value from the nearest pixel in the input image; does not alter the radiance values of the original image. This method can result in a blocky or disjointed image because no averaging is performed.

4X4 Cubic Convolution: This method considers the nearest 16 pixels synthesizing digital numbers using a polynomial calculation. This method produces a smoother appearance than nearest neighbor method while providing slightly sharper edge detail.

MTF: This method uses an 8 x 8 pixel window to determine the value of the destination pixel. This is a sensor-specific kernel based on an empirical modeling of the optical and electronic properties of the sensors. This method produces the sharpest edge detail of all of the methods.

Pan–sharpening: DigitalGlobe's proprietary method designed for pan-sharpened products. This kernel is only available with Pan-sharpened products.

Enhanced: The Enhanced Kernel uses a high pass Laplacian filter applied to the panchromatic data as a pre-processing step before pan-sharpening. The result is an image with very fine detail and excellent color balance. This option is only available for pan-sharpened products.

What is the benefit of using one resampling kernel over another?
The **Nearest Neighbor** method provides the most spectral fidelity. It is the best option for scientific applications and spectral classification where the user may want the 'most pure' pixel.

The **4X4 Cubic Convolution** method provides a good balance between smoothness and sharpness. It is not recommended for pan-sharpened products.

The **MTF** method provides for sharpness in detail but can result in an over-sharpening effect introducing artifacts in homogenous areas such as water bodies. Not recommended for QuickBird.

Pan-sharpening is for combining the low GSD of the panchromatic band with the color from the multispectral bands to produce a low resolution color product.

The **Enhanced Kernel** results in very fine detail and is recommended for any user doing feature extraction or delineation. As with all sharpening kernels, it may introduce artifacts. Enhanced is recommended for pan-sharpened products.

What is bit depth?
Bit depth refers to the amount of energy that is stored in an image. Each pixel is assigned a value; the range of these values depends on your bit depth. All of DigitalGlobe's satellites collect data using an 11 bit dynamic range. This allows 2048 possible intensity values that can be assigned to a particular pixel.

Because computers do not read 11 bit data DigitalGlobe takes the first 11 bits of data and stores it in a 16 bit file. Placeholders are added to account for the 5 bit data difference. The data still spans the 0-2048 intensity values. DigitalGlobe also offers 8 bit data. To get to 8 bit data DigitalGlobe compresses the original 11 bit data and data spanning the 2048 values of an 11 bit data is rescaled to 256 values.

8 bit data vs. 16 bit data?
8 bit data only ranges from 0-256 while 16 bit's range goes from 0-2048. 16 bit files will be larger than 8 bit and may be more cumbersome for storage; however, for multispectral analysis, 16 bit offers more information per pixel. 8 bit data can have Dynamic Range Adjustment applied to it while 16 bit data cannot.

What is Dynamic Range Adjustment or DRA?
DRA is a visual enhancement that is applied to the image to help with color correction and contrast enhancement and is stored in the Look up Tables. Generally, customers who do not have the tools to perform color stretches on imagery should opt for DRA. This allows the image to open up in an application and look tonally balanced and color corrected.

What are my options for file formats for Core Imagery products?
Imagery products are available in the following formats:

- GeoTIFF
- NITF 2.0
- NITF 2.1

For Cloud Cover assessment, is 0-15% inclusive of 15%?
Cloud Cover assessment resulting in a value over 15% i.e. 15.35% would fall out of specification. 15.00% is within specification.

Glossary

AOI

Area of Interest. The area on the Earth that you want to view.

CAVIS

An atmospheric correction instrument allowing for identification of clouds, aerosol, vapor, ice, snow.

CE

Circular Error.

CE90

Circular Error at 90% confidence. Indicates that the actual location of an object is represented on the image within the stated accuracy for 90% of the points.

CIR

Color Infrared.

COTS

Commercial-Off-The-Shelf.

DEM

See Digital Elevation Model.

Digital Elevation Model (DEM)

A digital model of terrain relief, usually derived from stereo imagery. A DEM is used to remove terrain distortions from Orthorectified Imagery products.

DRA

Dynamic Range Adjustment. An optional post-processing feature that enhances the visual interpretability of the image.

DTED

Digital Terrain Elevation Data.

FTP

File Transfer Protocol.

GCP

See Ground Control Point.

GE01

GeoEye-1 satellite.

Geographic Projection

Maps longitudes as straight vertical lines and latitudes as straight horizontal lines all spaced out consistently for constant intervals.

GeoTIFF format

Georeferenced tagged image file format. A GeoTIFF file is a TIFF file that is embedded with geographic data tags.

GML

Geography Markup Language. GML is XML code used to express geographical features.

Ground Control Point (GCP)

A known geographic coordinate location on the ground. A GCP can be collected from ground survey or maps (Primary GCP), or derived via triangulation of primary GCPs (Secondary GCP). GCPs can be planimetric (x, y; latitude, longitude) or vertical (x, y, z; latitude, longitude, elevation).

Ground Sample Distance (GSD)

The size of a single pixel as measured on the ground. This is also referred to as “resolution”.

GSD

See Ground Sample Distance.

IK02

IKONOS satellite.

Image Support Data (ISD)

A set of files which contain all the necessary data necessary to use and process Core Imagery products. These files can be viewed as a collection point for all ancillary data that is expected to be useful to a customer.

ISD

See Image Support Data.

JPEG2000 format

The JPEG2000 format is a JPEG format that was introduced in the year 2000. It has considerable advantages over basic JPEG format including error resilience and progressive transmission.

LE

Linear Error.

LE90

Linear Error at 90 percent confidence. Indicates that the actual elevation of an object is represented within the stated accuracy for at least 90% of elevation posts.

MBR

Minimum-bounding rectangle.

Metadata

Ancillary data that describes and defines the imagery product. DigitalGlobe provides metadata in a set of Image Support Data files.

Mosaic

The process of digitally assembling images to create contiguous large-area coverage.

MS

See Multispectral.

Multispectral

Imagery with data recorded in multiple discrete spectral bands. Imagery collected in four or eight ranges of wavelengths in the electromagnetic spectrum.

Nadir

The point on the ground vertically beneath the sensor.

National Imagery Transmission Format

See NITF format.

Nearest Neighbor Interpolation

Uses the value of the closest point and disregards all other values, yielding a piecewise-constant interpolant.

NED

National Elevation Dataset DEM. NED DEM is available in the United States. Accuracy in Alaska is not as high as in the contiguous United States.

NIIRS

National Image Interpretability Rating Scale.

NIR1

Near Infrared 1.

NIR2

Near Infrared 2.

NITF format

National Imagery Transmission Format. A United States Department of Defense standard for transmitting and storing digital imagery.

NRG

Near-Infrared, Red, Green.

Off-nadir Angle

The angle between nadir and the point on the ground that the sensor is pointing. Off-nadir angle can be measured in the along-track (forward) direction or across-track (sideways) direction.

Orthorectification

The process of removing image distortions introduced by the collection geometry and variable terrain, and re-sampling the imagery to a specified map projection. Also referred to as ortho-correction or terrain correction.

Pan/Panchromatic

A wide spectral band which is comprised of reflected light in the visible spectrum (blue, green, red and NIR). It is displayed as a black and white image.

Pan-sharpened

Processed used to colorize imagery by fusing multispectral and panchromatic bands.

Photogrammetry

The art, science, and technology of obtaining reliable information about physical objects and the environment through the process of recording, measuring, and interpreting photographic images and patterns of electromagnetic radiant imagery.

Pixel

Picture element. The smallest element comprising a digital image.

PNIIRS

Predicted National Image Interpretability Rating Scale.

Product Framing

The manner in which Core Imagery products are delivered. Products are either Scene-based or Area-based.

QB02

QuickBird satellite.

Radiometric Correction

The correction of variations in data that are not caused by the object or scene being scanned, such as non-responsive detectors, scanner inconsistencies, and atmospheric interference.

Remote Sensing

The measurement or acquisition of data about an object by an instrument not in contact with the object. Satellite imagery, aerial photography, and radar are all types of remote sensing.

Resolution

The resampled image pixel size derived from GSD.

RGB

Red, Green, Blue.

RMSE

Root Mean Square Error.

RPC

Rational Polynomial Coefficient camera model. RPCs provide the camera geometry obtained at the time of the image collection.

Scale

The ratio of distance on a map as related to the true distance on the ground. Products with a larger scale have higher geometric accuracies than products with a smaller scale.

Seamlines

Seamlines are the lines at which two separate images overlap. These overlapping images can be blended along the seamline to show a more uniform image.

Sensor Azimuth

The azimuth of the sensor measured from the target.

Sensor Correction

The correction of variations in data that are caused by variations in sensor geometry, attitude, and ephemeris.

Spatial Mosaic

The assembly of multiple images, each of which shows a portion of the order polygon, into a single image. Usually involves edge matching adjacent images.

SRTM

Shuttle Radar Topography Mission digital elevation models.

Stereo

The collection of two or more images of the same Area of Interest (AOI) from different viewing angles.

Sun Azimuth

The azimuth of the sun as seen by an observer sitting on the target measured in a clockwise direction from north.

Sun Elevation

The angle of the sun above the horizon.

Sun-Synchronous

An orbit which rotates around the Earth at the same rate as the Earth rotates on its axis.

Swath Width

The width of an image.

SWIR

Shortwave infrared.

Target Azimuth

The azimuth of the target as seen by an observer sitting on the satellite measured in a clockwise direction from north.

Terrain Correction

The correction for variations in data caused by terrain displacement due to off-nadir viewing.

TLC

Time-lagged Line Count.

Universal Transverse Mercator Geographic Coordinate System (UTM)

See *UTM*.

USGS

United States Geological Survey.

UTM

Universal Transverse Mercator Geographic Coordinate System. UTM utilizes a two-dimensional Cartesian system to specify locations on the Earth's surface.

WV01

WorldView-1 satellite.

WV02

WorldView-2 satellite.

WV03

WorldView-3 satellite.

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