DIGITALGLOBE
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WorldView-1 Product Quick Reference Guide

4.7.08 Version 1.2

DIGITALGLOBE®

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1. WorldView-1 Satellite

DigitalGlobe's WorldView-1 satellite is the most agile commercial satellite ever flown. The high-capacity, panchromatic imaging system features half-meter resolution imagery. The satellite is also equipped with state-of-the-art geolocation accuracy capabilities and exhibits stunning agility with rapid pointing and efficient in-track stereo collection. WorldView-1 is designed to efficiently and accurately image large areas with industry-leading geolocation accuracy. The WorldView-1 spacecraft is capable of collecting up to 750,000 square kilometers (290,000 square miles) of imagery per day.

WorldView-1 Characteristics	
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: 94.6 minutes
Sensor Bands	Panchromatic
Sensor Resolution (GSD = Ground Sample Distance)	0.50 meters GSD at nadir 0.59 meters GSD at 25° off-nadir
NIIRS Equivalency	NIIRS potential of greater than 5.0
Dynamic Range	11-bits per pixel
Swath Width	17.6 kilometers at nadir
Pointing Accuracy & Knowledge	Accuracy: <500 meters at image start and stop Knowledge: Supports geolocation accuracy below
Retargeting Agility	Acceleration: 2.5 deg/s/s Rate: 4.5 deg/s Time to slew 300 kilometers: 10.5 seconds
Onboard Storage	2199 gigabits solid state with EDAC
Max Viewing Angle / Accessible Ground Swath	Nominally +/-45° off-nadir = 1036 km wide swath Higher angles selectively available
Per Orbit Collection	331 gigabits
Max Contiguous Area Collected in a Single Pass	60 x 110 km mono 30 x 110 km stereo
Revisit Frequency	1.7 days at 1 meter GSD 4.6 days at 25° off-nadir or less (0.59 meter GSD)
Geolocation Accuracy (CE90)	Geolocation Accuracy specification of 6.5m CE90% at nadir, with actual accuracy in the range of 4.0 – 5.5m CE90%, excluding terrain and off-nadir effects

Table 1. WorldView-1 Spacecraft Characteristics.

2. WorldView-1 Products

DigitalGlobe offers WorldView-1 Imagery Products in Basic, Standard, and Orthorectified options. The levels of processing and geolocation accuracy for Basic and Standard are shown in the table below.

Product Level	Processing	CE90
Basic Imagery	Sensor Corrected (Raw)	6.5-meters*
Standard Imagery	Georectified	6.5-meters*

*Measured using Image Support Data files and GCPs

Table 2. WorldView-1 Imagery Products and Associated Accuracies, Excluding Viewing Angle and Topographic Displacement.

2.1 Basic Imagery Products

Basic Imagery products are the least processed of the WorldView-1 Imagery Products. Each strip in a Basic Imagery order is processed individually; therefore, multi-strip Basic Imagery products are not mosaicked.

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 attitude & ephemeris slowly change during the imaging process.

Physical Structure: Basic Imagery products are delivered at full swath width, cut into 14km lengths. Full strip width is 17.6 km at nadir; the area that this width represents on the ground depends on the collection parameters (off-nadir angle, orientation of collection, etc). Note that depending on area ordered, the length of the last piece could be less than 14 km. There will be at least 1.8 km overlap between each 14 km length delivered.

Physical Characteristics - Basic Imagery	
Minimum orderable area	25 sqkm archive/64 sqkm tasking
Minimum deliverable area	1 Scene
Maximum orderable area (single order)	50,000 km2
Product Framing	Products are delivered at full swath width, cut into 14km lengths. Full strip width is 17.6 km at nadir; the area that this width represents on the ground depends on the collection parameters (off-nadir angle, orientation of collection, etc).
Final product physical structure	framed to full sensor width
Pan strip width (pixels)	35,170
Pan strip width (km, approximate at nadir)	17.6 km
MS scene dimensions (pixels col, row)	N/A
MS scene size (approximate at nadir)	N/A
Processing Specifications	
Absolute geolocation accuracy (nadir)	Geometrically raw, supplied image support data and user-supplied DEM allows processing to 6.5m CE90% with actual accuracy in the range of 4.0 – 5.5m CE90%, excluding viewing geometry and terrain displacement
Additional geometric corrections applied	N/A
Geolocation information applied	N/A
Applied terrain information	N/A
Spatial mosaicing applied	N/A
Color balance applied	N/A
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; line-rate variations
Product Parameters	
Product Options	Panchromatic only
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 (default); 2X2 bilinear; Nearest neighbor; 8 pt sinc; MTF kernel
Output pixel spacing	As collected
Map projections	N/A
Ellipsoids and datums	N/A
Output alignment	N/A
Cloud cover	0-20%
Delivery Parameters	
Output product delivery media options	FTP Pull, DVD, firewire
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0
Image compression options	N/A
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)

Table 3. Characteristics of WorldView-1 Basic Imagery Products

2.2 Basic Stereo Pair Imagery Products

Basic Stereo Pair Imagery products are comprised of two Basic Images with 100% overlap over the customer's Area of Interest (AOI). Both images are collected with specific look angles that make them appropriate for stereo viewing. Imagery is collected in-track, meaning in the same pass. Basic Stereo Pair Imagery products are suitable for customers with a high level of image expertise and software which is capable of ingesting, processing and/or displaying stereo imagery.

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.

Physical Structure: Basic Stereo Pair Imagery products are delivered at full swath width, cut into 14km lengths. Full strip width is 17.6 km at nadir; the area that this width represents on the ground depends on the collection parameters (off-nadir angle, orientation of collection, etc). Note that depending on area ordered, the length of the last piece could be less than 14 km. There will be at least 1.8 km overlap between each 14 km length delivered.

Table 4. Characteristics of WorldView-1 Basic Stereo Pair Imagery Products

Physical Characteristics - Basic Stereo Imagery	
Minimum Deliverable Area	Full swath width x 14 km
Maximum Deliverable Area	Full swath width x 28 km
Product Framing	Full width
Final Product Physical Structure	Full width increments; (separate "component" files of full swath width by 14 km long)
Pan strip width (km, approximate at nadir)	17.6 km
Full-width component size	17.6 x 14
Processing Specifications	
Absolute Geolocation Accuracy (Nadir)	6.5m CE90 at nadir, with actual accuracy in the range of 4.0 - 5.5m CE90 at nadir *
Absolute Vertical Accuracy	10m LE90 with typical performance in the range of 6.5 to 8.0 meters LE90*
Additional geometric corrections applied	N/A
Geolocation information applied	N/A
Applied terrain information	N/A
Spatial mosaicking applied	N/A
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; any line-rate variations
Product Parameters	
Product Options	Panchromatic Only
Number of bits/pixel for deliverable image	8 or 16
Digital scaling method (8 bit only)	Linear with a maximum value set to 255
Resampling option	4x4 cubic convolution (default), 2x2 bilinear, Nearest neighbor, 8 point sinc, MTFkernal
Output tile size options	N/A
Output pixel spacing	As collected; no worse than 75 cm
Map projections	N/A
Ellipsoids and Datums	N/A
Output alignment	N/A
Overlap between stereo images**	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
File format options	NITF 2.0, NITF 2.1, GeoTiff 1.0
Image compression options	JPEG compression (only for NITF 2.1)
Compression profiles (only for NITF 2.1)	Visually lossless (default), numerically lossless
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)
* - Numbers based on convergence angle of approximately 35 degrees. Excludes terrain and off-nadir effects ** - Over Customer-defined AOI	

2.3 Standard Imagery Products

Standard Imagery products are processed to a further extent than Basic Imagery. They are more suitable for users that require imagery in a familiar ground-based coordinate system (such as UTM Zone or State Plane).

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. All Standard Imagery products have uniform GSD throughout the entire product.

Physical Structure: Standard Imagery products are area based and may be ordered by the square kilometer. 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. The delivered area for Standard Products is the order polygon is black-filled to the Minimum Bounding Rectangle.

Standard Imagery comes in two varieties:

Standard Imagery: Standard Imagery has a coarse DEM applied to it, which is used to correct 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, making it suitable for orthorectification by the customer. Ortho Ready Standard Imagery is projected to an average elevation, either calculated from a terrain elevation model or can be supplied by the customer.

Physical Characteristics - Standard Imagery	
Minimum deliverable area	25 sqkm archive/64 sqkm tasking
Maximum orderable area (single order)	50,000 km2
Product Framing	Area-based
Final product physical structure	Blackfill to MBR surrounding the ordered image pixels
Pan strip width (pixels)	N/A
Pan strip width (km, approximate at nadir)	N/A
MS scene dimensions (pixels col, row)	N/A
MS scene size (approximate at nadir)	N/A
Processing Specifications	
Absolute geolocation accuracy (nadir)	Geolocation Accuracy specification of 6.5m CE90% at nadir, with actual accuracy in the range of 4.0 – 5.5m CE90%, excluding terrain and off-nadir effects
Additional 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	none (Ortho Ready); coarse DEM (Standard)
Spatial mosaicing applied	N/A
Color balance applied	N/A
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; line-rate variations
Product Parameters	
Product Options	Panchromatic only
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 (default); 2X2 bilinear; Nearest neighbor; 8 pt sinc; MTF kernel
Dynamic Range Adjustment (DRA) option	Contrast enhancement (8 bit only)
Output tile size options	None; 8k x 8k pixels; 14k x 14k pixels; 16k x 16k pixels
Output pixel spacing	50 cm
Map projections	See QuickBird Imagery Products – Product Guide
Ellipsoids and datums	See QuickBird Imagery Products – Product Guide
Output alignment	Rotated to Map North up
Cloud cover	0-100%
Delivery Parameters	
Output product delivery media options	FTP Pull, DVD, firewire
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0
Image compression options	N/A
Image Support Data	
ISD files supplied to customer	Delivery (top level index) README file; Layout file, shapefiles, browse image, Product README, image metadata file, geometric calibration file; RPC00B file (OR2A only); license text file; tile map file
Spacecraft telemetry	Refined attitude/ephemeris (used to create product)

Table 5. Characteristics of WorldView-1 Standard Imagery Products

2.4 Orthorectified Imagery Products

Orthorectified Imagery products are GIS-ready and are used as image base maps for a wide variety of applications. These products can also be used for numerous applications that require a higher degree of absolute accuracy. As shown in Table 5, the product levels equate to different levels of processing and geolocation accuracy.

Product Level	Processing	CE90	RMSE
Ortho 1:12,000	Orthorectified	10.2-meters	6.2-meters
Ortho 1:5000	Orthorectified	4.23-meters	2.6-meters
Ortho 1:4,800	Orthorectified	4.1-meters	2.5-meters
Custom Ortho	Orthorectified	variable*	variable*

* Accuracy of the Custom Ortho is determined by the accuracy and quality of customer supplied support data.

Table 6. WorldView-1 Orthorectified Imagery Products and Associated Accuracies.

Processing: Orthorectified Imagery products are radiometrically corrected, sensor corrected, and orthorectified with a fine digital terrain model using the map projection and datum requested by the customer (reference QuickBird Imagery Products – Product Guide). For order polygons that require more than 1 strip, customers have the option to have their products mosaicked into a single product.

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 scale of the Orthorectified Imagery product ordered. Quotes for the support data will be provided on request (for locations where GCPs can be collected).

DigitalGlobe also offers customers the opportunity to order **Custom Orthorectified** Imagery products. To create these products DigitalGlobe uses customer provided support data to orthorectify WorldView-1 Imagery. There is no stated accuracy associated with the Custom Orthorectified Imagery product because the quality and accuracy of the finished product is directly dependent on the quality and accuracy of the support data. DEMs and GCPs are the most typical types of support data that customers provide to DigitalGlobe. Please contact DigitalGlobe for a complete list of acceptable types of support data and formats.

Physical Structure: The delivered area for Orthorectified Products is the order polygon is black-filled to the Minimum Bounding Rectangle.

Physical Characteristics - Ortho Imagery	
Minimum deliverable area	100 km2
Maximum orderable area (single order)	50,000 km2
Product Framing	Area-based
Final product physical structure	Blackfill to MBR surrounding the ordered image pixels
Pan strip width (pixels)	N/A
Pan strip width (km, approximate at nadir)	N/A
MS scene dimensions (pixels col, row)	N/A
MS scene size (approximate at nadir)	N/A
Processing Specifications	
Absolute geolocation accuracy (nadir)	1:12,000 (without control), 1:5000 (with control) 1:4800 (with control), custom (with customer supplied control)
Additional 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 mosaicing applied	Images mosaicked to minimize seamlines
Radiometric balance applied	Yes
Radiometric corrections	Relative radiometric response between detectors; non-responsive detector fill; conversion for absolute radiometry
Sensor corrections	Internal detector geometry; optical distortion; scan distortion; line-rate variations
Product Parameters	
Product Options	Panchromatic only
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 (default); 2X2 bilinear; Nearest neighbor; 8 pt sinc; MTF kernel
Dynamic Range Adjustment (DRA) option	Contrast enhancement (8 bit only)
Output tile size options	None; 8k x 8k pixels; 14k x 14k pixels; 16k x 16k pixels Product Units-customer specified (mosaic only)
Output pixel spacing	50 cm
Map projections	See QuickBird Imagery Products – Product Guide
Ellipsoids and datums	See QuickBird Imagery Products – Product Guide
Output alignment	Rotated to Map North up
Cloud cover	0-20%
Delivery Parameters	
Output product delivery media options	FTP Pull, DVD, firewire
Image data format options	NITF 2.0; NITF 2.1; GeoTIFF 1.0
Image compression options	N/A
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 product)

Table 7. Characteristics of WorldView-1 Orthorectified Imagery Products

3. Imagery Acquisition

DigitalGlobe imagery acquisition requirements are sensor specific (please note that specific order requirements cannot be placed for both sensors in unison). The information contained in this section refers only to acquisition specific to the WorldView-1 satellite.

3.1 WorldView-1 Tasking Orders

The new WV1 Standard Tasking option will be offered on WorldView-1. This is currently the sole tasking offering for the satellite, and includes the following parameters:

- The collection window will be provided by the customers, with a minimum of 30 days.
- A Physical Feasibility will be performed to make sure the satellite has sufficient access to the order. A Competitive Feasibility comparing one order to another will not be performed for this tasking level.
- Off Nadir options of 0-25 degrees and 0-45 degrees will be offered. Other increments are not offered at this time.
- There will be no Target Azimuth selection.

Cancellation Policy: Customers may cancel WV1 Standard Tasking Orders at any time, but will be charged for any imagery collected against the order which meets specifications. This could include all or part of the original order.

3.2 ImageLibrary

In addition to tasking the satellite, customers may order WorldView-1 Imagery Products directly out of the DigitalGlobe ImageLibrary. ImageLibrary ordering is described in DigitalGlobe's QuickBird Product Guide.

4. Product Delivery

DigitalGlobe provides its WorldView-1 Imagery Products to customers on a variety of industry standard image formats and media, to include: DVD, Firewire, and Electronic delivery.

4.1 File Formats

WorldView-1 Imagery Products are available in the following file formats:

- GeoTIFF 1.0
- NITF 2.0
- NITF 2.1

4.2 Delivery Timelines

Delivery time for products depends on the type of acquisition (tasking) and product options that a customer selects. Timeframes are defined in DigitalGlobe's QuickBird Product Guide.

Definitions

Please see DigitalGlobe's QuickBird Product Guide for definitions.