Getting Started with ENVI Tutorial

This tutorial provides a comprehensive introduction to using ENVI. It is designed for new ENVI users or those who have used ENVI Classic in the past and want to learn the newer ENVI user interface. You will learn how to display and navigate imagery, analyze raster data, create presentations, and more.

See the following sections:

Files Used in This Tutorial

Tutorial files are available from our ENVI Tutorials web page. Click the **High Resolution Ortho Photo** link to download the .zip file to your machine, then unzip the files. You will use this files in the tutorial:

File	Description
`CentralParkOrthophoto.dat` (and `.hdr`)	Orthorectified digital photograph of Central Park, New York City, USA, in ENVI raster format
`CentralParkWaterROI.xml`	Region of interest (ROI) file containing polygons that identify ponds in the orthophoto

The digital photograph is a public-domain U.S. Geological Survey (USGS) High Resolution Orthoimage downloaded from the USGS EarthExplorer web site. Gridded spatial resolution is 0.15 meters (0.5 feet). The image contains four bands (red, green, blue, near-infrared) and was acquired between April and May of 2014.

Technical Notes:

The orthophoto was originally acquired from an UltraCam Eagle digital camera, which has the following wavelength ranges for visible to near-infrared bands:

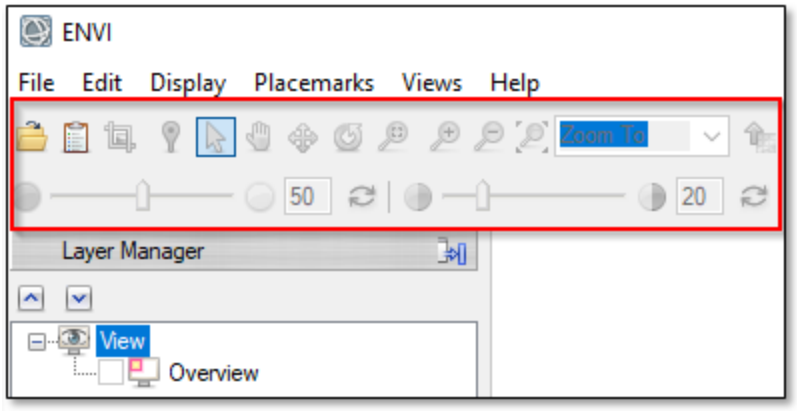
- Blue: 400 - 600 nm, peak at 450 nm
- Green: 480 - 700 nm, peak at 550 nm
- Red: 580 - 720 nm, peak at 640 nm
- Near-infrared: 680 - 1000 nm

Reference: Gruber, M., and M. Muick. "UltraCam Eagle Prime Aerial Sensor Calibration and Validation." Vexcel Imaging GmbH (2016).

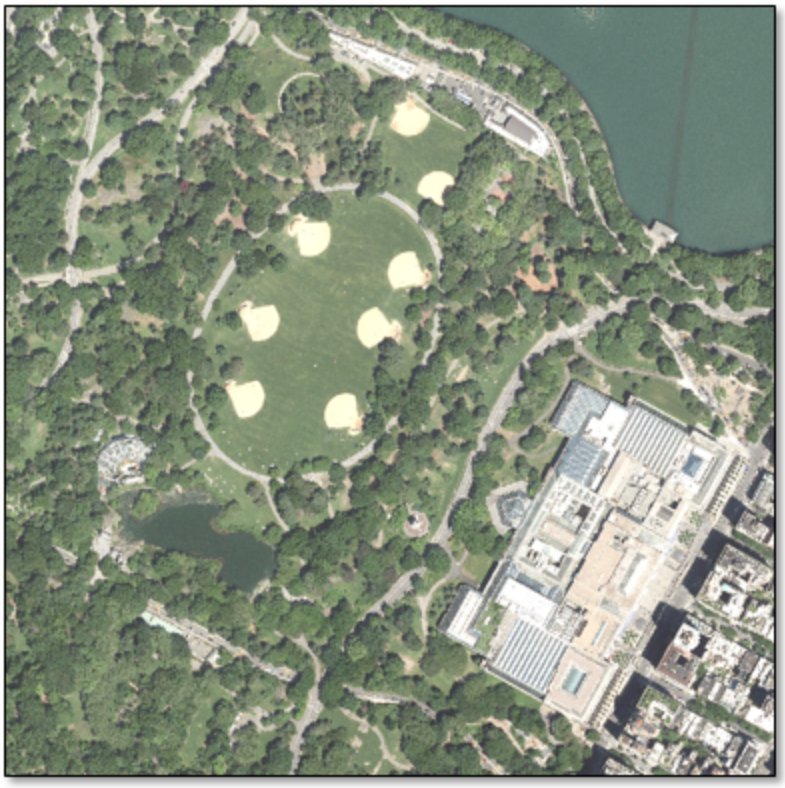
The orthophoto did not have any wavelength information, so we manually added the peak wavelengths for each band to the ENVI header file. For the near-infrared band, we used the center wavelength (840 nm).

Explore an Image

1. Start ENVI.
2. Click the **Open** button in the toolbar. The toolbar is located along the top of the ENVI application:



3. When the Open dialog appears, navigate to the location where you saved the tutorial data. Select `CentralParkOrthophoto.dat` and click **Open**. The center of the image is displayed at full (100%) resolution in the view.
4. Press the **F12** key on your keyboard to view the full extent of the image. This is a true-color image that shows natural and man-made features.



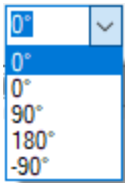
5. From the menu bar (located above the toolbar), select **Views > Reference Map Link**. A separate window appears with a map of the image location. The cyan-colored box indicates the extent of the image, and the dot in the middle indicates the image center. You can see that the image covers a portion of Central Park in New York City. It contains several softball fields, ponds, and an amphitheater. The large building in the lower-right corner is the Metropolitan Museum.

6. Explore the image using these techniques:
   - If your mouse has a scroll wheel, use it to zoom in and out of the image. If not, press the **F9** key to zoom in or the **F10** key to zoom out in fixed increments. The zoom level is displayed in the toolbar; for example:

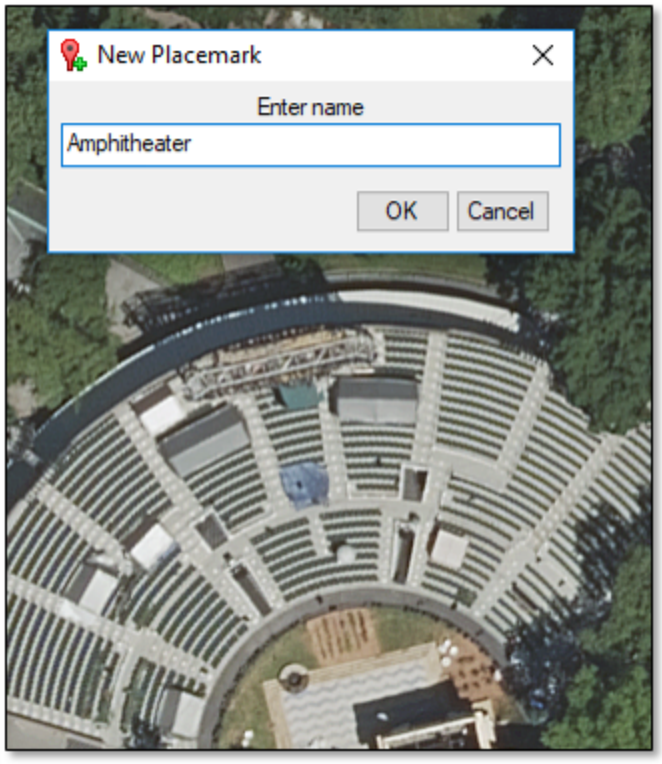
     

   - To zoom into a specific area, click the **Zoom** button in the toolbar and draw a box around the area to zoom.
   - To zoom to 100% resolution, press the **F11** key.
   - To pan around the image, click the **Pan** button in the toolbar. Left-click and drag the mouse to pan. Or, click and drag the middle mouse button or scroll wheel.

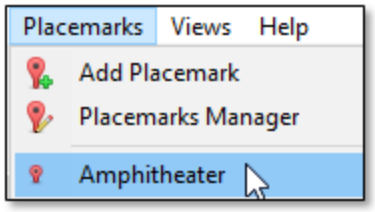
- To rotate the image, click the **Rotate View** button in the toolbar. Left-click and drag the mouse to rotate. Or, select a rotation angle from the drop-down list in the toolbar.



7. Zoom to an area that you are interested in, then select **Placemarks > Add Placemark** from the menu bar.
8. In the New Placemark dialog, enter a name for the location and click **OK**; for example:



The custom location is saved under the **Placemarks** menu. When you move to another area in the image, you can go back to the saved location by clicking **Placemarks** and selecting it from the list; for example:



As you move the cursor around the image, the latitude and longitude coordinates of the cursor location are displayed in the Status Bar at the bottom of the ENVI application. The Status Bar contains three horizontal segments. By default, the first (left) segment displays geographic coordinates, and the second segment displays the map projection details for the image. The third segment is blank. The following figure shows an example of the first two segments:

You can choose to display different types of image information in each segment by right-clicking and selecting an option.

9. Right-click in the first (left) segment and select **Raster Data Values**. The red, green, and blue data values are displayed for the current pixel location; for example:

10. Zoom to full resolution (100%) in the image, then click the **Overview** check box in the Layer Manager. The Layer Manager is located near the upper-left corner of the application. A small yellow overview window is displayed in the upper-left corner of the view.

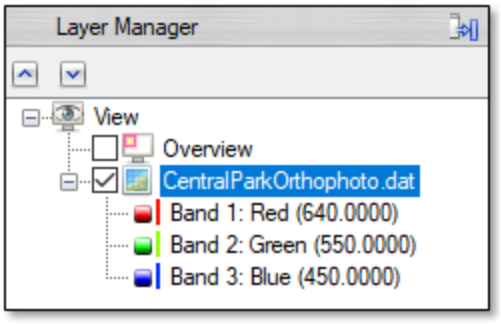
11. Pan around the image. The red box in the overview window shows the extent of the current view location, relative to the entire image.
12. Uncheck the **Overview** option to hide the overview window.

Now that you understand some basic exploration techniques, let's learn how to work with multiple data layers and views.

Work with Layers and Views

The Layer Manager shows the datasets that are displayed in the view. Since there is only one view (you will learn about multiple views later), the image layer is listed under one View category.

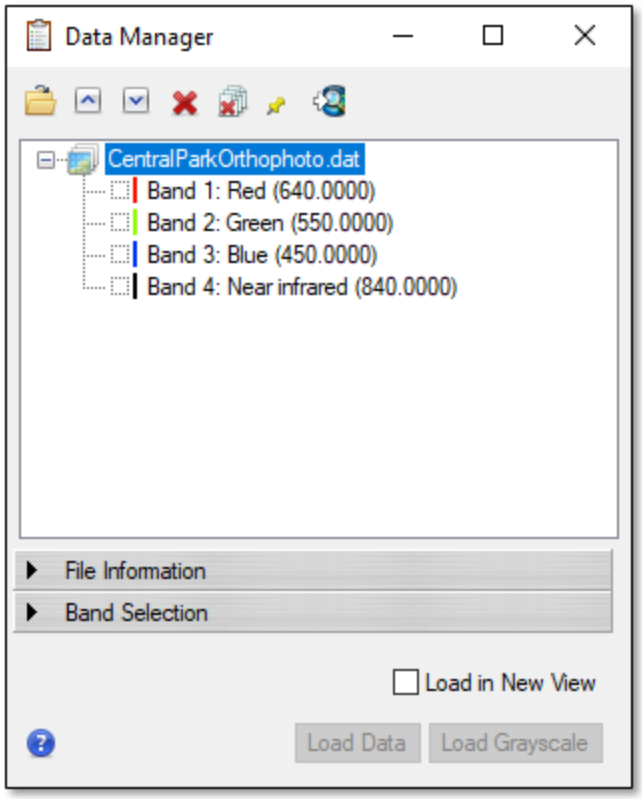
1. Click the **+** button next to **CentralParkOrthophoto.dat** to see the bands that are used to display a true-color composite for this image.



2. Click the **Detach** button in the Layer Manager to detach it from the application. It becomes a floating window that you can resize and move to a different location.

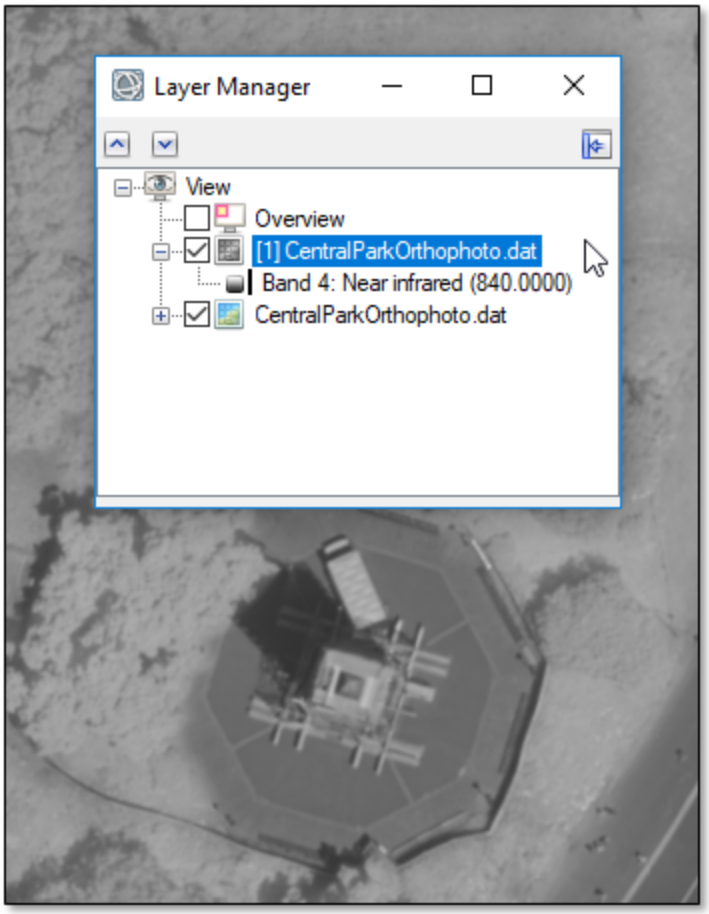
3. Click the **Data Manager** button in the toolbar.

   The Data Manager lists the datasets that are currently open in ENVI. For images, it also lists the available bands. Since the associated header file for this image (`CentralParkOrthophoto.hdr`) contains wavelength information, the Data Manager also lists the wavelengths for each band.

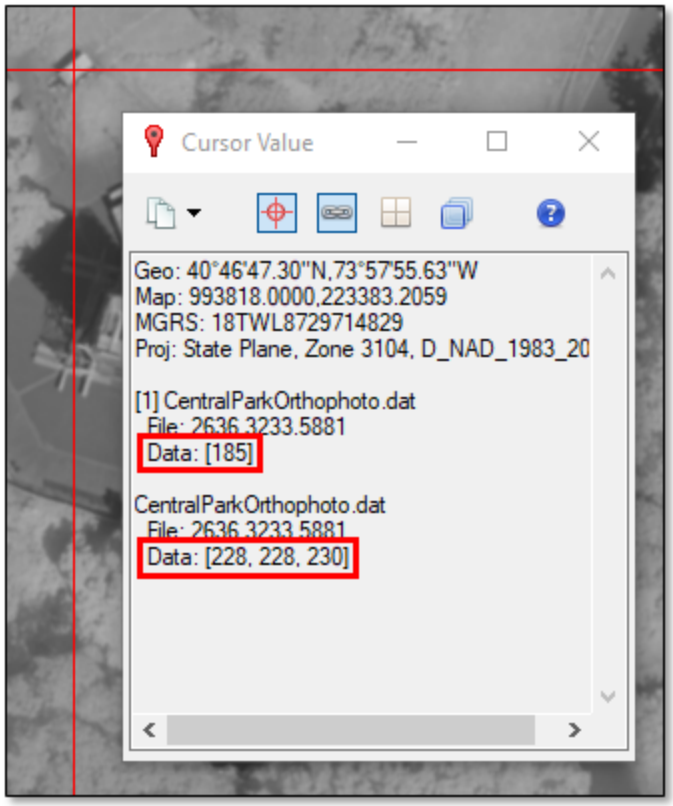


In the Data Manager, you can see that the image contains a fourth band (Band 4: Near infrared).

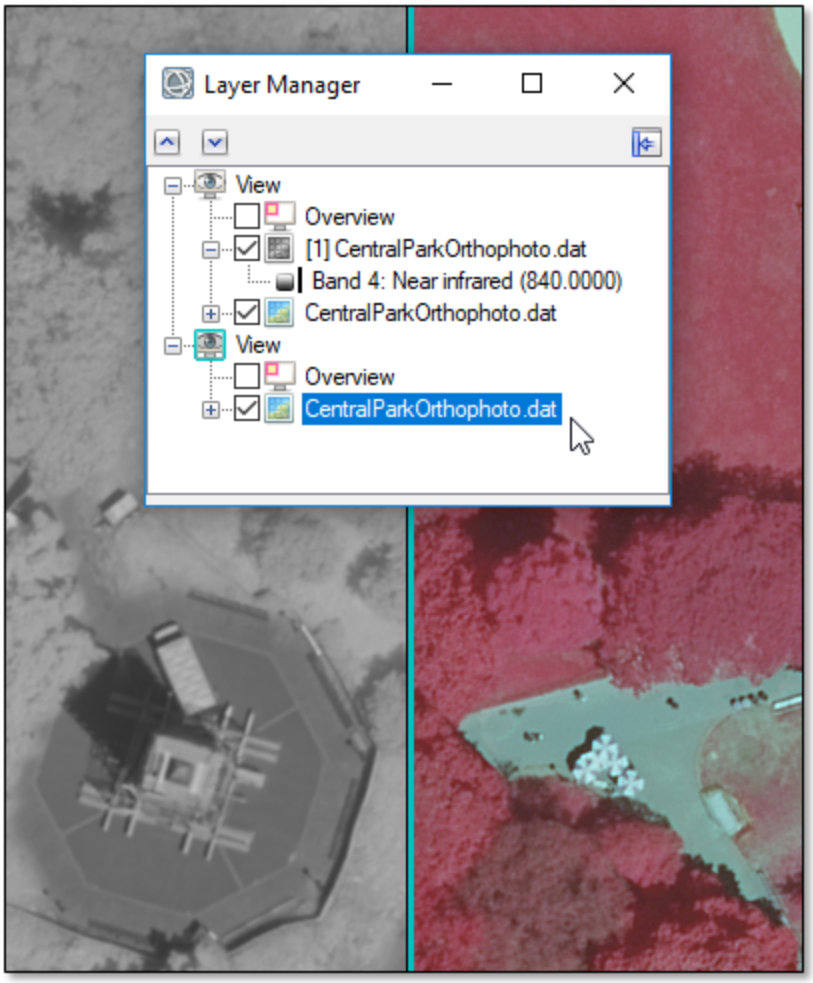
4. Select **Band 4: Near infrared** and click the **Load Grayscale** button. The near-infrared band appears in the view, and the Layer Manager shows that a second image layer has been added to the view.



5. To toggle between the two images, uncheck the **[1] CentralParkOrthophoto.dat** layer in the Layer Manager to hide it. Then check the layer to display it.
6. Click the **Cursor Value** button in the toolbar. Red crosshairs appear in the display, along with the Cursor Value dialog.
7. Click anywhere in the image. The red crosshairs move to that pixel location, and the Cursor Value dialog reports the data values from the grayscale image layer and the true-color layer for that pixel.

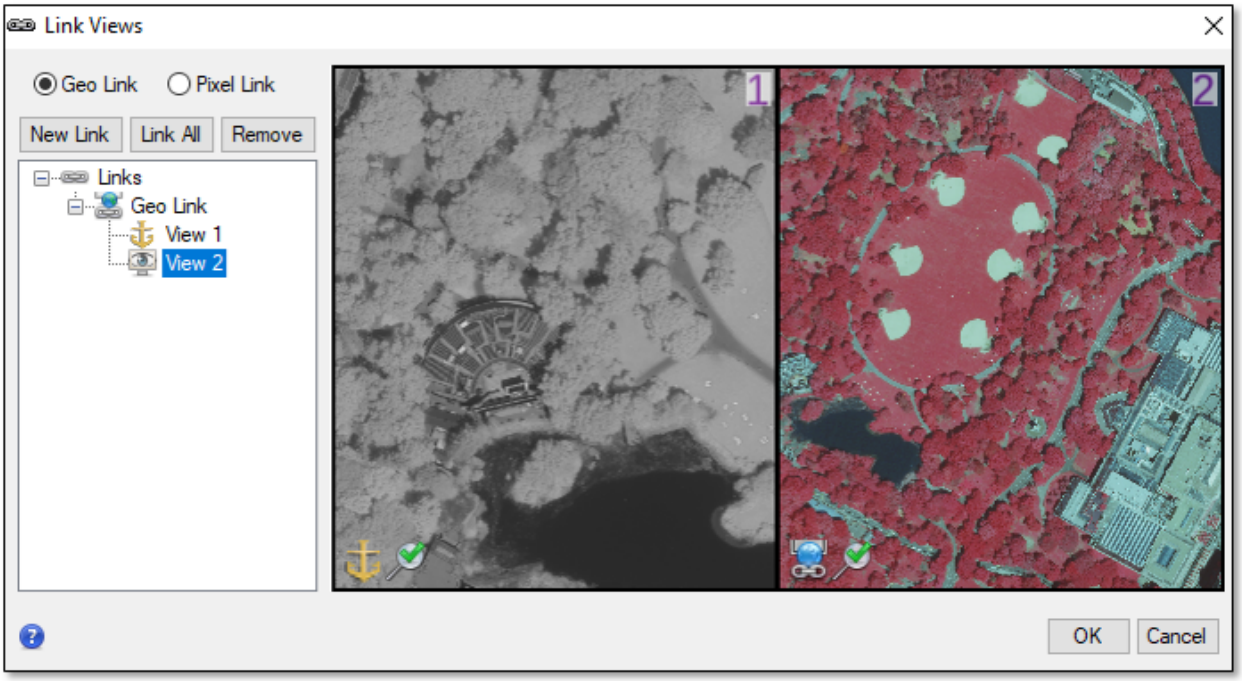


8. Close the Cursor Value dialog.
9. In the Data Manager, enable the **Load in New View** option.
10. Right-click on **CentralParkOrthophoto.dat** in the Data Manager and select **Load CIR**. A second view is added to the view, which contains a color-infrared version of the orthophoto. The colors are not real according what the human eye sees. Instead, this type of image is commonly used for discriminating between features based on the infrared response. The Layer Manager shows that a second view has been added.



Having two views provides a convenient way to compare images side-by-side. However, notice that when you zoom or pan in one view that the other view remains the same. You will need to establish a geographic link between the views.

11. From the menu bar, select **Views > Link Views**.
12. In the Link Views dialog click the **Link All** button, then click **OK**.



Now when you zoom or pan around one view, the second view moves accordingly.

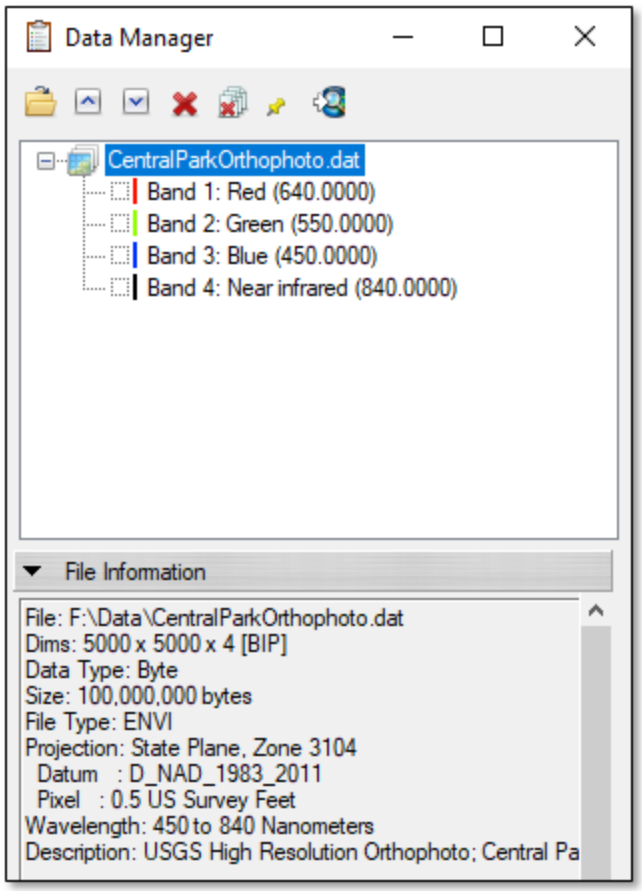
13. Now is a good time to save the view layout. If you close and restart ENVI, it will not remember the layers and views that you last displayed. From the menu bar, select **File > Views and Layers > Save**.
14. In the output file dialog, navigate to a directory where you want to save the file, and name it `TwoViews.json`.
15. Click **Save**. If you close ENVI at any point in this tutorial, you can restore the views and layers from this step by selecting **File > Views and Layers > Restore** from the menu bar.
16. Click inside of the view that contains the grayscale and true-color image layers. A cyan-colored border surrounds the view to indicate that it is the currently selected view.
17. From the menu bar, select **Views > One View**. The color-infrared view is removed.
18. In the Layer Manager, right-click on **[1] CentralParkOrthophoto.dat** and select **Remove**. Now the view only contains the true-color image.

Next you will explore the image data in more detail, beginning with metadata.

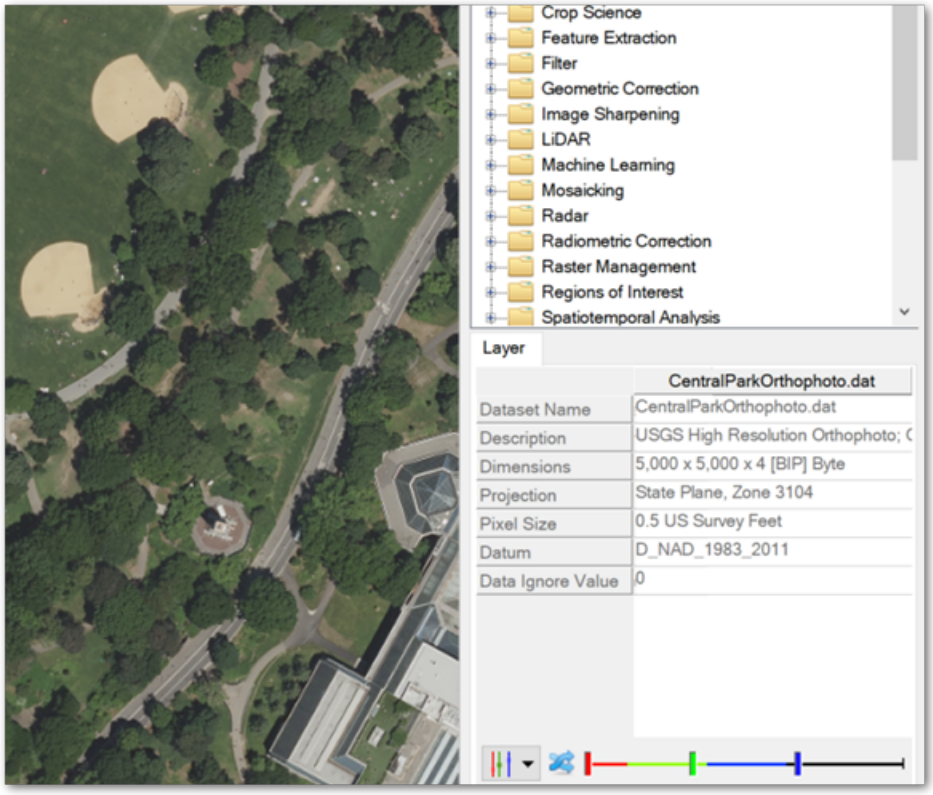
View and Edit Metadata

Metadata provide details about a dataset in general such as its source, data type, and projection. Follow these steps to view the orthophoto metadata:

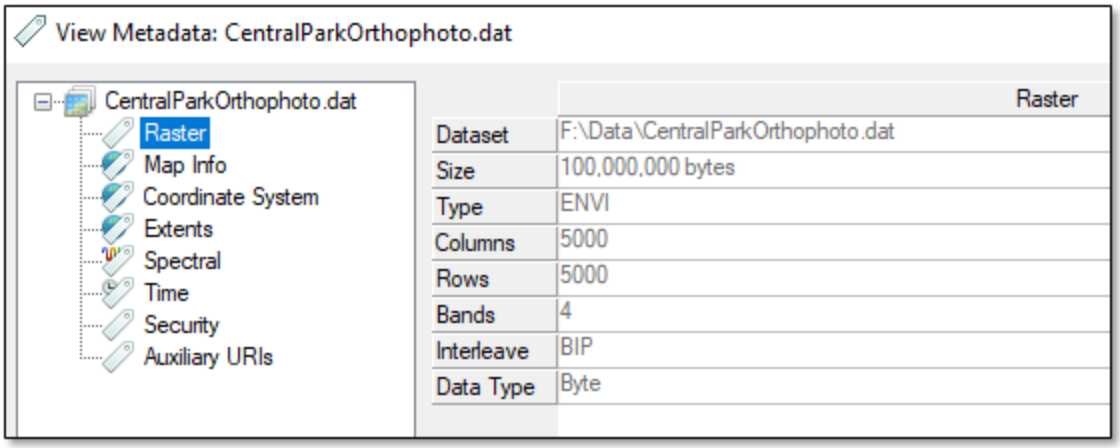
1. In the Data Manager, expand the **File Information** category. Here you can view basic metadata such as file location, dimensions, interleave, data type, size, file type, projection, and wavelength range.



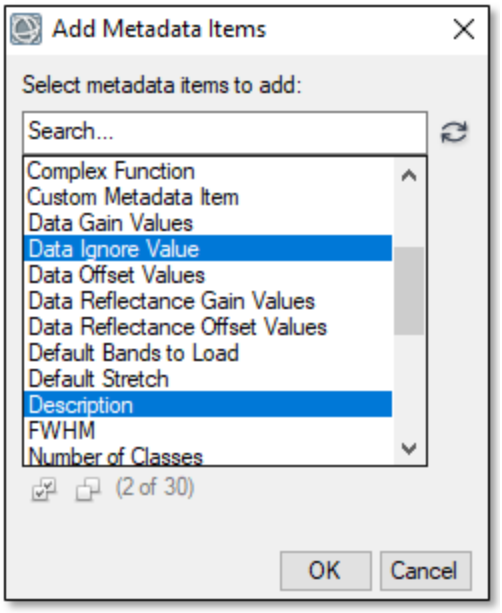
2. You will also find basic metadata such as dimensions, interleave, data type, projection, and data ignore value in the Layer tab, which is located below the Toolbox.



3. Right-click on **CentralParkOrthophoto.dat** in the Layer Manager and select **View Metadata**. Here you can view the full set of metadata for the orthophoto. The Raster node shows most of the same metadata as you viewed in the Data Manager.



4. Click the **Extents** node on the left side of the View Metadata dialog. This node shows the UTM map coordinates of the four corners of the image, along with the units of the map projection. Next, you will add two new fields to the metadata.
5. Click the **Edit Metadata** button in the View Metadata dialog. The Edit ENVI Header dialog appears. Here you can see the metadata fields that are currently populated with values.
6. Click **Add** in the Edit ENVI Header dialog. The Add Metadata Items dialog appears.
7. Use the **Ctrl** key on your keyboard to select both **Data Ignore Value** and **Description**.



8. Click **OK**.
9. Scroll to the bottom of the Edit ENVI Header dialog. The Data Ignore Value and Description metadata fields have been added.

10. If an image has a specific pixel value that you want to remain transparent when displaying the image and to ignore when doing any processing, you can set that value in the **Data Ignore Value** metadata field. An example of an area to ignore would be background pixels that surround an image. While this orthophoto does not have any background pixels, you should still learn how to set a data-ignore value as it is a common scenario when working with remote sensing imagery. Enter a value of **0** in the **Data Ignore Value** field.
11. Add a custom description in the **Description** field; for example: `USGS High Resolution Orthophoto, Central Park, 2014, 0.5 foot resolution`.
12. Enable the **Display result** option.
13. Click **OK** in the Edit ENVI Header field. The image closes and reopens while the associated header file (`CentralParkOrthophoto.hdr`) is updated with the new metadata.
14. Right-click on **CentralParkOrthophoto.dat** in the Layer Manager and select **View Metadata**. In the Raster node, note the new Description and Data Ignore Value fields, along with the values you just added.
15. Close the View Metadata dialog.

Explore Data in More Detail

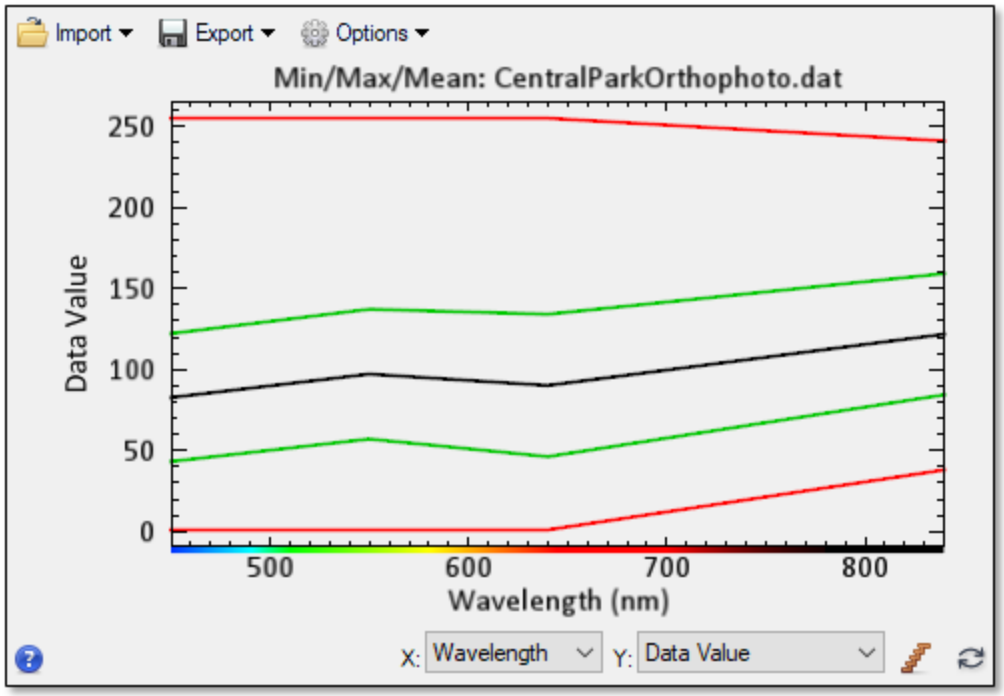
In this section you will learn more about the data itself.

Image Statistics

1. The orthophoto used in this tutorial is a byte image that contains data values ranging from 0 to 255 in the red, green, blue, and near-infrared bands. To confirm this, right-click on **CentralParkOrthophoto.dat** in the Layer Manager and select **Quick Stats**. Two progress dialogs appear, followed by a Statistics View dialog.

   The top part shows a graphical summary of the following across all bands:

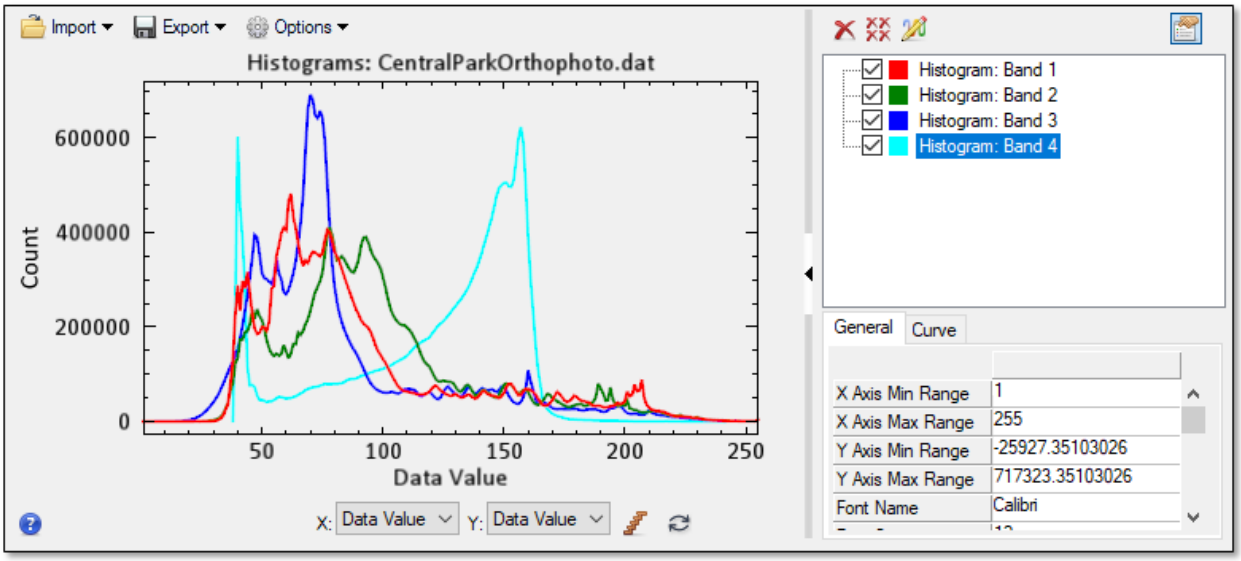
   - Minimum and maximum data values (red)
   - Mean data value (black)
   - Standard deviation (green, centered over the mean)



The Basic Stats section shows the actual minimum, maximum, and mean data values in each band, along with the standard deviation.

Basic Stats	Min	Max	Mean	StdDev
Band 1	1	255	90.119177	43.936754
Band 2	1	255	97.119088	40.040257
Band 3	1	255	82.672116	39.464420
Band 4	38	241	121.759532	37.383005

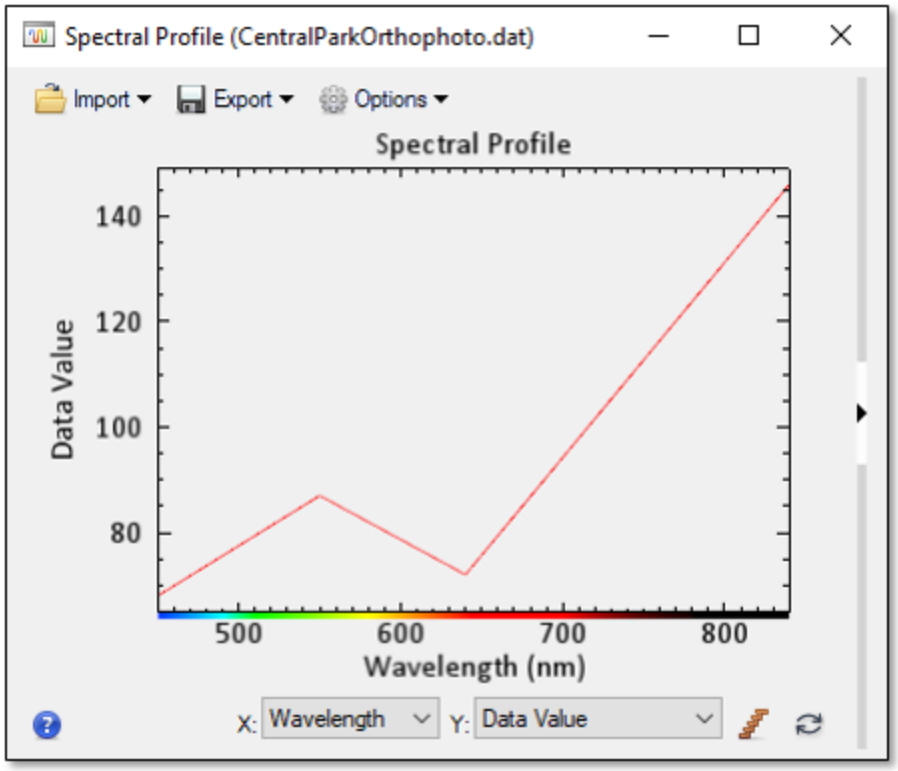
2. Click the **Select Plot** drop-down list at the top of the Statistics View, and select **All Histograms**. A plot shows the histograms for all four bands.
3. Click the right-facing arrow to the right of the plot. This expands to show the plot key so that you can see the bands and their corresponding colors.



4. Close the Statistics View dialog.

Spectral Profiles

1. Right-click **CentralParkOrthophoto.dat** in the Layer Manager and select **Profiles > Spectral**. Red crosshairs appear in the display, and the Spectral Profile dialog appears. A spectral profile shows the data values for a selected pixel (Y-axis) in all four bands spanning the visible to near-infrared wavelength range (X-axis).
2. In the **Go To** field (located in the toolbar), type the values **2641p, 3588p** and press the **Enter** key. These are pixel coordinates for a dark-green tree within the orthophoto. The "p" indicates that these are pixel coordinates, not to be confused with any map coordinates that might have the same values. The spectral profile updates to show the spectral signature of healthy, green vegetation. The curve peaks in the green wavelength region (around 550 nm), decreases in the blue and red wavelengths, and increases dramatically in the near-infrared region (above 620 nm).

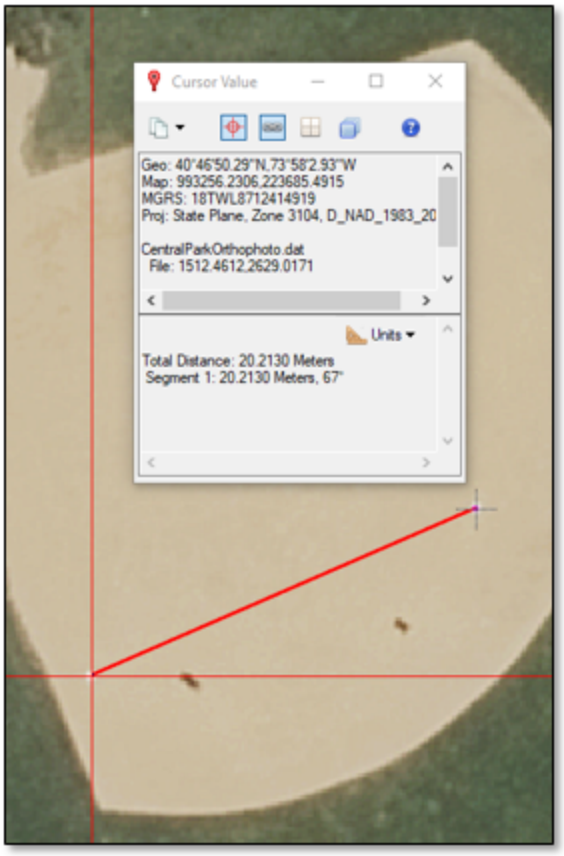


3. Close the Spectral Profile dialog.

Measure Distances

If an image is georeferenced to a standard map projection (as with this orthophoto), you can measure the distance between objects.

1. Click the **Mensuration** button in the toolbar. Red crosshairs appear in the display, and the Cursor Value dialog appears.
2. In the **Go To** field, enter pixel coordinates **1512.46p, 2629.02p** and press the **Enter** key. The image centers on the first base in a softball field.
3. Click on the first base exactly where the crosshairs intersect, then click on the second base (up and to the right). A red line is drawn between the two bases.



4. Right-click and select **Accept**. The Cursor Value dialog reports the distance of the line segment (approximately 20.3 meters), along with the angle (67 degrees). The line segment becomes a polyline annotation that is added to the Layer Manager.
5. Click the **Units** drop-down list in the Cursor Value dialog, and select **US Survey Feet**. What is the length of the line segment?
6. Close the Cursor Value dialog.
7. Right-click on **New Annotation** in the Layer Manager and select **Remove**.
8. When prompted to save the changes to the new annotation, click **No**. The line segment is removed from the view and the Layer Manager.

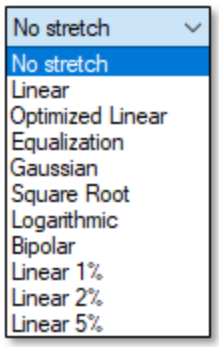
Create Presentations

Next, you will learn how to modify the display properties of the image and add grid lines to the image. Steps like these are normally taken to create screen captures or full-resolution presentations that you can share with others. They do not modify the original image data in any way.

Apply a Stretch

You can apply one of 10 quick stretches to the image using the **Stretch Type** drop-down list in the toolbar. By default, no stretch is applied to this orthophoto.

1. Experiment with each option to see the effect it has on the image.



2. Experiment with the **Brightness**, **Contrast**, **Sharpen**, and **Transparency** sliders in the toolbar.

   Tip: The **Contrast** slider is only available when you choose a **Linear**, **Equalization**, **Gaussian**, **Square Root**, or **Logarithmic** stretch type.

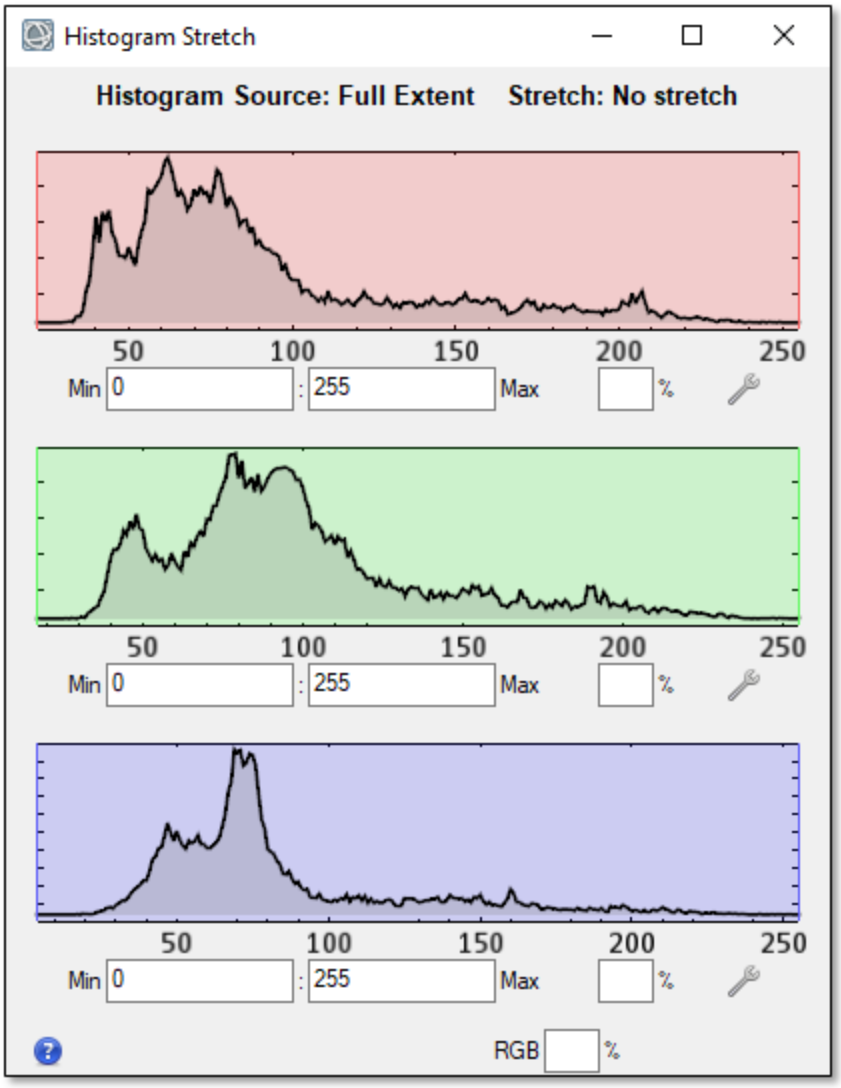
   You can click the **Reset** button next to each slider to go back to the default value. To the left of the **Stretch Type** drop-down list are three buttons that let you choose how the stretch is computed. By default, the **Stretch on Full Extent** button is enabled, which means the selected stretch is based on the histogram of the entire image.

3. Press the **F11** key on your keyboard to zoom to full resolution.

4. Click the **Stretch on View Extent** button in the toolbar. Now the selected stretch is only computed from the pixels that are displayed in the view.

5. Pan around the image and notice how the stretch looks the same even though you are viewing a different area. You have to click the **Stretch on View Extent** button each time you pan around, to apply the stretch to the viewable area.

6. Click the **Stretch on View Extent with auto update** button , then pan around the image. The selected stretch is automatically recomputed each time you view a different area.
7. Click the **Stretch on Full Extent** button.
8. Click the **Histogram Stretch** button in the toolbar. The Histogram Stretch dialog lets you adjust the histogram values for the red, green, and blue display bands.
9. Drag the minimum and maximum vertical sliders in each histogram to see the effect the changes have on the image.

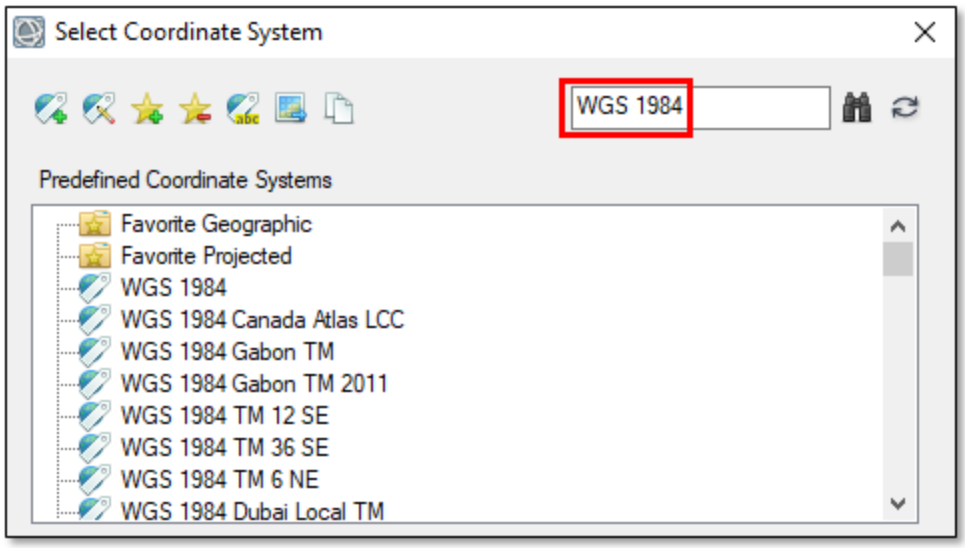


10. To learn more about the different options available, click the blue help button in the Histogram Stretch dialog. A web browser will launch, and you will be taken to the *Display Tools* topic in ENVI Help.
11. Close the Histogram Stretch dialog.

    Tip: To cancel any changes you made in the Histogram Stretch dialog, click the **Reset** button to the right of the **Stretch Type** drop-down list in the toolbar.

Add Grid Lines

1. Click the **Zoom** drop-down list in the toolbar and select **12.5% (1:8)**.
2. Click the **Annotations** drop-down list in the toolbar and select **Grid Lines**. Grid lines and labels are added to the display, but the spacing is not optimal and the labels are too small. You will modify these properties next.
3. Grid line properties are displayed beneath the Toolbox in the lower-right corner of the ENVI application. Click in the white space next to the **Coordinate System** property and click the arrow icon. The Select Coordinate System dialog is displayed.
4. Type **WGS 1984** in the search field of the Select Coordinate System dialog, and press the **Enter** key.



5. Double-click **WGS 1984** in the search results. The coordinate system changes to **GCS_ WGS_1984** and the Select Coordinate System dialog is dismissed.
6. Modify the following grid line properties, while leaving the remaining properties at their default values:
   - **X Spacing**: 0.002
   - **Y Spacing**: 0.002
   - **Text Font Size**: 72
   - **Geographic Format**: Degrees

- **Geographic Precision**: 2
- **Grid Thickness**: 2

The image should look similar to the following figure:

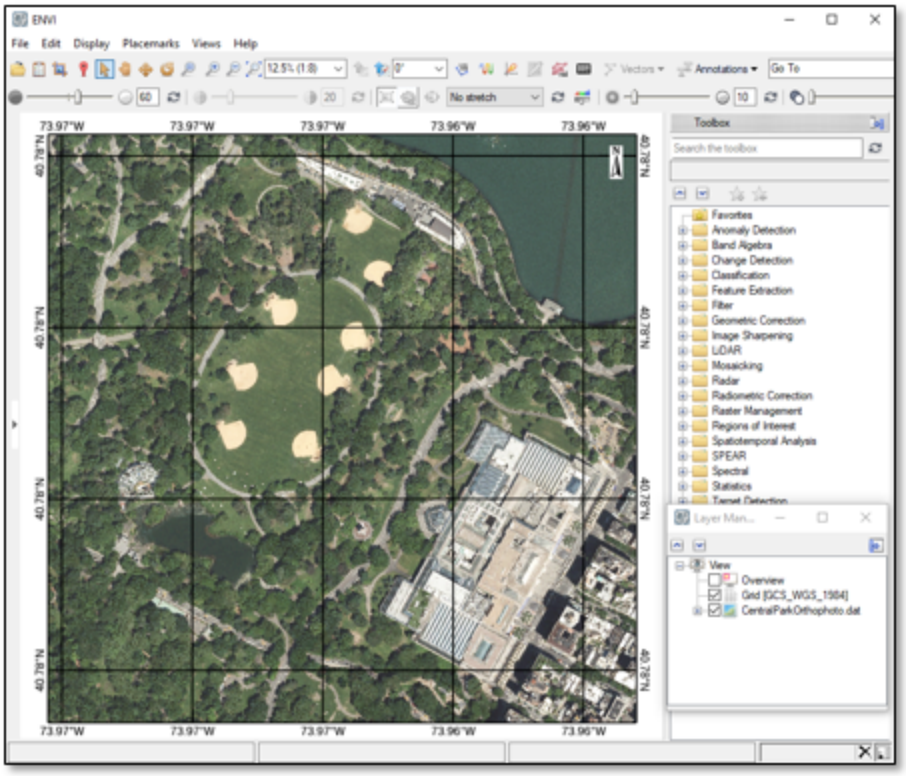
Update the North Arrow Symbol

1. From the menu bar, select **File > Preferences**.
2. Click **North Arrow** in the list of items on the left side of the Preferences dialog.
3. Click in the white space next to **Symbol**, then click the small arrow that appears.
4. Select any of the north arrow symbols that are available and click **OK**.
5. Click **OK** in the Preferences dialog.

Create a Screen Capture of the View

In the following steps you will create a screen capture (also called a *chip*) of the contents of the view. The options under **File > Chip View to** will preserve any display enhancements such as brightness, stretch type, etc. It also captures any annotations that are visible in the view.

1. With the zoom percentage still at 12.5%, resize the ENVI application so that the image and grid lines fill up the view and no white space is left; for example:



2. From the menu bar, select **File > Chip View to > File**. The Chip to File Parameters dialog appears.
3. From the **Output Format** drop-down list, select **JPEG**.
4. Select an output filename and location for the screen capture.
5. Disable the **Display result** option.
6. Click **OK**.
7. Open the new JPEG file in a separate image or photo viewing application to verify that it looks good.
8. Optionally experiment with chipping the view to **PowerPoint**, **Geospatial PDF**, and/or **Google Earth**.

The **Chip View to** options are best used for taking a quick snapshot of the contents of a view; for example, to send via e-mail or to embed in a PowerPoint presentation. However, these are not ideal options when creating publication-ready images, posters, or PDF files. In these cases, you will likely want to create an output image that preserves the original resolution of the input image. You will learn how to do this next.

Export a Full-Resolution View to an Image File

The **Export View to > Image File** menu option exports the contents of a view, or the entire dataset extent, to an RGB 24-bit image file in ENVI or TIFF format. It preserves any annotations and image enhancements you add; however, it does not preserve the north arrow.

1. Maximize the ENVI application so that it fills the screen. Or, click and drag the lower-right corner of the application to resize it however you want.
2. Click the **Grid** layer in the Layer Manager to select it.
3. Change the **Text Font Size** property to **18**. Properties are displayed beneath the ENVI Toolbox.
4. Change the **Grid Thickness** property to **1**.
5. Select the **CentralParkOrthophoto.dat** layer in the Layer Manager.
6. Press the **F11** key on your keyboard to zoom to full resolution. You do not have to pan to any particular location.
7. Click the **Zoom** drop-down list in the toolbar and select **Use Map Scale**. The map scale should be 1:613.
8. From the menu bar, select **File > Export View to > Image File**. The Export View to Image File dialog appears.
9. Click the **Full** radio button for **Output Extent**. You will export the full extent of the dataset to an image file.
10. In the **Map Scale** field, enter a denominator value of **613**.
11. Leave the **Pixel Size** and **Zoom Factor** fields at their default values (0.5 and 1.0).
12. From the **Output Format** drop-down list, select **TIFF**.
13. Select an output filename and location for the full-resolution TIFF file.
14. Disable the **Display result** option.
15. Click **OK**.

16. Open the new TIFF file in a separate application to verify that it looks good. It should contain the entire dataset, including the grid lines. When viewed at 100% resolution, the grid line labels have a font size of 18 points.
17. Right-click on the **Grid** layer in the Layer Manager and select **Remove**.

Two similar options are also available:

- **File > Export View to > Geospatial PDF**: This option lets you control the print resolution and page size for PDF output.
- **File > Export Selected Layer to TIFF**: This option exports a single image layer displayed in the view to a TIFF file. It saves the entire image extent, including any enhancements (except for sharpening) at full resolution. No other layers are retained such as annotations or vectors.

Next you will learn more about data-processing tools in ENVI.

Process Data

At the heart of ENVI is a wide variety of analytics that process image data into information used for vegetation studies, land use monitoring, defense and intelligence, and other applications. Examples of analytics include change detection, feature extraction, and classification. All of the analytics are available from the Toolbox, located on the right side of the ENVI application. The ENVI Toolbox also contains tools used for image preprocessing, raster operations, geographic positioning, and mosaicking. Tools are organized by folder according to different applications.

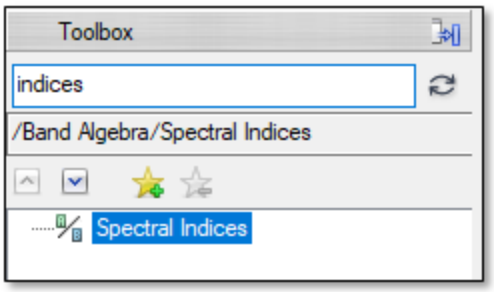
In this section you will run two different tools while learning about masks and regions of interest (ROIs).

Spectral Indices

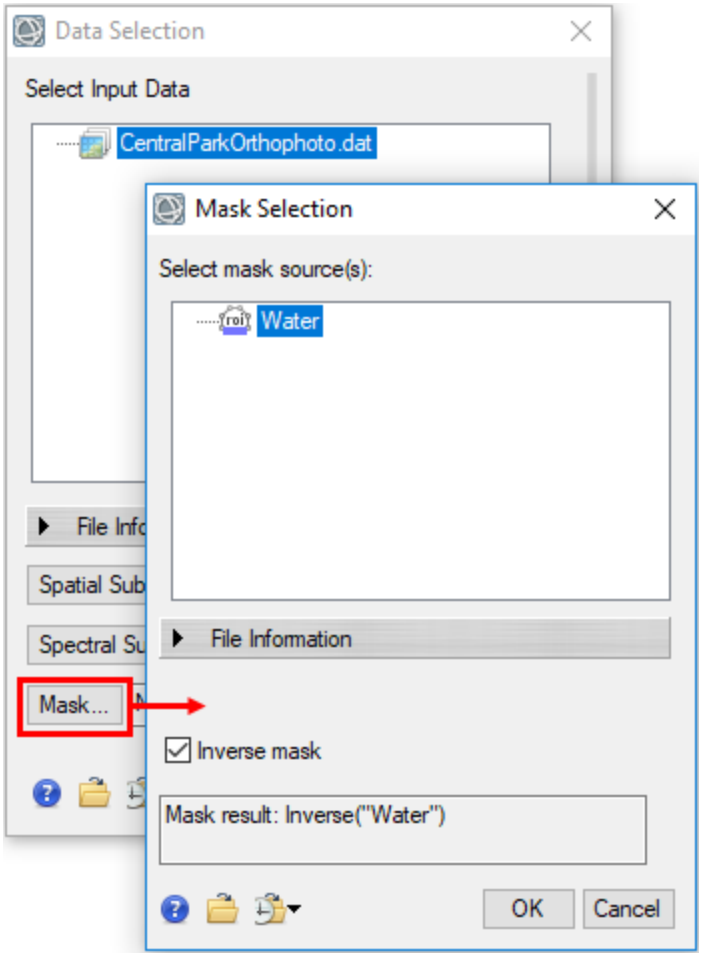
Spectral indices are combinations of spectral reflectance from two or more wavelengths that indicate the relative abundance of a feature of interest. Vegetation indices are the most common type such as the Normalized Difference Vegetation Index (NDVI). To ensure the most quantitatively accurate results, the input image used for spectral indices should be in units of reflectance and corrected for atmospheric effects. You do not need to perform those steps in this tutorial. However, we provide a region of interest (ROI) file that you can use to mask out water from the image, before creating spectral index images.

1. Press the **F12** key on your keyboard to zoom to the full extent of the orthophoto.
2. Click the **Open** button  in the toolbar.

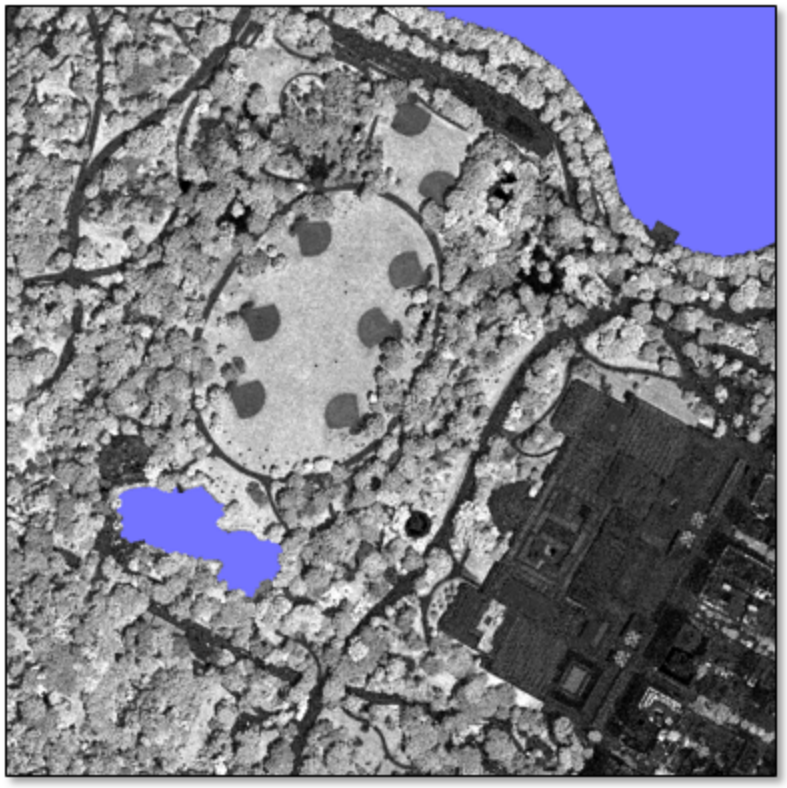
3. Navigate to the directory where you saved the tutorial data, and select `CentralParkWaterROI.xml`. Click **Open**. Colored polygons overlay the ponds in the orthophoto.
4. Type **indices** in the search window of the Toolbox.



5. Double-click **Spectral Indices**. The Data Selection dialog appears.
6. Click the **Mask** button.
7. Select the **Water** ROI.
8. Enable the **Inverse mask** option.



9. Click **OK** in the Mask Selection dialog, then again in the Data Selection dialog.
10. In the Spectral Indices dialog, select **Triangular Greenness Index**. This index (TGI) highlights vegetation greenness in an image with red, green, and blue bands. The TGI is highly correlated with leaf chlorophyll content.
11. Keep the default selection of **File** for Input Raster.
12. Choose an output directory for the file, and name it `CentralParkTGI.dat`.
13. Enable the **Display result** option.
14. Click **OK**. When processing is complete, the TGI image is displayed. Brighter pixels correspond to vegetation that has a light-green color in the orthophoto.

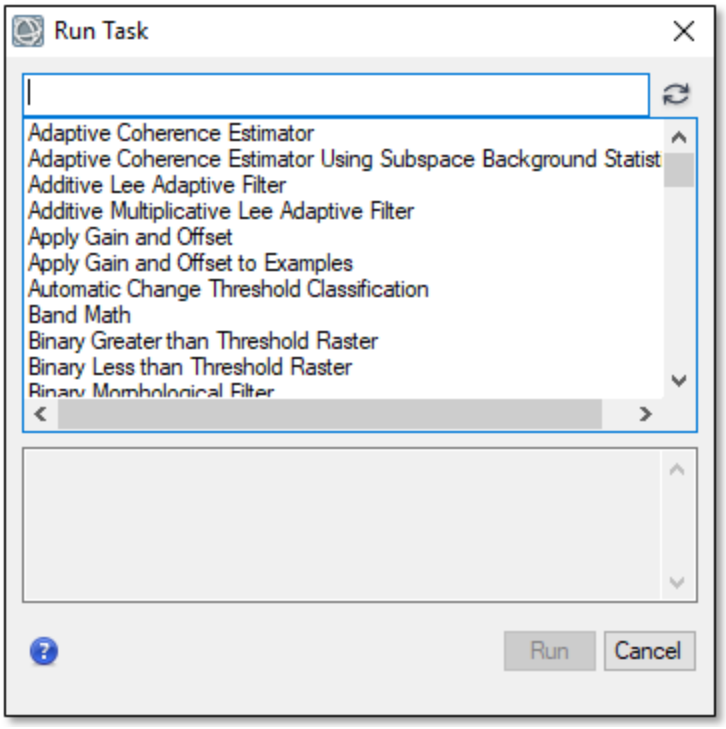


15. Toggle the **CentralParkTGI.dat** layer on and off in the Layer Manager, to compare it with the orthophoto.
16. Right-click on the **CentralParkTGI.dat** and **Regions of Interest** layers in the Layer Manager, and select **Remove**.
17. Click the **Clear Search** button in the Toolbox.

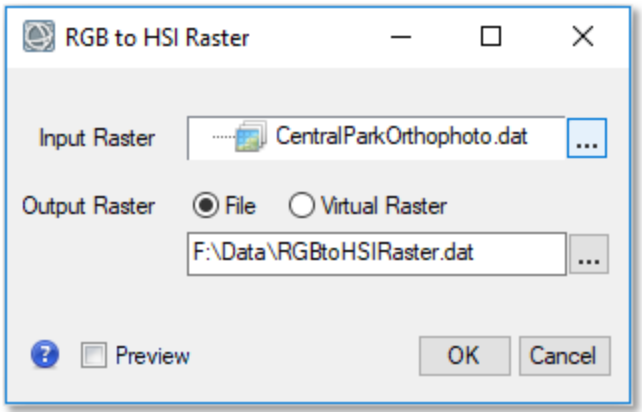
Run Tasks

The ENVI application programming interface (API) contains over 200 tools called ENVITasks that you can use in a programming script. Some ENVITasks are exposed as tools in the ENVI Toolbox; for example, Spectral Indices. Others are not, such as RGB to HSI Raster and Export to PNG. However, you can still run these unexposed tasks through the ENVI user interface using the **Run Task** tool. The following steps provide an example.

1. In the Toolbox, expand the **Task Processing** folder and double-click **Run Task**. The Run Task dialog appears.

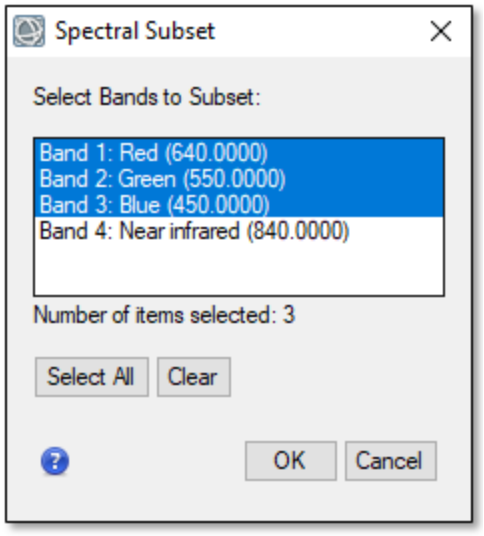


2. In the Run Task dialog, type **rgb** in the search field.
3. Select **RGB to HSI Raster**, and click **Run**. The RGB to HSI Raster dialog appears.

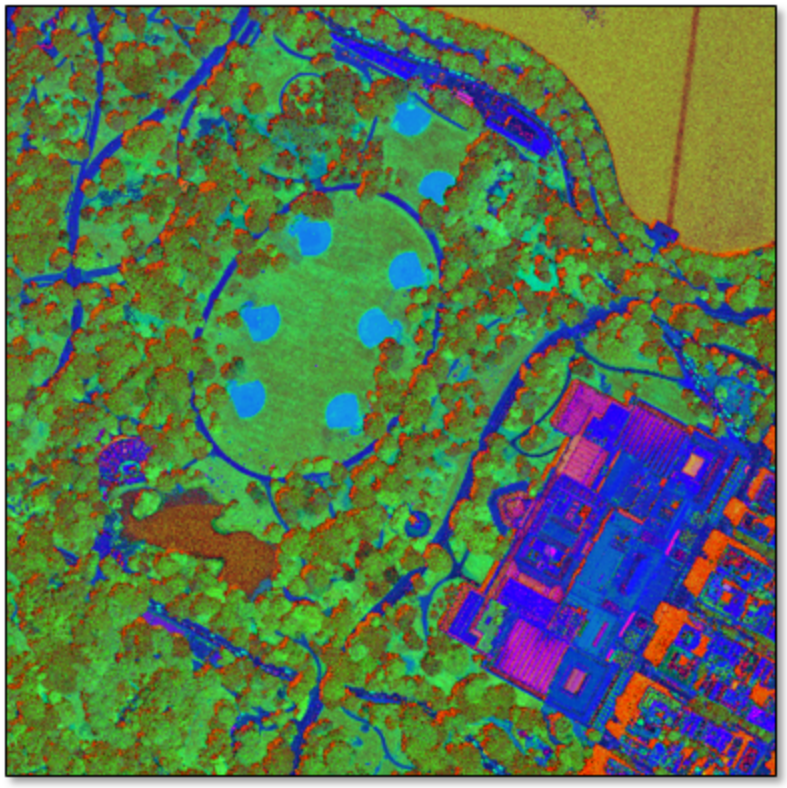


This task will create a new image that has been transformed from a red/green/blue (RGB) color space to a hue/saturation/intensity (HSI) color space. It requires an input image that only has three bands in the order of red, green, and blue. Since the orthophoto has four bands, you must define a spectral subset that only includes the first three bands.

4. Click the **Browse** button ... next to the **Input Raster** field. The Data Selection dialog appears.
5. Click the **Spectral Subset** button. The Spectral Subset dialog appears.
6. Click **Band 1: Red**, then press the **Shift** key on your keyboard and select **Band 3: Blue**. Bands 1-3 are now selected.



7. Click **OK** in the Spectral Subset dialog, followed by **OK** in the Data Selection dialog.
8. Click the **Virtual Raster** radio button next to **Output Raster**, to write the output image to memory instead of disk.
9. Click **OK** in the RGB to HSI Raster dialog to run the task. The new HSI image appears in the view.



This concludes the tutorial. Close ENVI by selecting **File > Exit** from the menu bar.

Learn More

As you continue to explore ENVI, here are some resources to help you:

- ENVI supports imagery from many different sensors as well as vector formats. For a full list of data formats, see the *Supported Data Types* topic in ENVI Help.
- You can export images to different formats using the **File > Save As** menu. This only saves the raster data, regardless of the contents of the view.
- See the *Visual Programming with the ENVI Modeler* topic in ENVI Help to learn how to create powerful workflows in ENVI, including batch processing and running analytics in different environments.
- See the *ENVI API Programming* in ENVI Help to learn how to write programming scripts that use ENVI+IDL functionality.

- See the Tutorials topic in ENVI Help for more exercises on using ENVI in different applications.