

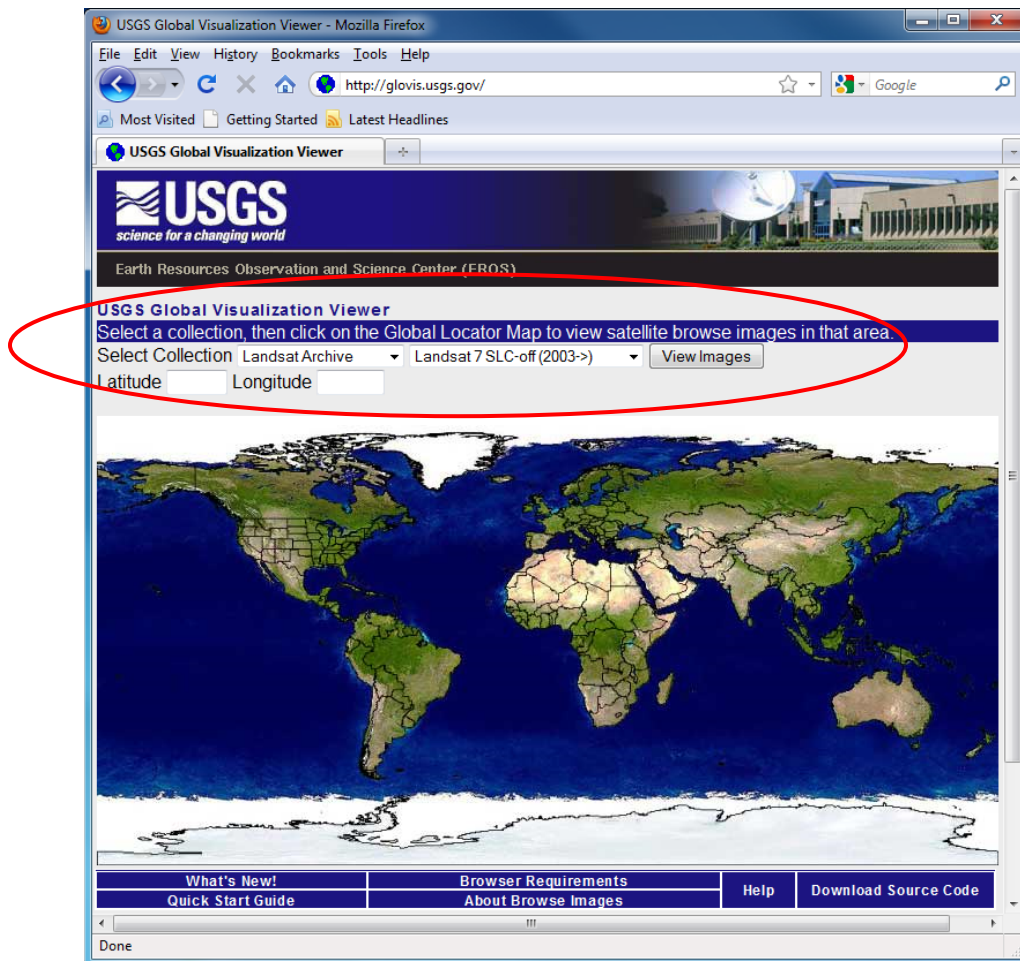
ACQUIRING AND IMPORTING LANDSAT DATA

These instructions are for acquiring new Landsat data from the U.S. Geological Survey (USGS) and importing/viewing it using ERDAS IMAGINE and ArcGIS software. We will retrieve images from the online database called GloVis. Additionally, instructions for retrieving images from another online database called WIST are included.

New versions of images from past years are also available for order at no cost. For information about the data formats, see http://landsat.usgs.gov/products_productinformation.php and http://landsat.usgs.gov/Landsat_Processing_Details.php.

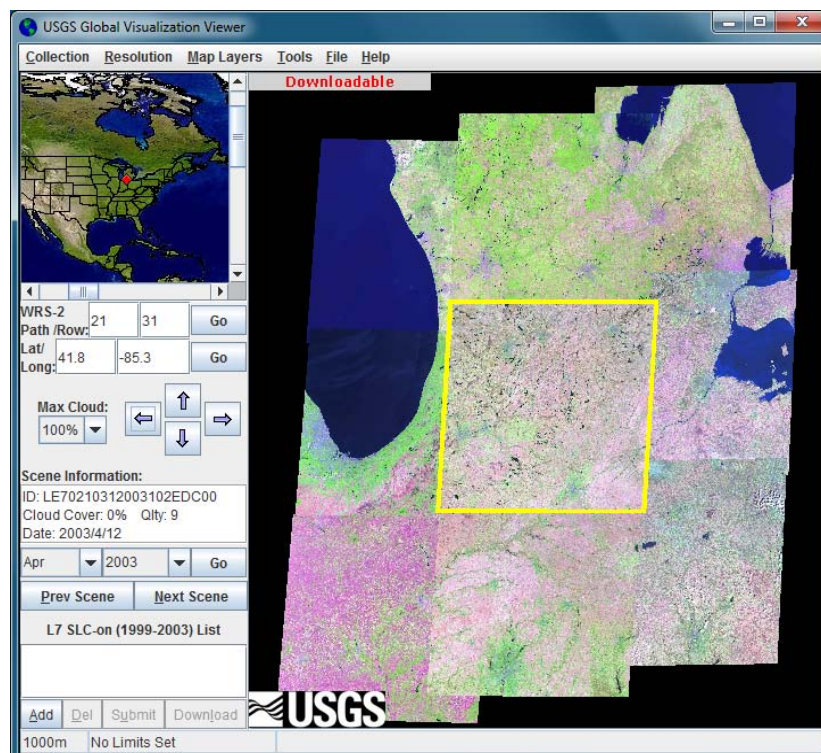
Method 1: Using GloVis to Locate and Download Landsat Scenes

- Go to <http://glovis.usgs.gov/>
- From the dropdown menus above the map, choose **Landsat Archive** and the Landsat satellite from which you need images (see below).
- If you are searching for Landsat data between 1984-1999, and 2003-present, choose Landsat-5 TM; if you are looking for Landsat data 1999-April 2003, choose Landsat-7 ETM+ (Landsat-7 developed a problem after approximately April 2003).



- Click on your search area on the world map (or type in the coordinates if you know them).

To select the scene you want to download, a viewer will appear in a separate window (you must have your browser's pop-up blocker disabled). It will show a group of images around the point you chose on the world map. Use the arrows to the left of the images to find the precise area you are looking for (you can also type in the precise coordinates or Landsat path and row if you know them). To better orient yourself, you can choose **Map Layers** from the menu at the top of the window and select to view Cities, Roads, or other layers overlaid on the scenes. Once you find your correct path/row and image, you can use the **Prev Scene** and **Next Scene** buttons to find images of a particular year and month (this is helpful for finding a cloud-free image). You can also use the arrow buttons (or keyboard arrows) to move to the scenes in the path/row adjacent to the highlighted scene.



- Highlight the desired image by clicking on it, and then click **Add** in the lower left corner of the viewer (you may have to enlarge the window to see all buttons).
 - Some newer images are available for immediate download; click **Download** and select **Yes** to confirm the download. You will have to create a username and password (or sign in to your account) in order to download data. Return to the page where you registered or signed on, and a **Data Download** window appears. Click **Start Download**.
 - If your image is not available for immediate download, click **Submit**. You will have to create a username and password (or sign in to your account) in order to download data. A **Shopping Basket** window appears; click **Checkout** and then

Continue, Submit Order (the order is free). USGS will process the request and send a link to your e-mail address from which you can download the image.

Method 2: Using WIST to Locate and Download Landsat Scenes

Open the NASA WIST website at <https://wist.echo.nasa.gov/wist-bin/api/ims.cgi?mode=MAINSRCH&JS=1> and create an account. Sign in on the Login Form and then select the **Search** tab in the upper left of your web browser.

- In the **Choose Keywords for One or More Categories** box, make sure the **By Discipline** option is selected at the bottom of the box and pick a discipline/topic from the five available discipline choices (Atmosphere, Cryosphere, Land, Oceans, and Solar/Other). For this exercise, choose **Landsat 1-5 or Landsat 7**. In the window above the discipline menu, scroll down the list of available Landsat data sets products and find your desired data set.
- In the **Choose a Data Search Type** box, make sure the **Primary Data Search** option is selected.
- In the **Choose Search Area** box, click and drag your cursor to rotate the Earth to your area of interest or enter the lat/long coordinates in the boxes on the right side of the page (zoom in as needed). Make sure the **Orthographic** option is selected.
- In the **Choose a Date/Time Range** box, make sure the **Standard Date Range** option is selected and enter your dates of interests in the proper format (or leave blank).
- Click the **Start Search** button.

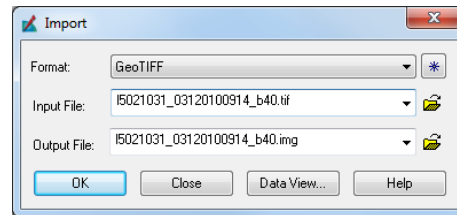
A **Granule List** will be populated with all of the images that fall within your search parameters (i.e. area and dates of interest). Select your desired images. Click the **Add selections to cart** button in the top left corner. A **Data Quality Summary** appears; continue to the Shopping Cart. You will be asked to select your ordering options. Click the **Go to Step 2: Order Form** button to proceed. Verify **Your Contact Address** information. Scroll down toward the bottom of the page and click **Go to Step 3: Review Order Summary Before Submitting Order** or **Submit Order** (Landsat data is free of charge).

Your order will be delivered as a link within an email (takes anywhere from a few minutes up to 3 business days). When you receive the email, scroll toward the bottom and click on the link below the line that reads **Ftp Pull Download Links: OR** you can download the ZIP file version by clicking on the lower of the two links. Save the files and/or unzip them to your working directory.

Importing Landsat Data into ERDAS IMAGINE (into .img format)

Images acquired from GloVis are downloaded as zipped TAR files (.tar). They will unzip as TIFF files (actually GeoTIFF files although the extension is .tif), which IMAGINE can read. You must unzip them first into your desired location before importing them into IMAGINE.

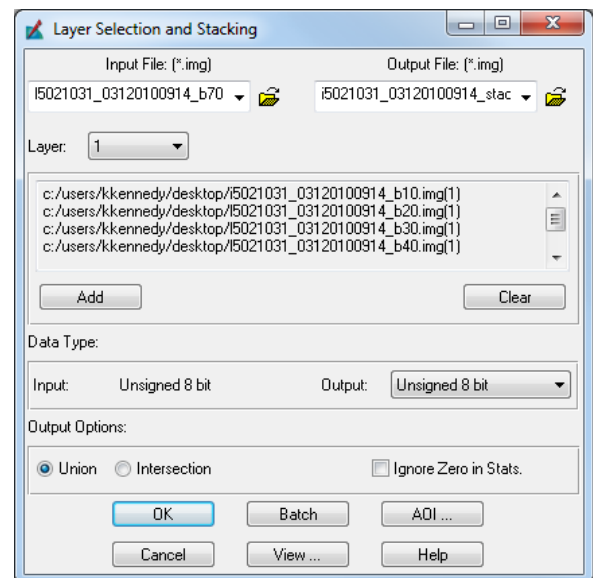
- Start a new session of **ERDAS IMAGINE 2010**.
- On the **Manage Data** tab, click the **Import Data** button.
- In the **Import** window that appears, select **GeoTIFF** from the **Format** drop-down list. Then you'll navigate to the first .tif of the unzipped input file. Then, although IMAGINE will fill in the output file for you, unfortunately it doesn't know to navigate to the right folder. So you'll have to navigate to the right output folder and retype the name. It can be same name as the input file, but IMAGINE will now attach its .img extension. Hit **OK** when ready to go to next screen.



Import specifications will appear in a new window. Click **OK**, since you do not need to add any new information. IMAGINE will import your image and create a copy in the .img format (IMAGINE does not automatically open imported files – they will appear in the folder you indicated). Click **OK** when the process is finished.

Each .tif file represents a different Landsat band (called layers in IMAGINE). You will need to separately import all seven .tifs corresponding to your image into IMAGINE, and then combine them to form a single stacked image. Only bands 1-5 and 7 (the visible and infrared bands) become part of the final stacked image, but import band 6 (the thermal band) into IMAGINE .img format as well.

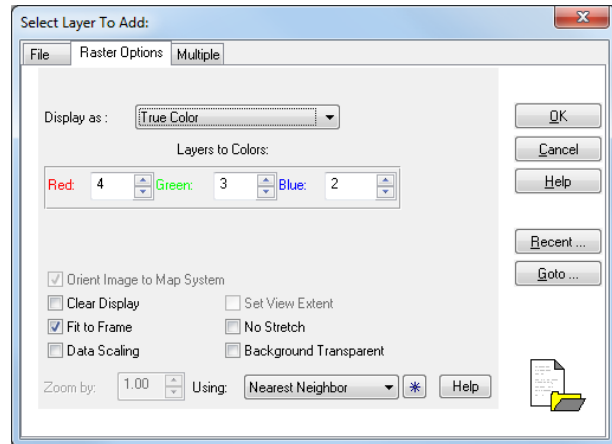
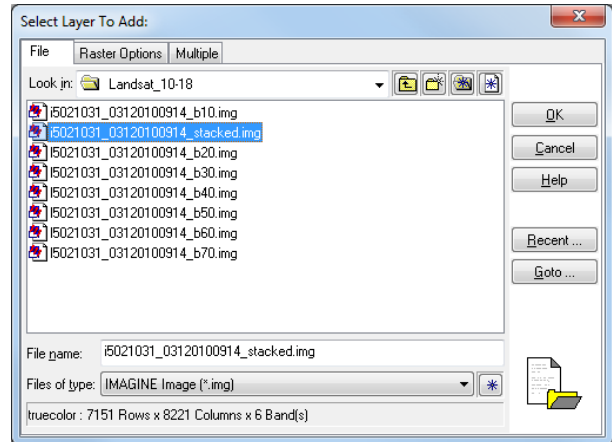
- When you are finished importing, on the **Raster** tab, click **Spectral | Layer Stack**.
- In the **Layer Selection and Stacking** window, navigate to your new .img files and select the first .img band (or layer), e.g. ... b1.img.
- Then create an output file name and navigate to the correct location. Make sure **Layer:** underneath the input file name, is set to **All**.
- Click **Add**. This will add the ...b1.img you opened above.
- Add each .img band/layer individually, and in exact numerical order (except do not add band 6). Do this by navigating to the next image, clicking "Add", etc. Click **OK**. When the process finishes running, click **Close**. Your stacked image will be in the location you indicated.



Viewing Your Landsat Scene & Properties in IMAGINE

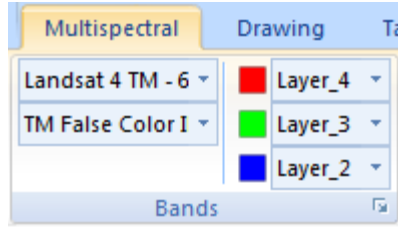
To view your new Landsat image, you must load it into IMAGINE. IMAGINE does not automatically display imported images.

- If you don't already have a View open, from the **Home** tab, click **Add Views | Create New 2D View**. Add raster data by right-clicking in 2D View #1 and selecting **Open Raster Layer..** The **Select Layer to Add** dialog box displays.
- Make sure that **Files of Type** is set to ***.img**. Navigate to your image.
- Before clicking **OK**, choose **Raster Options** at the top of the window. Here you can choose how to display the image. IMAGINE sets **Display as:** automatically to **True Color**. There are several other options, but True Color is most appropriate for multi-band raster images. For each band, pixels with higher reflectance have a higher digital number (DN; usually between 0-255 for 8-bit data) and are thus displayed with a brighter shade of color (e.g. bright red vs. dark red). Be aware, however, that the display True Color does not necessarily mean "natural" color (i.e. natural color meaning what our eyes would see when looking at a landscape).
- When you are ready to load your image, click **OK**. Right-click on the view and then choose **Fit to Frame** to see the entire image.



Now we will explore the **True Color** display method a bit further. There are three display colors (red, blue, and green; called RGB) which are referred to as the primary colors. All other colors can be created by mixing these colors. Our computer monitor uses three color guns (Red, Green and Blue or RGB) to display images. Each band in a multi-band image file like Landsat is simply a matrix of digital numbers — they don't have colors until displayed. This matrix is displayed on a monitor as a raster image comprised of X by Y individual pixels with each pixel represented by a DN. We can assign each of the three monitor color guns (RGB) to three Landsat image bands at a time and display a color composite image. Higher DNs will have brighter colors.

- On the **Multispectral** tab, go the **Bands** area. Here you can assign which Landsat bands (rightmost column) are displayed in which monitor colors (colored column to the left). Note that the default is monitor Red = Landsat Band 4 (Near Infrared reflected energy), monitor Green = Landsat Band 3 (Red reflected light), monitor Blue = Landsat Band 2 (Green reflected light).



- The most useful monitor color gun assignments are those that allow you to interpret an image (Landsat or other types) easily. The following are three widely used monitor color gun assignments for Landsat imagery (in RGB order):
 - Landsat ETM+, natural color – bands 3, 2, 1
 - Landsat ETM+, standard false color infrared – bands 4, 3, 2
 - Landsat ETM+, natural-like false color infrared - bands 6, 4, 2

Now, to view your image's properties:

- On the **Home** tab, click **Layer Info | View/Edit Image Metadata**.
- Examine the **ImageInfo** screen that comes up, including each of the four tabs. We will look at the **General** and **Projection** tabs further below.

General: The General tab displays some basic information about the layer you are viewing. The **File Info** field contains information about the file structure (file type, size of file, etc.). The **Layer Info** field contains information about the image. For example, by looking at the width (X dimension) and height (Y dimension) fields, you can tell that the image is a matrix of, for example, 470 x 546 pixels. The **Statistics Info** field contains information about the values (digital numbers or DNs) of the pixels in the image (the minimum/maximum pixel values in the image, etc.). The DNs are an indicator of how “reflective” the material on the surface of the Earth was over the area that the image represents. The **Map Info** field contains the UTM coordinates (see below) plus the size of the pixels (for example, if the pixels are 30m x 30m in size, then one Landsat pixel represents 900 m² of actual area on the Earth's surface). The **Projection Info** field describes what projection the image is in. See below for more information.



Projection: A projection is the method by which locations on the curved Earth are rendered onto a flat surface, such as a map. There are many types of projections (see the **Projection Type** field on the Projection tab). For example, in the **UTM** or **Universal Transverse Mercator** projection, the earth is divided into sixty vertical strips called zones, and the coordinate locations within these zones are measured east or west from

the central meridian of the zone and north or south of the Equator. A datum is a reference point from which longitude and latitude is measured.

If you are satisfied with the information in the **ImageInfo** window then you have likely successfully imported your new image.

Importing Landsat Data into ArcGIS

Images acquired from GloVis are downloaded as zipped TAR files (.tar). They will unzip as TIFF files (actually GeoTIFF files although the extension is .tif), which ArcGIS can read. You must unzip them first into your desired location before importing them into ArcMap.

- Start a new session of **ArcMap**.
- Click the **Add Data** button . You may first have to connect to your working folder in order to access its data. Select the **Connect to Folder** button  and navigate to your working folder that contains **Landsat data** by clicking the ▷ **symbols** to expand the folder tree. **Highlight** the folder where you plan to work (and which contains **Landsat data**) and click **OK**.
- Navigate to one of the .tif files in your Landsat data and click **Add**. ArcMap may ask if you would like to “create pyramids” for your raster data. Click **Yes** to build pyramids. Repeat the Add Data step to add all of your Landsat .tif file layers to the map.
- On the left side of your screen is the Table of Contents. The order in which the layers appear in the Table of Contents is the same as the order in which they appear in your map. If you click on a layer and drag and move it below another in the Table of Contents, it will also move below that layer in the map display. The check boxes next to the layers indicate which layers are active. If you uncheck one of the boxes, that layer will disappear from your map on the screen; you can re-check it to re-display it.
- Double-click on a layer name to bring up the “Layer Properties” dialog where you can change the Symbology of each layer to create the display format you desire.