BlackBridge
Delivering the World

RapidEye Mosaic™ Product Specifications

Version 1.1.1 | January 2013

www.blackbridge.com
rapideye@blackbridge.com

CONTENT

INDEX OF TABLES

INDEX OF FIGURES

ABBREVIATIONS

CE90	Circular Error 90 percent
DEM	Digital Elevation Model
DTED	Digital Terrain Elevation Data
GCP	Ground Control Point
JPEG	Joint Photographic Experts Group
ISD	Image Support Data
N/A	Not Applicable
NIR	Near Infra-red
NMAS	National Map Accuracy Standards
RMSE	Root Mean Squared Error
SRTM	Shuttle Radar Topography Mission
TBC	To Be Confirmed
TBD	To Be Defined
TIFF	Tagged Image File Format
UTC	Coordinated Universal Time
UTM	Universal Transverse Mercator
WGS	World Geodetic System

1 Introduction

Blackbridge offers image users a data source containing an unrivaled combination of large-area coverage, frequent revisit intervals, high resolution and multispectral capabilities. These attributes are leveraged to create the RapidEye Mosaic™ product. This document provides information related to the RapidEye satellites system and the RapidEye Mosaic™ product in the following area:

RapidEye Satellite Constellation: The RapidEye satellite constellation offers something new and unique to the world of commercial remote sensing.

Product Description: RapidEye Mosaic™ product attributes and quality are discussed.

Product Ordering: Details on how to order RapidEye Mosaic™ products are described.

Product and Delivery Options: RapidEye Mosaic™ products are offered with several processing and delivery options.

Product Licensing: Blackbridge offers customers several licensing options to ensure that all users who need to use the imagery may do so.

Product Naming: Provides a description of the product naming convention used for the RapidEye Mosaic™ products.

Image Support Data: All RapidEye Mosaic™ products are supported with several different metadata files to aid the customer with the use and analysis of the data.

2 RapidEye Satellite Constellation

The RapidEye constellation of five satellites stands apart from other providers of satellite-based geospatial information in its unique ability to acquire high-resolution, large-area image data on a daily basis. The RapidEye system collects up to 5 million square kilometers of data per day. The RapidEye Mosaic™ products leverage this collection capacity and the extensive RapidEye data archive to offer image users accurate, consistent and virtually cloud-free image datasets over regional or country-wide areas.

Table 1 below outlines general mission characteristics for the RapidEye system.

MISSION CHARACTERISTIC	INFORMATION	
Number of Satellites	5	
Spacecraft Lifetime	Over 7 years	
Orbit Altitude	630 km in Sun-synchronous orbit	
Equator Crossing Time	11:00 am local time (approximately)	
Sensor Type	Multi-spectral push broom imager	
Spectral Bands	Capable of capturing all of the following spectral bands:	
	Name Blue Green Red Red Edge NIR	Spectral Bands (nm) 440 – 510 520 – 590 630 – 685 690 – 730 760 – 850
Ground sampling distance (nadir)	6.5 m	
Pixel size (orthorectified)	5 m	
Swath Width	77 km	
On board data storage	Up to 1500 km of image data per orbit	
Revisit time	Daily (off-nadir) / 5.5 days (at nadir)	
Image capture capacity	Up to 5 million sq km/day	
Camera Dynamic Range	12 bit	

Table 1: RapidEye System Specifications

3 RapidEye Mosaic™ Product Specifications

RapidEye Mosaic™ products consist of multiple RapidEye image takes that have been orthorectified and radiometrically color balanced to a uniform appearance that are then assembled to create a single, seamless large area image. This product was designed for a wide variety of applications that require background imagery with an accurate geolocation and a uniform appearance with minimal clouds. Off-the-shelf RapidEye Mosaic™ products have the following basic characteristics (please see Section 5 for possible custom processing options):

- Three-band, true color (RGB)
- Image bit depth of 8-bit
- Five (5) meter pixel spacing
- Cloud-free (less than 3 % cloud cover, some areas excluded)
- Images geometrically aligned and radiometrically balanced to one another
- Positional accuracy of 15m RMS or better (25m CE90 or better)
- UTM, WGS84 projection
- Delivered in GeoTiFF format

The RapidEye Mosaic™ product is radiometric, sensor and geometrically corrected and aligned to a cartographic map projection. The geometric correction uses DEMs with a post spacing of between 30 and 90 meters. Ground Control Points (GCPs) are used in the creation of every product and the positional accuracy of the product will vary depending on the quality of those points.

Table 2 lists the attributes for the standard RapidEye Mosaic™ product.

PRODUCT ATTRIBUTE	DESCRIPTION
Product Components and Format	RapidEye Mosaic™ product consists of the following file components: Image File – GeoTIFF file that contains image data and geolocation information Metadata File – XML format metadata file Browse Image File – GeoTIFF format Spatial Image Map (SIM) fileset – ESRI shapefile (SHP) format
Image Bands	Red, Green, Blue (RGB)
Image Bit Depth	8-bit unsigned integer
Pixel spacing	5m
Cloud cover	3% or less (except in tropical area or areas with persistent clouds)
Product Size	Standard tile size is a 30 minute x 30 minute tile which corresponds to approximately 55km (11,000 lines) by 55km (11,000 columns) at the Equator. < 0.5GB per Tile for 3 band, 8-bit images.
Horizontal Datum	WGS84

Table 2: Attributes for RapidEye Mosaic™ Products

3.1 PRODUCT TILING AND TILE NAMING

All RapidEye Mosaic™ products are tiled from a larger parent image. Tiling of the product is done to insure that output product does not exceed the allowable size for the image format, and allows the end user the ability to

quickly load only needed tiles into their system. This section describes the product tiling and tile naming convention used for the standard, off-the-shelf mosaic product.

Description

All standard RapidEye Mosaic™ products are tiled to an area of 30 minutes by 30 minutes based on a 1 degree geocell grid. Each tile will represent one of four quadrants within a defined one degree geocell. Each one degree geocell is defined to the appropriate whole degree values for both latitude and longitude for the UTM zone that the geocell belongs to since the product has a UTM projection. Since longitudinal distance varies by latitude, geocell and their quadrants will vary in size depending on their location.

Tile Naming

Each mosaic tile has two naming components: 1) a geocell name, and 2) a quadrant name. The geocell name is based on the lower left hand corner value of the latitude and longitude, and the quadrant name is based on which quadrant of the geocell the imagery is coming from. Quadrants are named according to row and column starting with the upper left quadrant. The complete tile name is in the following format and is also illustrated in Figure 1:

<geocell name> - <quadrant name>

where:

<geocell name> = <lat>N/S_<long>E/W

<lat> = nn

<long> = nnn

<quadrant name> = <RnCn>

For example:

52N012E-R2C1

Custom mosaic products will follow the same tiling and naming scheme unless otherwise requested by the customer during the ordering process, subject to feasibility.

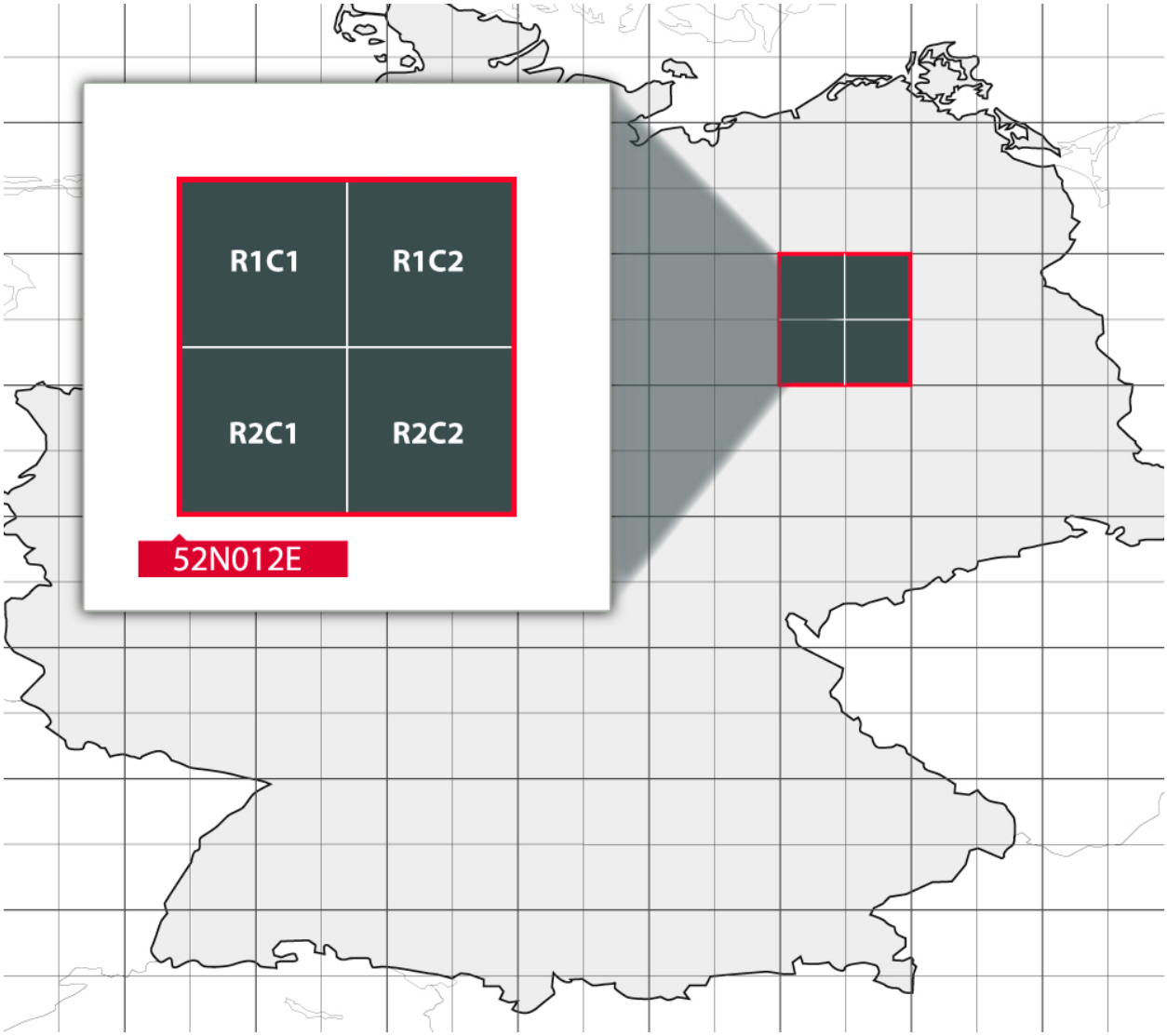

Figure 1: Example of Tile Naming

3.2 PRODUCT QUALITY ATTRIBUTES

The following sections detail the quality attributes related to the RapidEye Mosaic™ product.

3.2.1 Geometric Product Accuracy

3.2.1.1 Product Locational Accuracy

The accuracy of the RapidEye Mosaic™ products depends on the quality of the reference data used (GCPs and DEMs). The positional accuracy of the RapidEye Mosaic™ product will meet 15m RMS (25m CE90) based on areas with a slope of 10 degrees or less. In cases where this accuracy cannot be met those mosaics will be identified and a suitable accuracy for the product will be agreed upon.

3.2.1.2 Internal Geometric Accuracy

The images used to create the RapidEye Mosaic™ product will be put together in such a way as to create a seamless product that contains no or very minimal geometric breaks of linear features (e.g. Roads, rivers, etc.) that lie in multiple images. If such noticeable geometric breaks are unavoidable they will be below 2.5 pixels (12.5m) between images.

3.2.2 Cloud Cover

RapidEye Mosaic™ products are created with less than 3 percent cloud cover in most cases, with many areas being cloud-free. However, in tropical regions or other areas of high persistent cloud cover the allowable cloud cover percentage may exceed 3 percent and an attempt will be made to minimize the cloud cover within a reasonable Time of Interest (TOI) for the product. In special cases for custom mosaic products, Blackbridge will work with the customer to achieve an acceptable cloud cover for problematic areas. The RapidEye Mosaic™ product may also contain minor areas with visible haze and cloud shadow.

3.2.3 Product Radiometry and Radiometric Accuracy

All RapidEye Mosaic™ products will be tonally balanced to create a visually pleasing, seamless product. The images used to create the mosaic will come from as limited a time range as possible, subject to cloud cover requirements, so as to minimize differences between images. However, in some cases it may be possible to see seasonal variations in vegetation and other features between images and no guarantee can be made that all images in the RapidEye Mosaic™ can be seamlessly color balanced.

3.2.4 Handling of Water and Water Bodies

All inland water bodies will contain valid imagery within a mosaic. Some exceptions may be made on a per case basis for the largest of the global inland water bodies. All mosaics containing coastlines will contain water out to 3km from the main coast line, but the color balancing of that water can not be guaranteed. Mosaics in areas with numerous small islands will contain valid imagery over the water that connects the islands up to a point where open water is reached, and then the limits applicable to coastlines (as described above) are applied from there.

4 Product Ordering

RapidEye Mosaic™ products can be purchased directly from Blackbridge or through a Blackbridge sales partner. This section provides an overview of requirements for specifying an Area of Interest (AOI), Time of Interest (TOI) and placing an order.

4.1 AREA OF INTEREST (AOI) POLYGONS

Blackbridge prefers to receive an ESRI shapefile of the Area of Interest (AOI). The ESRI shapefile must have polygon topology (not line or point topology). Blackbridge will also accept a KML file or geographic coordinates with a specified buffer size to be applied. Projection should be in UTM or Geographic coordinates, WGS 84 datum. The Area of Interest must be one contiguous area meeting the minimum size requirements. If the area is not contiguous, each area will be treated as a separate AOI and will be held to the same specifications of minimum size and pricing.

4.2 REQUESTING QUOTATIONS

To request a quote or place an order, contact your Blackbridge sales partner. Please see http://www.blackbridge.com/rapideye/buy/distributors.htm for a list of sales partners in your area. If a sales partner does not exist in your region, you may contact Blackbridge directly at rapideye@blackbridge.com or call (49) 30 609 8300 ext 555.

To request a quotation, please provide us with the following information:

1. Definition of AOI (Area Of Interest)

Please see specifications above section 4.1 . Note that the minimum order size for off-the-shelf mosaics is 500 km². Minimum order size for custom mosaics is 3500 km².

2. Definition of TOI (Time of Interest)

For custom RapidEye Mosaic™ orders the TOI should be defined by the exact start and end date for the images used in the product. If a custom order has a TOI in the future, the first possible date to start image collection will be 2 days after receiving the confirm purchase order from the customer.

3. Definition of License Type

Blackbridge grants the right to use the Products under a standard End-User License Agreement (EULA). Blackbridge offers several licensing options to address the needs of end-users. Please see our website for more details:

http://www.blackbridge.com/rapideye/about/resources.htm?tab=7

4. Processing and Delivery Options

Please provide any desired processing or delivery options that differ from the standard product specifications.

4.2.1 Delivery of the Data

The image products will be delivered to a secure ftp account, unless otherwise specified. The customer service representative will provide login credentials via email.

5 Product and Delivery Options

Table 3 summarizes the product and delivery options available for all RapidEye Mosaic™ products.

PROCESSING OPTION	DESCRIPTION
Spectral Band Combinations	For off-the-shelf mosaics • RGB (Red, Green, Blue – **standard**) For custom mosaics • RGB (Red, Green, Blue) • 5-band (Blue, Green, Red, Red Edge, Near-Infrared) • CIR (Near-Infrared, Red, Green)
Image Bit depth	For off-the-shelf mosaics • 8-bit (**standard**) For custom mosaics • 8-bit • 16-bit
Projection	For off-the-shelf mosaics • UTM WGS84 (**standard**) For custom mosaics • UTM WGS84 (default) • Geographic (Lat/Long) WGS84 • Customer defined (if feasible)
Image File Formats	For off-the-shelf mosaics • GeoTIFF (.tif, - **standard**); • JPEG2000 (.jp2) For custom mosaics • GeoTIFF (.tif, - default); • JPEG2000 (.jp2) • Customer defined (if feasible)
Image Tiling	For off-the-shelf mosaics • 30' x 30' tiles (**standard**) For custom mosaics • 30' x 30' tiles (default) • Customer defined (if feasible)
Delivery	FTP Pull (**standard**) Portable USB Hard-Drive

Table 3: Product Processing and Delivery Options

6 Product Licensing

Blackbridge grants the right to use the Products under a standard End-User License Agreement (EULA). Blackbridge offers several licensing options to address the needs of end-users. Please consult the latest Price List for available license types at:

http://www.blackbridge.com/rapideye/about/resources.htm?tab=7

The inclusion of the imagery or data contained in the RapidEye Products in any product by an end-user is considered value-added work. Resale or distribution of these value-added products is not permitted under the standard EULA. To redistribute the Products or value-added products to third parties, the customer must request additional licensing from Blackbridge. Licensing allowing additional use may be granted to the customer upon the conclusion of a license upgrade. Contact Blackbridge for details.

7 Product Naming

The naming of RapidEye Mosaic™ products provides useful important information about the product and allows the user to quickly identify or sort multiple products. The name of each product is designed to be unique and is composed of the following elements:

<tileID>_<production year>_<processing level>_<order number>.<file extension>

For example:

53N012E-R1C2_2011_RE-3M_0123456789.tif

where:

<tileID> = 53N012E-R1C2

= 53N012E is lower left coordinate of one degree geocell

= R1C2 is the quadrant tile of the geocell

<production year> = 2011 (year mosaic was produced)

<processing level> = RE-3M (RapidEye orthomosaic product)

<order number> = 0123456789

<file extension> = tif (GeoTIFF)

Note: ISD Metadata files for the product will have a file type name appended to the appropriate file after the order number, please see Section 8 for more information. Product tiling and naming are described in Section 3.1.

8 Image Support Data

All RapidEye Mosaic™ orders are accompanied by a set of image support data (ISD) files. These ISD files provide important information regarding the mosaic image or are useful sources of ancillary data related to construction of the mosaic image. The four ISD files are:

1. XML Metadata File
2. Browse Image File
3. License File
4. Spatial Image Map Fileset

Each file is described along with its contents and format in the following sections.

8.1 XML METADATA FILE

All RapidEye Mosaic™ products will be accompanied by a single XML metadata file. This file contains a description of basic elements of the image. The file is written in Geographic Markup Language (GML) version 3.1.1.

8.1.1 Contents

Table 4 describes the fields present in the XML metadata file for all product levels.

METADATA FILE FIELD CONTENTS			
FIELD	**DESCRIPTION**	**RANGE/VALUE**	**CONDITIONS**
"metaDataProperty" Block			
EarthObservationMetaData			
identifier	Dataset name and production year		
acquisitionType	Type of image acquisition	NOMINAL	
productType	Product level of image	L3M	
status	Status type of image, if newly acquired or produced from a previously archived image	ARCHIVED	
archivedIn			
archivingInformation			
archivingCenter	Location where product is archived	BER	
archivingDate	Date when product was archived		
archivingIdentifier	Catalog ID of product within the RE Archive Management System		
productCreationDate	Date the product was created		
license			
licenseType	Name of selected license for the product		
resourceLink	Hyperlink to the physical license file		
versionIsd	Version of the ISD		
orderId	Order ID of the product		
pixelFormat	Number of bits per pixel per band in the product image file(s).	8U – 8 bit unsigned 16U – 16 bit unsigned	

METADATA FILE FIELD CONTENTS			
FIELD	**DESCRIPTION**	**RANGE/VALUE**	**CONDITIONS**
"validTime" Block			
TimePeriod			
beginPosition	Start date and time of acquisition for source image take used to create mosaic, in UTC		
endPosition	End date and time of acquisition for source image take used to create mosaic, in UTC		
"target" Block			
Footprint			
multiExtentOf			
MultiSurface	Defines the EPSG code of the polygon projection		
surfaceMembers			
Polygon	Defines the surface polygon of the mosaic order		
exterior			
LinearRing			
posList	Position listing of the nodes that define the order polygon in geodetic coordinates in the format: ULX ULY URX URY LRX LRY LLX LLY ULX ULY where X = latitude and Y = longitude		
centerOf			
Point			
pos	Position of center of the order in geodetic coordinate X and Y, where X = latitude and Y = longitude		
"resultOf" Block			
earthObservationResult			
product			
productFormat	File format of the mosaic product	GeoTIFF JPEG2000	
rowGsd	The GSD of the rows (lines) within the mosaic product		
columnGsd	The GSD of the columns (pixels) within the mosaic product		
numBands	Number of bands in the mosaic product	1-5	
bandCombination	Combination of spectral band included in the product: - RGB = (Red, Green, Blue) - 5-band = (Blue, Green, Red, Red-Edge, NIR) - CIR = (NIR, Red, Green)	1 = RGB 2 = 5-band 3 = CIR 4 = Custom	
The following fields are repeated for each image used to create the mosaic			
sourceImageryPool			
archivingIdentifier	Catalog ID of the image used from the RapidEye DMS processing system		

METADATA FILE FIELD CONTENTS			
FIELD	DESCRIPTION	RANGE/VALUE	CONDITIONS
acquisitionDate	Date and time image was acquired from the satellite		
The following fields are repeated for each mosaic tile in the order			
mosaicDecomposition			
mosaicTile	Field contain name of the geocell and quadrant of the tile		
fileName	Name of mosaic tile		
size	The size of the mosaic tile in kbytes		
referenceSystemIdentifier	Identifies the reference system used for the mosaic tile		
footprint			
multiExtentOf			
MultiSurface			
surfaceMembers			
Polygon	Defines the surface polygon of the mosaic tile in geodetic coordinates X and Y, where X = latitude and Y = longitude		
exterior			
LinearRing			
posList	Position listing of the four outermost corners for the mosaic tile in geodetic coordinates in the format: ULX ULY URX URY LRX LRY LLX LLY ULX ULY where X = latitude and Y = longitude		
centerOf			
Point			
pos	Position of center of the mosaic tile in geodetic coordinate X and Y, where X = latitude and Y = longitude		
browse			
browseInformation			
type	Type of browse image that accompanies the image product as part of the ISD	QUICKLOOK	
referenceSystemIdentifier	Identifies the reference system used for the browse image		
fileName	Name of the browse image		
sourceImageryIdList	List of all image catalog IDs used to create the tile		

Table 4: XML Metadata File Field Descriptions

8.1.2 File Naming

The XML metadata file will follow the naming convention <orderID>_metadata.xml.

Example:

0123456789_metadata.xml

8.2 BROWSE IMAGE FILE

All RapidEye Mosaic™ product tiles will be accompanied by a reduced resolution browse image file.

8.2.1 Contents

The browse image file contains a reduced-resolution representation of the product. It has the same aspect ratio and radiometric corrections as the product, but with a pixel resolution of roughly 50m. The GeoTiFF file will contain 3 bands and will be an 8-bit image that is georeferenced to a WGS84 Geographic (Latitude-Longitude) projection. The 3-band browse image contains the Red, Green, and Blue bands. Since the browse image is derived from the parent image, the re-projection into geographic coordinates may create areas of blackfill on the borders of the browse image that will not be present in the full resolution parent image.

8.2.2 File Naming

The Browse Image file will follow the naming convention described in Section 7

Example:

53N012E-R1C2_2011_RE-3M_0123456789_browse.tif

8.3 LICENSE FILE

All RapidEye Mosaic™ orders will be accompanied by a license file for the order.

8.3.1 Contents

The license file is a simple text file that contains the text of the license that was selected at the time the image order was placed.

8.3.2 File Naming

The license file will follow the naming convention <orderID>_license .txt.

Example:

0123456789_license.txt

8.4 SPATIAL IMAGE MAP (SIM) DATASET

All RapidEye Mosaic™ orders will be accompanied by a Spatial Image Map dataset.

8.4.1 Content

The Spatial Image Map (SIM) dataset consists of a vector polygon file showing the outline of the images used to create the image mosaic imagery for the order area. The polygon is formatted as a series of files in ESRI® shapefile format and is in a WGS84 Geographic projection. Each polygon within the shapefile will have the following fields of metadata information:

Shape ID – the ID number of the polygon

identifier – name of 1B image used

acqDate – date of acquisition of the image used in the mosaic

serialID – ID of the RapidEye satellite used to take the image

scViewAng – spacecraft off-nadir viewing angle

illAzAng – illumination (sun) azimuth angle for image

illElevAng – illumination (sun) elevation angle for image

catID – catalog ID of the image used in the mosaic

8.4.2 File Naming

The SIM dataset shapefile will follow the naming convention <orderID>_SIM.<file_extension>

Example:

0123456789_SIM.dbf

0123456789_SIM.prj

0123456789_SIM.shp

0123456789_SIM.shx

Appendix A – Glossary of Terms

The following list defines terms used to describe RapidEye Mosaic™ products.

Digital Elevation Model (DEM)	• A digital model of the terrain surface, usually derived from stereo imagery. A DEM is used to remove terrain distortions from the imagery for the geo-corrected products.
Dynamic Range	• The number of possible DN values for each pixel in a band of an image. The RapidEye sensor has a 12-bit dynamic range which translates into 4096 possible values.
Geocell	• An area that conforms to a one degree by one degree area of latitude and longitude. At the Equator this area is approximately 110 kilometers by 110 kilometers and decreases in size toward the poles.
Ground Control Point (GCP)	• A visible point on the ground with known geographic coordinates. GCPs can be planimetric (latitude, longitude) or vertical (latitude, longitude, elevation). GCPs can be collected from ground survey, maps, or orthorectified imagery.
Ground Sample Distance (GSD)	• The size of one pixel, as measured on the ground.
Metadata	• Ancillary data that describes and defines the RapidEye imagery product. See Section 8 for a complete breakdown of metadata files and the fields within them.
Orthorectification	• The correction of distortions caused by terrain relief displacement on the image.
Pixel	• The smallest element comprising a digital image.
Resolution	• The resampled image pixel size derived from the GSD.
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 the ground area that is recorded by one image strip.
Terrain Correction	• The correction for variations in data caused by terrain displacement due to off-nadir viewing.