



# Geolmaging Tools

Satellite and Aerial Sensor Support  
for ArcGIS Workflows

**Quick Guide**

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## ***Using this Guide***

Data for the GeoImaging Tools tutorial has been downloaded from the GeoEye-1 website.

[http://www.geoeye.com/CorpSite/resource/sample\\_imagery.aspx](http://www.geoeye.com/CorpSite/resource/sample_imagery.aspx)

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# GeoImaging Tools for ArcGIS

## *Introduction*

The GeoImaging Tools for ArcGIS is a set of tools that will allow users to view, process and analyze their raster imagery within the ArcGIS environment. GeoImaging Tools for ArcGIS will orthorectify imagery on-the-fly, and create a file format that is understood by the ArcGIS Server Image Extension.

The ArcGIS Image Server Extension extends the ArcGIS Server capabilities by providing dynamic mosaicking and on-the-fly processing capabilities. Overall the ArcGIS Image Server Extension simplifies data management and enables the distribution of data by serving large volumes of rasters to a range of client applications.

Image Services are beneficial because they give users the ability to make use of orthorectified raster files from a number of sensors within the ArcMap environment. Image Services are optimized for imagery and in general can load data faster. Data transmission can be adjusted for low-bandwidth networks. The imagery served through the Image Service can be used as inputs for geoprocessing. Publishing an image service makes a raster dataset accessible as a source for analysis over the web.

The ArcGIS Server Image Extension simplifies the management of data; users can publish imagery in their raw format, and individual image services can be created from large numbers of individual images in different projections, locations, and resolutions. This capability reduces the need to store processed data. Multiple image services can be created for one set of source imagery and each image service will use different sets of images with different processing steps being applied. Clients of the Image Service can dynamically create mosaics and change the ordering of overlapping imagery.

This tutorial will demonstrate the process of creating an OrthoEngine project using GeoEye-1 data with the Rational Polynomial Coefficient (RPC) math model; setting the project's projection; ingesting the data, and completing the project up to the orthorectification stage. Once the project is at this stage, the data will be exported to RPDef format in order to be used in the ESRI Image Service Extension.

## *GeoImaging Tools for ArcGIS & Sensor Support*

GeoImaging Tools for ArcGIS supports 70+ sensors for RPDef export, including those listed in the following table. These sensors can be exported to the RPDef format, which can then be used for the creation of an Image Service in ArcGIS.

Ikonos	Landsat-1	RapidEye 1	SPOT 1	WorldView-1
GeoEye-1	Landsat-2	RapidEye 2	SPOT 2	ASTER
QuickBird	Landsat-3	RapidEye 3	SPOT 3	CartoSAT-1
RADARSAT-2	Landsat-4	RapidEye 4	SPOT 4	ASAR
ALOS PALSAR	Landsat-5	RapidEye 5	SPOT 5	Kompsat-2
TerraSAR-X	Landsat-7			
Cosmo-SkyMed				

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## ***Processing GeoEye-1 data in Geomatica OrthoEngine***

GeoEye-1 was launched in September of 2008 and is currently the highest resolution commercial earth imaging satellite. GeoEye-1 has the capability to simultaneously acquire 0.41m panchromatic imagery, and 1.65m multispectral imagery.

## ***Rational Polynomial Coefficients (RPC)***

GeoEye-1 data is delivered with RPCs which can be used to georeference the raw scene in the absence of adequate GCPs. Further collection of 1 – 4 additional GCPs into the project can be used to significantly improve the accuracy of the math model.

## ***About GeoEye-1***

GeoEye-1 has the ability to collect images with a ground resolution of 16 inches in its panchromatic mode. In its multispectral mode, GeoEye-1 images at 64 inches. This satellite is a polar-orbiting satellite and can revisit any point on the Earth's surface every three days or sooner. As a result of its high resolution, GeoEye-1 benefits a number of applications such as defense, air and marine transportation; oil and gas; energy, mining and agriculture.

## ***Setting up a GeoEye-1 Project in OrthoEngine***

This example gives you the opportunity to work with Geomatica OrthoEngine to perform orthorectification of GeoEye-1 data. The sample GeoEye-1 dataset for this tutorial can be downloaded from

[http://www.geoeye.com/CorpSite/resource/sample\\_imagery.aspx](http://www.geoeye.com/CorpSite/resource/sample_imagery.aspx).

## ***Creating the Project***

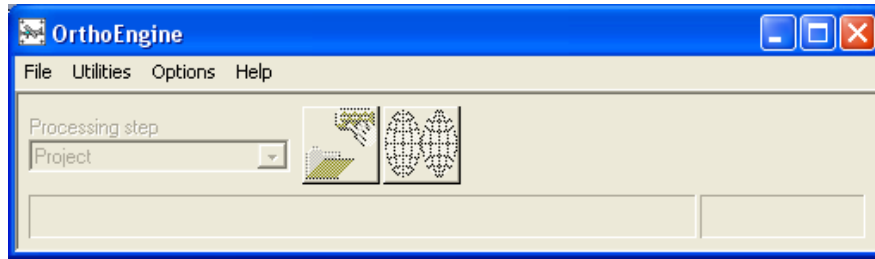
The first step in correcting the data is to create a project within OrthoEngine. The project file that you create contains information about the images being corrected, as well as projection information and information regarding the mathematical model used to correct the data. The three main steps in creating a project include the following:

1. Specifying the math model;
2. Setting the projection;
3. Importing the imagery

The following set of instructions outline the steps for creating a project specific to working with GeoEye-1 data.

## ***Starting GeoImaging Tools for ArcGIS on Windows Systems***

In Windows, begin by starting Geomatica by clicking on Start | All Programs | PCI Geomatics | GeoImaging Tools for ArcGIS. The main GeoImaging Tools for ArcGIS toolbar opens.

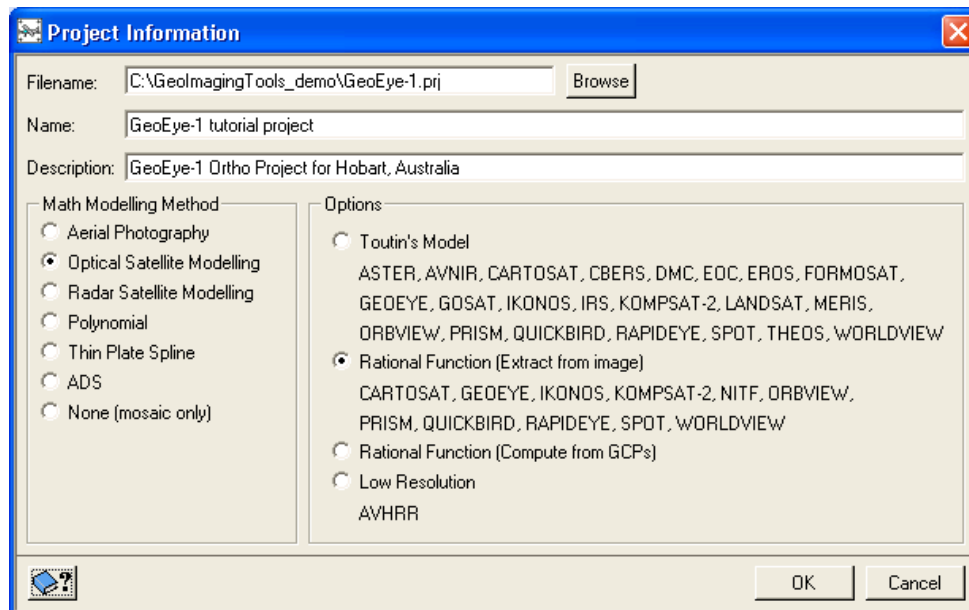


## Creating a Project and Importing Data

OrthoEngine works on a project-by-project basis. Therefore, you need to open an existing project or create a new project before you gain access to OrthoEngine functions. In this lesson, you will create a new GeoEye-1 project.

### To create a new project:

1. Click New on the File menu.  
The Project Information dialog opens.
2. Click Browse.  
The File to Create dialog opens. Choose a directory in which to store your GeoEye-1 OrthoEngine project.
3. Enter the name GeoEye-1.prj in the File name field.
4. Click Open.  
The File to Create dialog closes. The path and filename appear in the File name field in the Project Information dialog.
5. Enter the name GeoEye-1 tutorial project in the Name field.
6. In the Description field, type GeoEye-1 Ortho Project for Hobart, Australia.
7. In the Math Modeling Method panel, select Optical Satellite Modeling.
8. In the Options panel, select the Rational Function (Extract from image) model.



9. Click OK.  
The Project Information dialog closes and the Set Projection dialog opens.

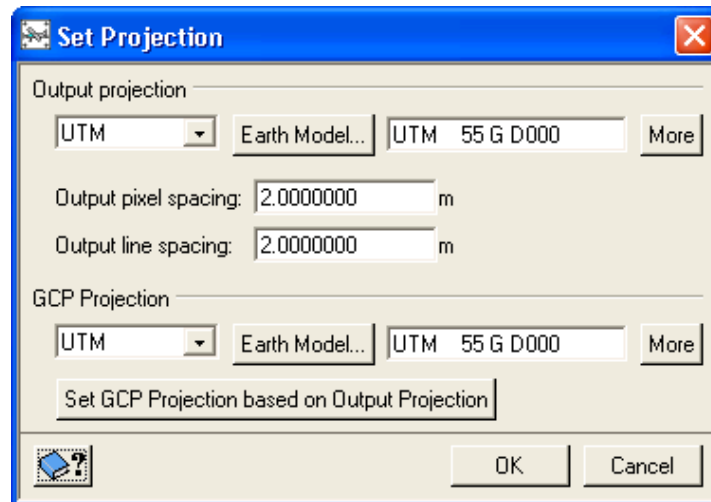
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## Setting the Output Projection Parameters

The projection information needs to be set at the beginning of each project. In the Set Projection dialog, the projection information for the project will be entered.

1. Select UTM from the drop-down menu in the Output Projection panel.  
The Earth Models dialog opens.
2. Click the Earth Model button and select D000 as the datum from the datum tab and click Accept.  
The UTM Zones dialog opens.
3. Click to select Zone 55 and click Accept.
4. Select Row G and click Accept.
5. For the Output Pixel Spacing, type 2.0.
6. For the Output Line Spacing, type 2.0.  
The value of 2.0 meters represents the desired resolution of the ortho images mosaic file.



## Setting the GCP Projection

1. Click the Set GCP Projection based on Output Projection button.  
The GCP Projection adopts the same settings used for the Output Projection.
2. Click OK.  
The Set Projection dialog closes.

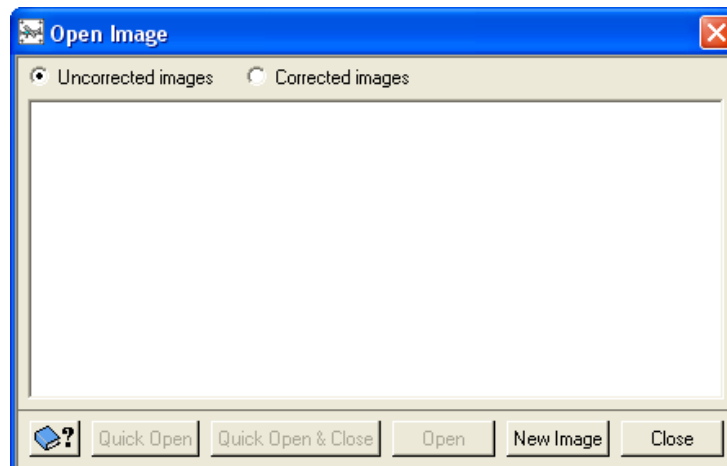
## Importing the Imagery

### To input the images to the current project

The dataset below shows a GeoEye-1 dataset that was downloaded from [http://www.geoeye.com/CorpSite/resource/sample\\_imagery.aspx](http://www.geoeye.com/CorpSite/resource/sample_imagery.aspx). The Hobart, Australia dataset is the one that will be used for this tutorial. Below is the directory containing the GeoEye-1 data as it comes from the GeoEye-1 website.

Name	Size	Type
GeoEye_logo.tif	792 KB	Microsoft Office Document Imaging File
po_312012_aoi.dbf	1 KB	DBF File
po_312012_aoi.prj	1 KB	PRJ File
po_312012_aoi.shp	1 KB	SHP File
po_312012_aoi.shx	1 KB	SHX File
po_312012_bgrn_0000000.hdr	1 KB	HDR File
po_312012_bgrn_0000000.tfw	1 KB	TFW File
po_312012_bgrn_0000000.tif	458,753 KB	Microsoft Office Document Imaging File
po_312012_bgrn_0000000_rpc.txt	4 KB	Text Document
po_312012_component.dbf	1 KB	DBF File
po_312012_component.prj	1 KB	PRJ File
po_312012_component.shp	1 KB	SHP File
po_312012_component.shx	1 KB	SHX File
po_312012_image.dbf	2 KB	DBF File
po_312012_image.prj	1 KB	PRJ File
po_312012_image.shp	1 KB	SHP File
po_312012_image.shx	1 KB	SHX File
po_312012_metadata.txt	8 KB	Text Document
po_312012_pan_0000000.hdr	1 KB	HDR File
po_312012_pan_0000000.tfw	1 KB	TFW File
po_312012_pan_0000000.tif	1,714,184 KB	Microsoft Office Document Imaging File
po_312012_pan_0000000_rpc.txt	4 KB	Text Document
po_312012_rgb_0000000_ovr.jgw	1 KB	JGW File
po_312012_rgb_0000000_ovr.jpg	181 KB	JPEG Image
SingleOrganization_license.txt	12 KB	Text Document

1. From the Processing Step menu on the OrthoEngine toolbar, select Data Input.  
A new toolbar with two icons appears on the main panel. You can input data from either CD-ROM or PCIDSK file.
2. On the Data Input toolbar, click Open a new or existing image.  
The Open Image dialog box opens.

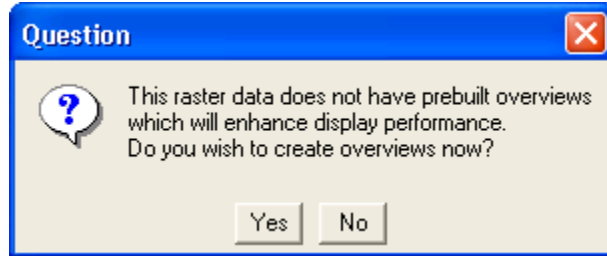


3. Click New Image in the Open Image dialog.  
A File Selector dialog opens.

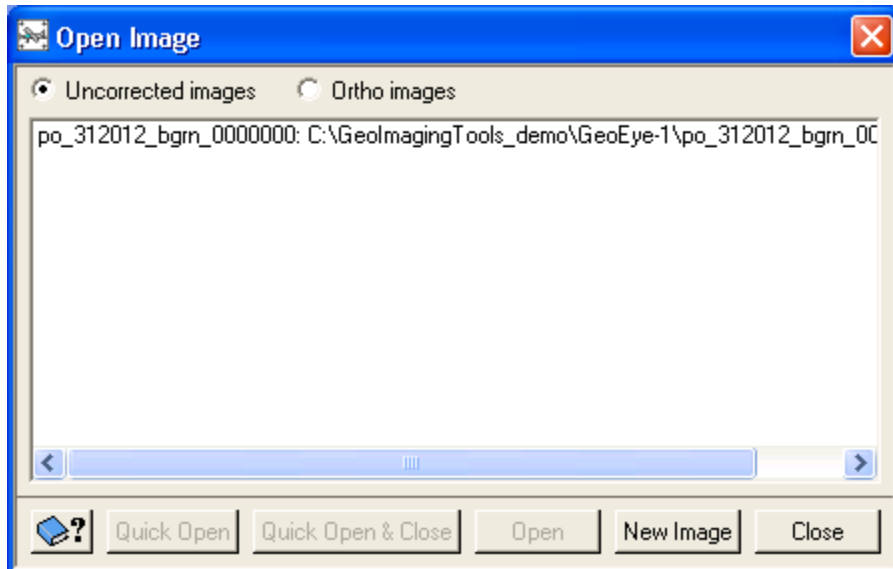
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4. Browse to the folder containing the GeoEye-1 data.  
Select the file po\_312012\_bgrn\_0000000.tif from the file selector dialog.
5. Click Open.  
A panel is displayed prompting you to create overviews.
6. Click No.



References to the imported file will appear in the Open Image panel.



7. Repeat steps 3 to 5 to read data for additional raw scenes that you add to the project. In this case, we will use only one image.  
You will see the additional files listed in Open Image dialog as they are added to the project.
8. Click Close to close the Open Image panel.

## Saving the Project

This is a good time to save your project.

1. Click File on the main OrthoEngine toolbar.
2. Click Save in the file menu.

The project file is saved in the specified folder. In addition, OrthoEngine automatically creates a backup file every 10 minutes. The backup file uses the same file name as the project file, but with a .bk extension.

### Tip

If you need to revert to the backup file, rename the backup file so that it uses the \*.prj extension. OrthoEngine can load this project file as it would any other \*.prj file. In OrthoEngine, the \*.prj file refers to an OrthoEngine project and not a projection file as in ESRI software.

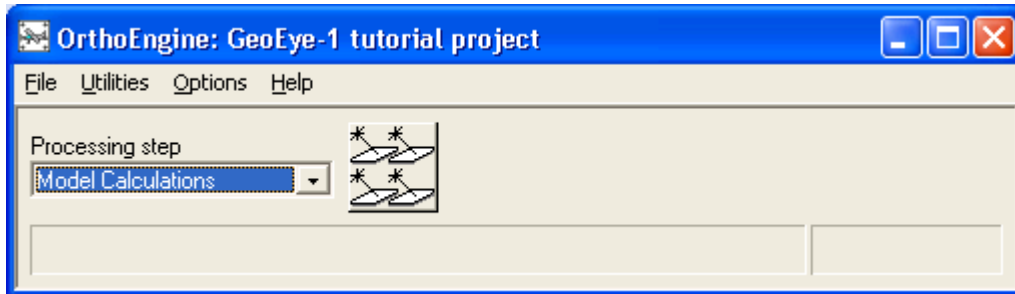
## Orthorectifying GeoEye-1 Data

When working with the RPC Model, the inclusion of ground control points (GCPs) is optional. Without any GCPs, the model is calculated based on the satellite's positioning information. The addition of GCPs, although not necessary, will refine the model, and as a result, improve its accuracy. This means, however, that as long as a DEM is included in your project, the images can still be orthorectified without any GCPs.

## Preparing for Orthorectification

### To build the model

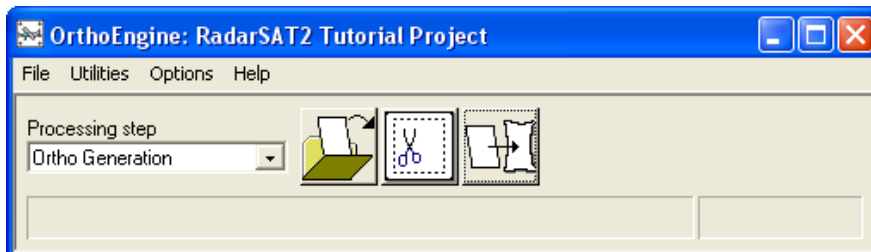
1. From the Processing Step menu, select Model Calculations.  
A new toolbar with one icon appears.



2. Click the Perform block adjustment button.

### To set up the images

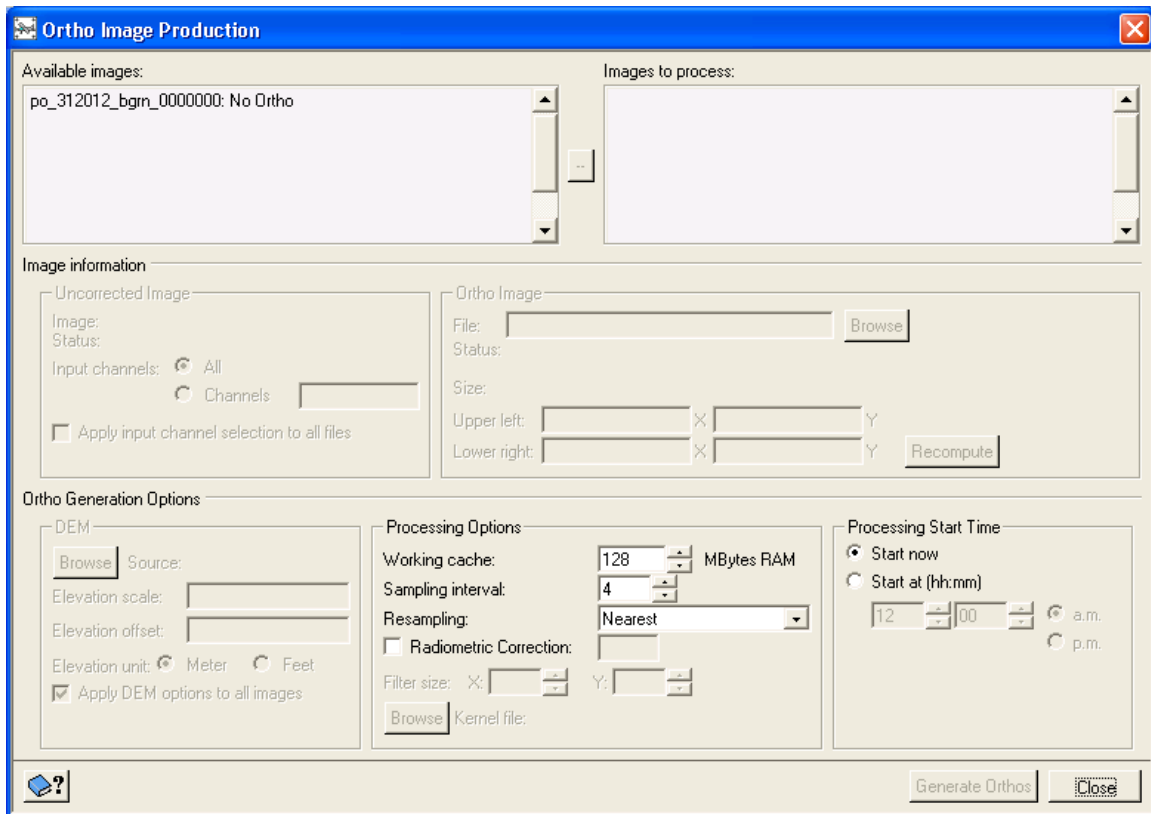
1. From the Processing Step menu, select Ortho Generation.  
The Ortho Generation toolbar appears.



2. On the Ortho Generation toolbar, click Schedule Ortho Generation.  
The Ortho Image Production dialog appears.
3. Select all images in the Available Image list.
4. Click the arrow to move all the images to the Images to Process list.

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## Specifying the Digital Elevation Model (DEM)

Since there is no DEM that we can specify for Hobart, Australia we will use an elevation offset value of 150m.

1. In the DEM panel, enter a value of 150 for the Elevation offset value.

The imagery is now ready to be orthorectified. However since we will be exporting the imagery for use in ArcGIS, we will not complete the orthorectification process.

### **Note**

*This is a good time to save your project file.*

## **Exporting Imagery for use in ArcGIS**

This section will cover the process of exporting imagery to the ESRI RPDef format which is the main function of the Geolmaging Tools for ArcGIS.

### **Exporting to RPDef**

1. On the OrthoEngine toolbar, select the Options menu.
2. Select Export and then select To ESRI RPDef...  
A file selector dialog opens. Browse to a directory where you would like to output the RPDef files to.
3. Click OK.  
The export process will begin.

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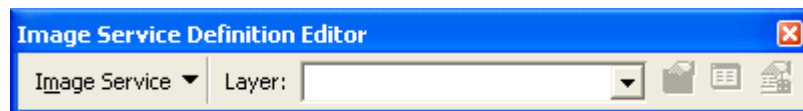
The files that are created during the export process are written to the specified directory. The RPDef file that is created contains a number of tags about the image that was exported. Below is a view of the output; note that a \*.rpdef file will be created for each individual image in the project.

Name	Size	Type
po_312012_bgrn_0000000.rpdef	21 KB	Raster Process Definition file

## Adding the Image Service Definition Editor Toolbar in ArcMap

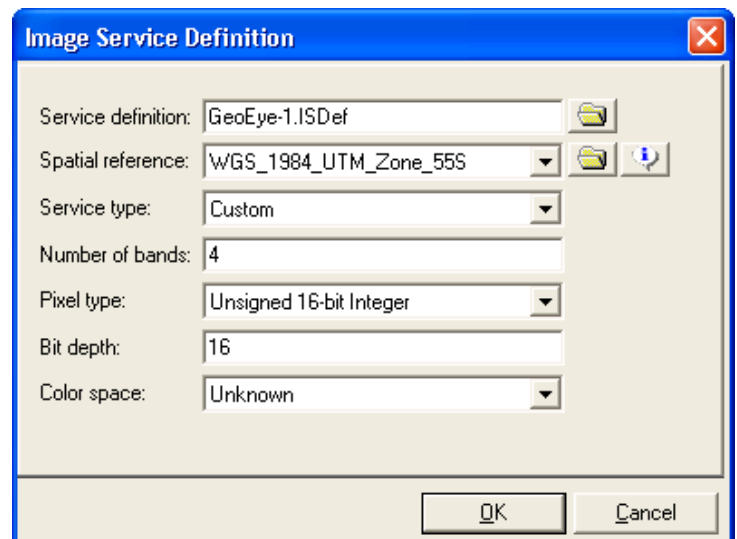
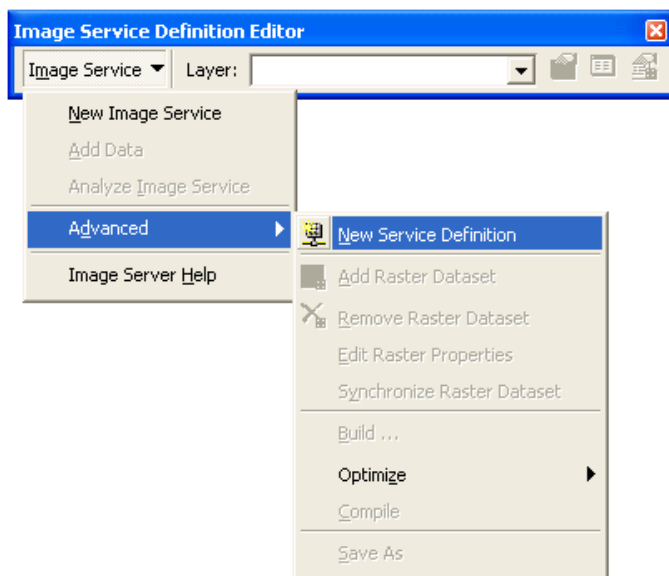
The Image Service Definition Editor Toolbar contains all of the commands necessary for creating an image service, building the service, and publishing the data to the service. Note that the Image Server needs to be installed in order for this toolbar option to be available from the ArcMap toolbar menu.

1. Open ArcMap.
2. Right-click in the toolbar area of ArcMap and select the Image Service Definition Editor Toolbar from list of available toolbars.  
The Image Service Definition Editor Toolbar is now available for use in ArcMap.



## Setting up the Image Service in ArcMap

1. From the Image Service menu on the Image Service Definition Editor Toolbar, select Advanced, and then select New Service Definition.  
The Image Service Definition panel opens.



2. Click the Browse button next to Service Definition.
3. In the File Selector dialog that appears, browse to a directory to store the Image Service Definition file and specify a filename.

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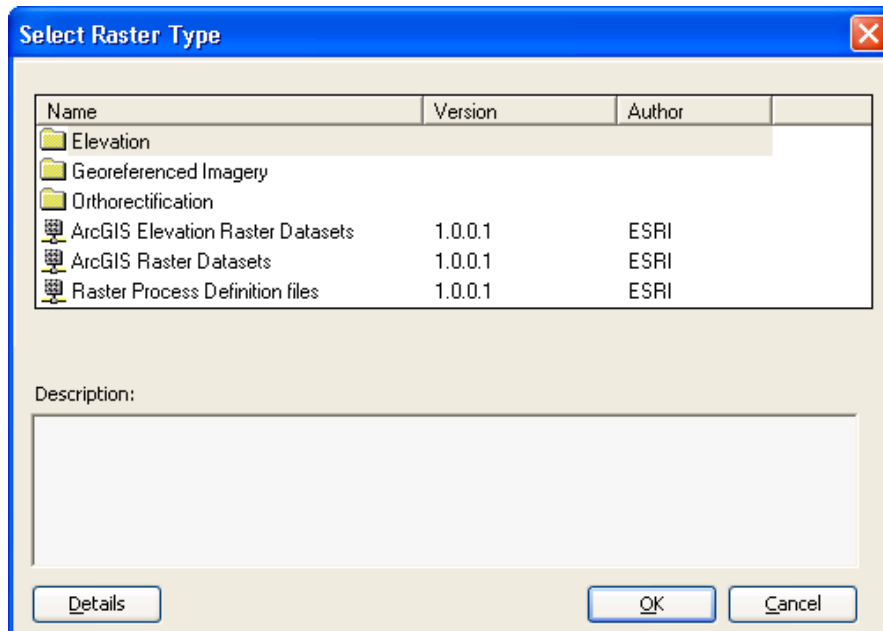
4. Click Save.
5. Click the Browse button next to Spatial reference.  
For the GeoEye-1 data that we are using, the spatial reference will be UTM 55S D000.
6. To specify this spatial reference, select the Projected Coordinate Systems directory.
7. Select UTM. Select the WGS 1984 directory.
8. Select the projection WGS 1984 UTM Zone 55S.prj.
9. Click Open.
10. For the Service type, select Custom from the dropdown list.
11. For the Number of bands, enter 4.
12. For the Pixel type, select Unsigned 16-bit Integer from the dropdown list.
13. For the Bit depth, enter 16.
14. For the Color space, select Unknown from the dropdown list.
15. Click OK.

The ISDef (image service definition) file is created in the specified directory, and is added to the ArcMap Layers list. Under the ISDef file a vector "Footprint" file appears.

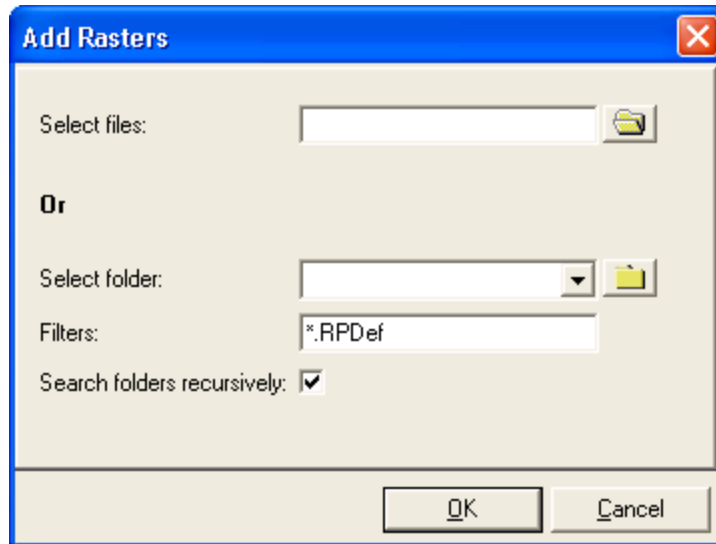
### Adding raster data to the Image Service Definition

Now that the ISDef is created with the parameters that we specified, we can now add raster datasets to the image service.

1. From the Image Service menu, select Advanced and then select Add Raster Dataset.  
The Select Raster Type panel opens.



2. Select the Raster Process Definition files file type.
3. Click OK.  
The Add Rasters panel opens.



Here you will choose the RPDef files that were exported from GeoImaging Tools for ArcGIS.

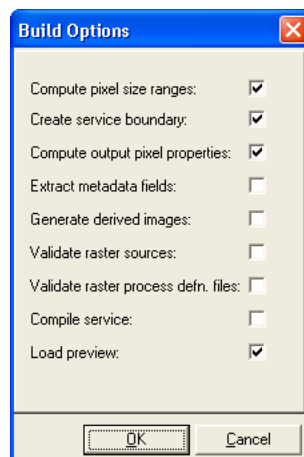
4. Click Browse next to Select files.  
A File Selector dialog opens. Browse to the directory where the RPDef files were created.

Alternatively, if you have a number of RPDef files that you would like to add to the Image Service, you can use the Select folder option, where you can select an entire directory of RPDef files to add to the Image Service.

5. Select the RPDef file and click Open.
6. In the Add Rasters panel, click OK.  
The image footprint is now visible in the ArcMap viewing area. This footprint contains the projection information provided in the Image Service and of the rasters that were specified.

## Building the Image Service

1. Select the Image Service menu and then select Advanced.
2. Select Build.  
The Build Options panel opens.



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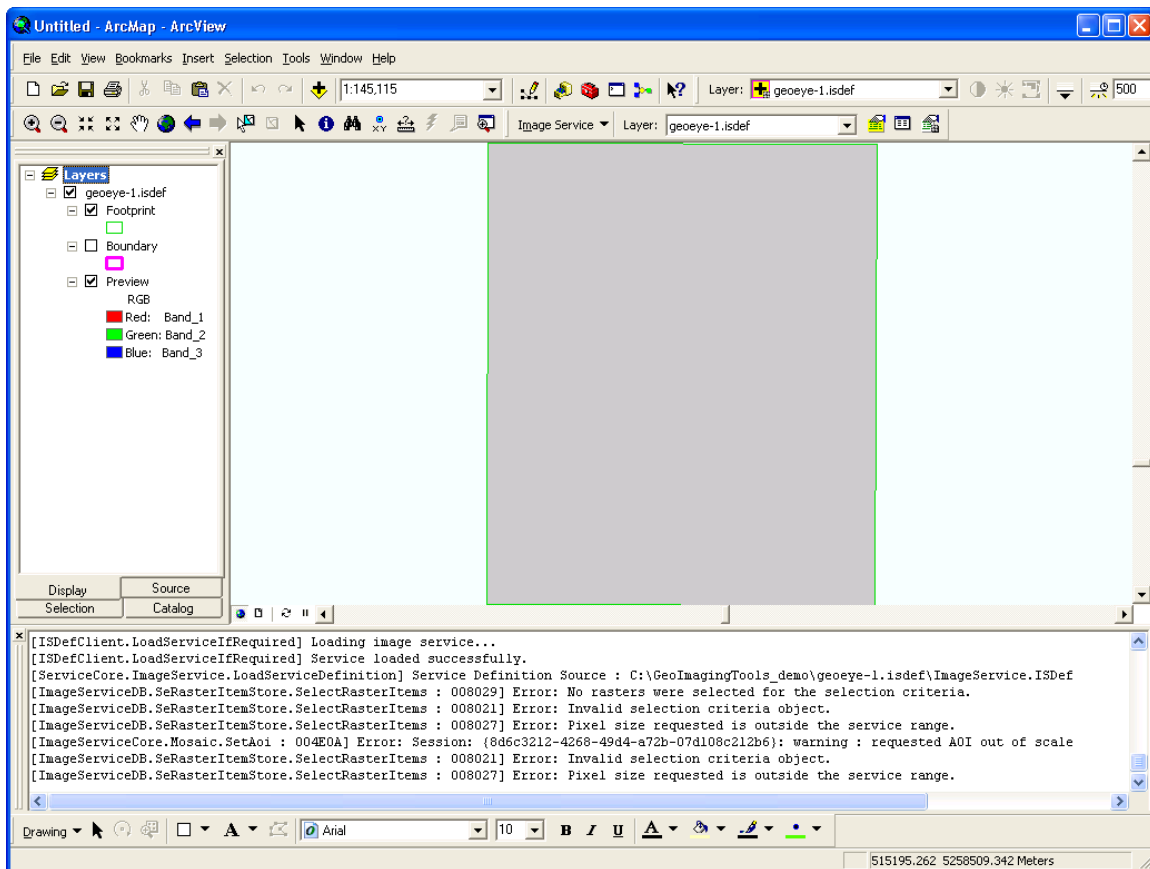
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
- Click OK to accept the default Build Options.  
The service is built successfully and a vector boundary layer is added to the ArcMap layers list. In addition to the boundary layer, a preview layer is added to the ArcMap layers list.

## Viewing the Raster

The boundary and preview layers are added to the ArcMap layers list but are unchecked (hidden) by default.

- Check the preview layer "on". The preview layer is displayed; however at full resolution appears as a black area.



- Right-click the preview layer and select Properties.  
The Layer Properties panel opens.
- Click the Symbology tab.
- Ensure that RGB Composite is selected in the Show list on the left-hand side of the Layer Properties panel.
- For Statistics, select From Current Display Extent from the dropdown list.
- For the Stretch Type, select Standard Deviations.
- Click OK to accept the changes made in the Layer Properties panel.
- Zoom in on the image using the Zoom In tool (  ). The image should be visible.

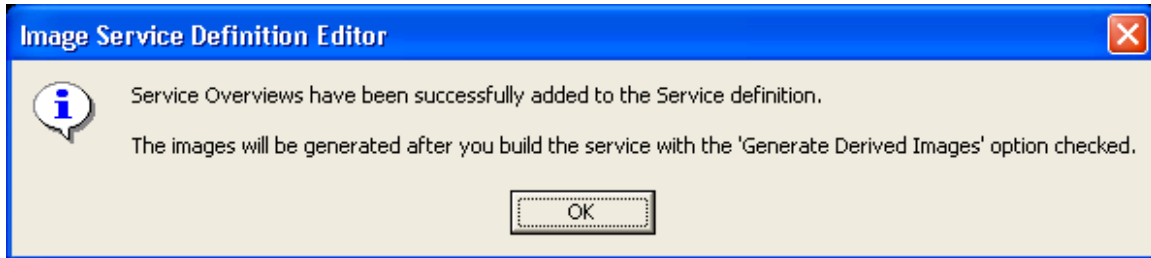
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## Defining Service Overviews

In order to view the image at any resolution, the definition of Service Overviews is necessary.

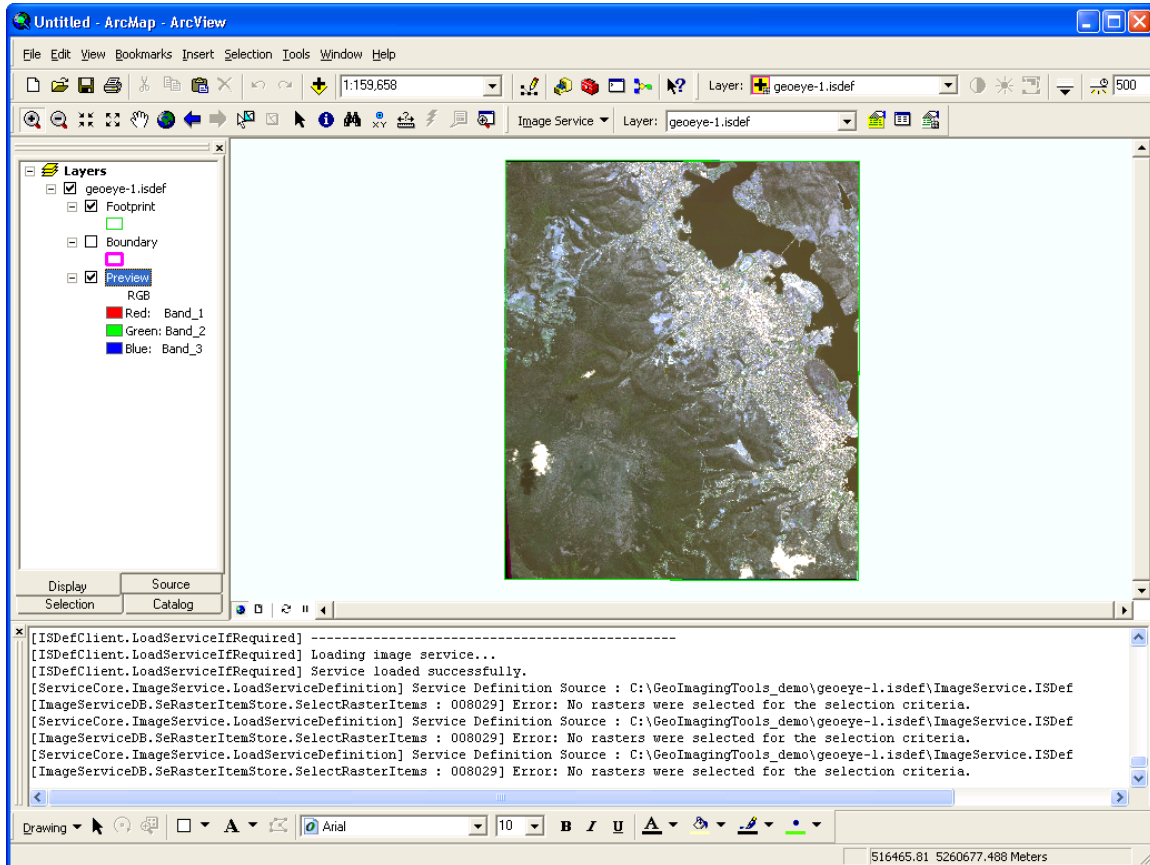
1. On the Image Service menu, select Advanced and then select Optimize. Select Service Overviews, and then Define. The Service Overviews Parameters panel opens.
2. Accept the default values for the Service Overviews by clicking OK. The Image Service Definition Editor responds by displaying a message box indicating that the Service Overviews have successfully been defined. The image is now displayed at any resolution.



- The service needs to be rebuilt in order to see the newly created overviews.
3. Select the Image Service menu and then select Advanced.
  4. Select Build. The Build Options panel opens.
  5. Click OK to accept the default Build Options. The service is built successfully and the raster file is visible at any resolution.

## Viewing the Image

The image is visible in ArcMap at any resolution.



## Further Processing with ArcMap

Once the Image Service has been set up, the rasters added, and the image service successfully built, the imagery needs to be compiled and published. At this point the imagery will be available to any other user who has access to the image service. This sharing of data across a server is advantageous since a number of users can view the data at any given time. With the loaded data, any number of raster files can be overlaid on the data, as well as contextual vector files. Clients can use the data as an input to processing.

## Further Processing with GeoImaging Tools

For the orthorectification of the GeoEye-1 scene used above, the inclusion of additional ground control points (GCPs) could have resulted in a more accurate output. The file product.xml distributed by GeoEye-1 already contains some GCPs, however if the user manually collects at least eight GCPs, the GCPs included with the product.xml file will be overwritten. To create GCPs in OrthoEngine, select the GCP processing step on the OrthoEngine toolbar, and click the Collect GCPs Manually icon. Note that the collection of GCPs must be carried out after adding the imagery to the project.

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