



Specifications for Customer- Provided Support Data

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DigitalGlobe offers you the option to order a Custom Orthorectified Imagery Product, in which DigitalGlobe will orthorectify imagery using your support data. Digital Elevation Models (DEMs) and Ground Control Points (GCPs) are the most typical types of support data that customers provide to DigitalGlobe.

If you are providing DEMs and GCPs, DigitalGlobe requests that you provide support data to us in a format that conforms to the specifications in this document. Alternate forms of control would require further discussion with DigitalGlobe to determine suitability.

1. Reference Systems

DEMs and GCPs must both be referenced to a common horizontal and vertical datum. Latitude/Longitude must be in decimal degrees to 8 decimal places, with all other coordinates and elevations to a minimum of a 100th of a meter. Data may be provided in the following reference systems.

All Regions

- Geographic Coordinates (decimal degrees), referenced to WGS84 Datum, with Mean Sea Level referenced to Height Above Ellipsoid elevations.
- Elevation units must be specified, acceptable units include; Meters

2. Ground Control Points (GCPs)

2.1 GCP Overview

All GCP points submitted to DigitalGlobe must be identifiable in the imagery that will be used to produce the Custom Orthorectified Imagery Product, at 50-60cm resolution panchromatic. DigitalGlobe will coordinate with you to determine suggested GCP locations for the product.

GCPs used must meet a certain distribution and quantity requirements. Consequently, GCPs that you have collected for previous projects will sometimes not meet those requirements without supplementary GCP points. However, it may be possible to utilize alternate data sources to derive GCP, such as digital orthophotos or GIS data, covering the project area if they are of sufficient resolution and accuracy.

2.2 GCP Accuracy

The accuracy of the final Custom Orthorectified Imagery Product is directly related to the accuracy of the DEM and GCP's utilized in its production. The following absolute accuracy specifications are recommended for GCP locations.

Horizontal Accuracy:	70cm (RMSE)
Vertical Accuracy:	125cm (RMSE)

GCPs that do not meet these requirements may be accepted, provided that they can be identified in the selected imagery, however, the accuracy of the finished product will vary depending on the accuracy and quality of the supplied GCPs.



2.3 Qualities of a Good GCP

2.3.1 GCP Location

An ideal GCP site would be a concrete sidewalk intersection or a corner of a concrete pad, surrounded by areas of contrasting color, near a major road intersection, void of any trees, buildings, or power lines, and located on public property. Avoid the following; shadows, mobile structures. Less ideal, but acceptable, options include driveway corners that meet an adjacent road, sidewalks exiting a house and intersecting with a concrete gutter on a blacktop street, or distinct corners of parking lots. However, when collecting in rural areas, points normally characteristic of urban areas may not be available, so features such as very distinct fence line intersections or the intersection of trail roads, if close to 90 degree intersection, may be used. DigitalGlobe will make the final determination as to whether the point will be sufficient to create a quality product. It is your responsibility to provide locations that are identifiable in the imagery and meet DigitalGlobe specifications. Some examples of good GCPs are imaged below.

(Note: DigitalGlobe may be able to provide imagery for use in GCP site selection.)



2.3.2 GCP Distribution

In order to achieve acceptable accuracy when controlling an image or group of images, GCPs must follow guidelines for placement and distribution. For a single strip order (approximately 272 square kilometers), six points are typically required, one near each corner of the image for control and two in the center, for use in Quality Control (see Figure 1). For orders of more than a single strip, GCP requirements vary, depending on the area of interest and the configuration of strips. DigitalGlobe will work closely with you to define GCP requirements.

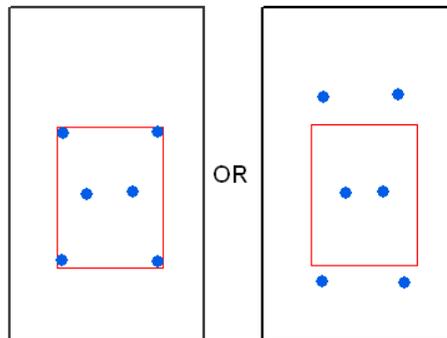


Figure 1. The points represent the ideal GCP distribution within a strip (black box shows a single strip with the AOI outline in red).

2.4 GCP Format

At a minimum, DigitalGlobe requests the following data to satisfy DigitalGlobe GCP requirements.

2.4.1 ASCII File

GCP coordinates and elevations must be provided in an ASCII Comma, Tab, or Space Delimited file containing the following information on each line (see Figure 2):

- Point Identification (text field)
- X Coordinate or Longitude (numeric field)
- Y Coordinate or Latitude (numeric field)
- Elevation (numeric field)

```
-126.35684087700 48.11846526040 257.80000000000 "GCP0"
-124.18603534700 49.11198353000 83.00000000000 "GCP1"
-127.27656437200 42.12309271760 447.50000000000 "GCP2"
```

Figure 2. ASCII Comma, Tab, or Space Delimited file showing Longitude, Latitude, Elevation (MSL), Point ID

2.4.2 Metadata File

The following information must be included in a separate ASCII Text (TXT) file:

- Horizontal reference datum (WGS84)
- Reference coordinate system (Geographic)
- Vertical reference (height above WGS84 ellipsoid, EGM96 Mean Sea Level)
- Horizontal Units (Decimal Degrees)
- Vertical Units (Meters)
- Estimated horizontal of GCPs (RMSE)
- Estimated vertical accuracy of GCPs (RMSE or LE90)

2.4.3 GCP Overview Map

For general reference in importing your data, at least one of the following is requested.

1. Hardcopy map of GCP locations, with background of significant landmarks, such as cities, county lines, roads, etc.
2. GIS data files in either ESRI shapefile or MapInfo (.tab) format.

2.4.4 GCP Identification Data

To precisely identify the GCP locations within the imagery, a combination of the following documents or files must be provided. The documentation should be sufficient for DigitalGlobe personnel to easily and accurately determine the correct GCP locations.

Site sketch sheet – detailed drawing of the GCP site and its surroundings, date and time of data capture

Site photos – digital photographs of the site taken by surveyor from a minimum of two viewpoints



Image Chip – small sample of imagery with the GCP location, cut out from larger image. DigitalGlobe can provide a copy of the imagery being used for the Custom Orthorectified Imagery Product, if required.

3. Digital Elevation Models (DEMs)

3.1 DEM Overview

DEMs may be acquired from a number of sources, including photogrammetric stereo compilation, softcopy image correlation, radar sensors, LIDAR sensors¹, or IFSAR sensors². These technologies can all be used to provide DEMs that are acceptable for Custom Orthorectified Imagery production, provided they meet accuracy requirements consistent with the intended accuracy of the resulting product, as outlined in Section 3.2 below.

In the case that your data originated as an irregularly spaced Digital Terrain Model (DTM), it is your responsibility to extract a DEM at a fixed posting prior to providing to DigitalGlobe. For large datasets, such as those typical of LIDAR, we request that you extract the specific area of interest (AOI), including a minimum of a 200-meter buffer outside the order polygon. In addition, for sensors that have the capability of returning multiple elevations at a given horizontal location, the data set most closely representing ground level is required. This data set is sometimes referred to as ‘Bald Earth’.

3.2 DEM Accuracy

The accuracy of the final Orthorectified Imagery Product is directly related to the accuracy of the DEM and GCP’s utilized in its production. The following DEM accuracies and densities are required to achieve the indicated Orthorectified Imagery Product accuracy.

<i>DEM Requirements</i>	<i>Desired Ortho Accuracy</i>	
	<i>1:12,000</i>	<i>1:25,000</i>
Vertical Accuracy (LE90):	10 meter	12 meter
Posting:	30 meter	30 meter

The above accuracies are guidelines only. DigitalGlobe will not guarantee an accuracy for Orthorectified Imagery products that are based on customer provided support data. DEMs that do not meet these requirements may be accepted, but the accuracy of the finished product will vary depending on the accuracy and quality of the supplied DEM.

3.3 DEM Format Options

3.3.1 - GeoTIFF

GeoTIFF files which follow the GeoTIFF 1.0 and TIFF 6.0 specifications may be provided. The GeoTIFF file is a single signed 16bit integer data plane, with null data values set to –32767. In order to insure

¹ LIDAR stands for Light Detection And Ranging. It differs from radar in that it uses lasers rather than radio waves to gather data.

² IFSAR stands for Interferometric Synthetic Aperture Radar.

compatibility with the DigitalGlobe system, specific tags within the TIFF and GeoTIFF headers should be properly populated. The following is a list of these tags and the proper manner to populate them.

Required TIFF Tags:

- Bits/Sample: 16
- Compression Scheme: none
- Samples/Pixel: 1
- Planar Configuration: single image plane

Required GeoTIFF Tags:

- ModelTiepointTag (2,3): Origin(0,0) tiepoint, Geographic coordinates at origin, decimal degrees
- ModelPixelScaleTag (1,3): Equal X & Y pixel scale, decimal degrees
- GTModelTypeGeoKey (Short,1): ModelTypeGeographic
- GeographicTypeGeoKey (Short,1): GCS_WGS_84

4. Shapefiles

Shapefiles used for either areas of interest or as a method of ground control are required to contain a .prj file.

5. Delivery of Customer Data to DigitalGlobe

You may deliver your support data to DigitalGlobe in one of the following media and format options:

- CDROM, ISO9660
- DVD, ISO9660
- Email and FTP Transfer of data is acceptable in most cases, if coordinated with the Production Services in advance.

Data should be addressed to:

Production Services
DigitalGlobe
1601 Dry Creek Drive
Longmont, CO 80503

The Production Control Center may be contacted at 303.684.4866 or cfarland@digitalglobe.com.





6. Disclaimer

As the accuracy of a Custom Orthorectified Imagery Product is dependent on the accuracy of customer provided support data, DigitalGlobe does not guarantee the absolute accuracy of the product. A Disclaimer, available from Customer Service, must be signed and returned to DigitalGlobe prior to order confirmation.

7. Customer Disclosure (Must be completely filled out prior to processing)

Statement of what the Customer is providing (eg; shapefiles, DEM, GCP, etc)

File: _____

File Type/Format: _____

File Description: _____

Data Source: _____

Horizontal Datum: _____

Vertical Datum: _____

Projection: _____

-Zone: _____

Units: _____

Post Spacing: _____

Data Header information and Delimiter: _____

Horizontal Accuracy: _____

Vertical Accuracy: _____

Additional information describing the file: _____

Customer Signature: _____

Date: _____