Chapter 10b: Streaming and Displaying Landsat imagery

Remote Sensing in an ArcMap Environment

Image source: landsat.usgs.gov

Tammy Parece
James Campbell
John McGee

This workbook is available online as text (.pdf’s) and short video tutorials via:
http://www.virgniaview.net/education.html
The project described in this publication was supported by Grant Number G14AP00002 from the Department of the Interior, United States Geological Survey to AmericaView. Its contents are solely the responsibility of the authors; the views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of the U.S. Government. Mention of trade names or commercial products does not constitute their endorsement by the U.S. Government.
The instructional materials contained within these documents are copyrighted property of VirginiaView, its partners and other participating AmericaView consortium members. These materials may be reproduced and used by educators for instructional purposes. No permission is granted to use the materials for paid consulting or instruction where a fee is collected. Reproduction or translation of any part of this document beyond that permitted in Section 107 or 108 of the 1976 United States Copyright Act without the permission of the copyright owner(s) is unlawful.

Introduction to ESRI’s Landsat Community

The United States Geological Survey (USGS) has provided (and continues to provide) ESRI with the complete Landsat Archives. ESRI has processed many of the Landsat images for various purposes. You can find the complete list of processed images and descriptions at: http://www.arcgis.com/home/group.html?owner=esri&title=Landsat%20Community.

Examples of processed images are:

- **False Color/Near Infrared (432) 1975-2010**
  - This image's band combination (4 3 2) gives results similar to traditional color infrared aerial photography and is useful for vegetation studies, monitoring drainage, soil patterns, and various stages of crop growth.
  - Imagery by esri
  - Last Modified: February 26, 2014
  - ★★★★★ (3 ratings, 2 comments, 194,531 views)

- **Landsat 8 Layers**
  - This map features multiple image layers presenting different views of Landsat 8 imagery of the world. ArcGIS Online subscription required.
  - Web Map by esri
  - Last Modified: April 18, 2014
  - ★★★★★ (5 ratings, 0 comments, 13,247 views)

As you can see from the prior two figures, ESRI has provided brief descriptions of the processed images. ESRI updates these on a daily basis, as the USGS provides new Landsat data. In some instances, the existing image database is updated. In other instances a new image database may be generated. For instance, when the flooding in the Balkans occurred in late May 2014, ESRI processed a new database just for the purpose of showing the flooding and resultant changes.
Remote Sensing in an ArcMap Environment

10b. Streaming and Displaying Landsat Imagery

Accessing the ESRI Landsat Data

Underneath the Figure within each description, you have two options—Open and Details.

Clicking on Details provides a more comprehensive description of Landsat and processing.

These details also describe the level of ESRI access needed to use the data. There are two types of access, a personal ArcGIS On-Line Subscription and an organizational subscription. With either type of sign-on, you can view the data in ArcGIS On-Line or through the ESRI sign-in through ArcGIS desktop.

For example, (in the above figure and in the green box), an ESRI organizational subscription is required to access the Landsat 8 Layers images. Check with your organization to see if they have an account and to obtain a log in identification number and password. Please be sure to check with your organization on usage limitations (K-12 educational institutions, please see Page 20 of this tutorial for more information).
If your organization does not have an organizational subscription, you can get a 30 day trial of ArcGIS Online.

If you have decided which dataset you need, click Open (green circle) located underneath the image, it will take you to ArcGIS On-Line and ask that you sign-in. Once you sign-in, ArcGIS On-Line will be activated.

Accessing ESRI’s Landsat Imagery Dataset through ArcGIS Desktop

Open ArcMap.

First, you need to sign into ESRI with your organization account sign-in.

You get the ArcGIS Sign In window, enter both your Username and Password, then click SIGN IN (note: hitting enter won’t work, you have to actually use your mouse and click on it).
How do you know that you successfully signed in? Go back to File, you will now see it says Sign Out – Your-username.

Next, you must access the on-line services before you can add any personal layers to ArcMap. Click on File and then ArcGIS Online.

You get the following window:
In the search box, type *Landsat* and then click on the magnifying glass.

You may only see those maps that have been saved by your organization. To access maps that others outside of your organization have created, make sure that the box *Only search in...* is unchecked.

You will get all the results of map documents created by ESRI using Landsat imagery. There were over 1024 maps were available when this tutorial was completed (red circle).

That is a lot of maps to page through, so, let’s refine the search and change the search type to *Landsat8*. (If you have already identified the exact map – as identified in pages 1 and 2 of this tutorial -- use the exact name of the map in the search window, including spaces if any).
This time, we see only 34 results (red circle).

As seen in the above window, the window on page 5, and below, the same listing of maps are shown as we saw when we went straight to ESRI’s website (page 1). We can also get the details from this window. Look for the map titled *Landsat 8 Layers*. As you can see we have both *Details* and *Open* as options. Click on *Details*. You will see the same details as you did before (page 2).
Remote Sensing in an ArcMap Environment
10b. Streaming and Displaying Landsat Imagery

Now click on **Open**, here or here.

The on-line map document from ESRI will eventually open in your ArcMap window, just be patient. You may see the following in the upper status bar. Don’t worry, be patient.

Once the map document is ready to open, you may see the window on the right. Be sure to check with your IT Department before clicking yes on this window. For now, just click **No**.

The document will then open in ArcMap.
Examining an ESRI Landsat 8 Map Document

You have accessed Landsat 8 scenes for the entire world. It defaults to show Northern Africa. You can navigate to your own region of interest in one of two ways.

1. You can navigate by using the pan tool to go to the region.

2. Or, the better option is to add your personal shapefile for your region and then zoom in to the area. Yes, you can now add your personal shapefiles!
In the map document window, below, I have added the boundary file for the City of Roanoke, Virginia and then zoomed to the layer. I have altered the symbology for this polygon file so it is hollow with a cyan-colored border.

Now let’s take a closer look at the **Table of Contents** in the window on the left side of ArcMap.
You see the City of Roanoke, Virginia boundary layer on top since that is the last layer added.

For this particular ESRI Landsat 8 map document, it has several different layers. ESRI just did not create a map document with Landsat 8 images, they also have World Boundaries and Places (top of the Table of Contents) and an underlying Basemap (bottom of the Table of Contents).

Also included in the Landsat 8 Layers map document are several Landsat layers that have been processed by ESRI for certain properties. The first one is Normalized Difference Moisture Index Colorized, Then NDVI Colorized. (You can refer back to Tutorial 16 - Spectral Enhancement of Landsat Imagery – for specific uses on NDVI, Color Infrared, and other band ratios. Available from http://virginiaview.cnre.vt.edu/education.html#RSinArcGIS10

or from the Virginia Geospatial Technology YouTube channel.)

Remember the varying bands of Landsat do represent different regions of the electromagnetic spectrum, so please refer to earlier tutorials for more information. Landsat 8 has additional bands
not present on prior Landsat satellites, and for specifics on the varying bands of Landsat 8, you should consult the USGS website on specific uses for the different Landsat bands.


Not all of the layers in the Table of Contents are turned on. But you can turn on and off layers for display purposes. It is better not to have them all turned on at the same time. Remember you have a map document with images for the entire world, so it takes some time to load and unload.

Let’s look at one of these layers as an example.

Uncheck World Boundaries and Places in the Table of Contents, and check Normalized Difference Moisture Index Colorized (red box).

Your map display will now look like this (note again, this is for the Roanoke, Virginia area):

ESRI has already processed the Landsat scene for this layer. It is a band ratio called Normalized Difference Moisture Index (NDMI). The formula for this ratio will vary, depending on the specific satellite system, so you should consult specific literature and the satellite system website to determine which bands should be used to calculate this or any other band ratio.

You could download Landsat Imagery yourself directly from EarthExplorer (Tutorial 8 – Downloading Landsat Imagery from EarthExplorer) and process it using ArcMap’s Image
Analysis or Spatial Analyst tools to develop the same index, but ESRI has saved you time and provided you with the results.

Colorized means that ESRI chose a default color scheme for this display. In the *Table of Contents*, it does show RGB, but since ESRI has already processed these particular images, these, again, are strictly colorization in the three basic visible colors – red, green and blue. You can change the symbology, if you wish, for different color combinations. This does not change the results.

ESRI has also already processed some of the images for display as specific band combinations (as discussed in *Tutorial 12 – Specific Band Combinations Using Landsat Imagery*). As an example, on the right – ESRI has processed these map documents with only three specific Landsat bands as noted in the map’s title.

Please note that there is one ESRI Landsat Map document that allows us to create our own band combinations - we will discuss this in a subsequent section.

Each one of the layers in the *Table of Contents* also has an *attribute table* (example below).

The *attribute table* lists general Landsat metadata for each scene. Remember again, this map document has Landsat scenes for the entire world. (For more details on metadata, refer back to *Tutorial 9 - Information about your Downloaded Landsat Imagery.*)
In the very bottom right corner of your map document window, you will see an index card (red square). If you click on this card you will get a Service Layer Credits window for each of the layers that are turned on in your Table of Contents. This window provides you with a quick reference for the images’ source and processors.

Adding Multiple ESRI Landsat 8 Datasets to the Same Map Document

Sometimes, you can add multiple Landsat files to the same map document.

Go back to File/ArcGIS Online (page 4), pull up the search window and again search for Landsat 8. This time, look for Landsat 8 Views. When you have one Landsat file already open and active in ArcGIS Desktop (ArcMap), the search window returns results, but not all the results say Details and Open (red circle below for Landsat8 Services). Some of them will say Details and Add (green circle below for Landsat 8 Views).
If the words are Details and Open, then ArcMap will only allow that map document to be opened as a new map document. If you click Open, ArcMap will close the current map document and load the new one. If the words are Details and Add, ArcMap will add this as an additional layer to the current map document.

Click on Add under Landsat 8 Views. Again, be patient while it loads!
Your results will show that Landsat 8 Views has been added as the top raster layer in your Table of Contents.

The layer is checked, so it is turned on and will be the layer that shows in the map display window.

ESRI Landsat 8 Services

ESRI’s Map Document - Landsat 8 Services allows you to access Landsat 8 scenes with eight of the Landsat bands enabled to use in various displays and analysis. With this particular data set, you can display different band combinations of your choosing and even extract specific Landsat brightness values to vector point files.

As you can see from this data set, you cannot Add it to a current map document, you can only Open it as a new map document. Search for this in your ArcGIS Online search window and Open it. Remember, this will automatically open to show the region of Northern Africa, so you will again need to navigate to your area of interest. Next, add your boundary shapefile for your area of interest and zoom to this area. You will see the following in your map document window:
And the following Layers show in your Table of Contents. Again, the City of Roanoke, Virginia boundary file is displayed on top. The raster files related to the Landsat 8 images are listed in order by ESRI. For more information on the specifics of the Landsat8_Panchromatic, PanSharpened, please visit the Landsat 8 website.

[Link to Landsat website]

The layer that allows us to display different band combinations with eight of the Landsat 8 bands is Landsat8_Analytic (red box). This raster layer also shows it is displayed in red, green, and blue, but for this layer, you can choose which bands are actually displayed in the map document window.

Uncheck all of the other layers (except your boundary layer) and check Landsat8_Analytic.
Your Map Document window will look like:

The above image is displaying Band 1 as red, Band 2 as green, and Band 3 as blue. The visual qualities of the image are easily enhanced!

Change this combination, red to 4, green to 3, and blue to 2.
Your map document window may look like this (a natural color image, for Landsat 8, Band 4 is red visible, Band 3 is green visible, and Band 2 is blue visible – see http://landsat.usgs.gov/band_designations_landsat_satellites.php):

If you don’t remember how to create band combinations – see Tutorial 12 – Creating Band Combinations from Landsat Imagery (http://www.virginiaview.net/education.html).

Does your image look different than the image above? You may need to change the resolution settings – radiometric, spatial and spectral. See Tutorials 14, 15 and 16 on radiometric, spatial and spectral enhancement of Landsat Imagery.

With the Landsat8 Analytic layer, you can work with the Image Analysis window in ArcMap, just as you would if you were working with Landsat images you downloaded directly from EarthExplorer. You can subset the image, you can make composite images, you can do land cover/land use classifications. You can also connect to the Virginia Geographic Information Network (VGIN) servers (or other GIS Servers) to access additional layers to add to your ESRI Landsat map document (Tutorial 3 – Connecting to a Drive or Server in ArcMap). For access to all the tutorials on using Landsat Imagery in an ArcGIS 10.X environment, go to:

http://virginiaview.cnre.vt.edu/education.html#RSinArcGIS10
Additional Landsat Map Document Details

So now you have accessed multiple layers or map documents from ESRI’s Landsat Database. If you forget the details on any particular document that you have opened or added to your desktop application, you do not need to go back to ArcGIS Online or the ESRI website to get some details. These details are contained within your map document. Go to File/Map Document Properties.

You will then see the window below, which gives you summary details you saw on pages 2 and 7.
Additional source information can be found in the individual layer properties window. Just right click on any layer name and click on the Properties tab.

You will get the Layer Properties window, below, which provides additional source credits.
Saving an ESRI Landsat 8 Map Document

Once you have finished with an ESRI map document, you can name it and save it to your organization’s map files, but if you have not made any specific additions (i.e., added your own personal files), saving may not be necessary. Again, please be sure to check with your organization’s usage details before saving any map documents to ESRI’s online services.

Additional Help for using ArcMap or ArcGIS On-Line

ESRI has many tutorials on-line, written and video on using different services and tools within ArcGIS on-line and ArcGIS Desktop.

ArcGIS online Help can be accessed:


The video tutorials can be accessed at this link:

http://training.esri.com/gateway/index.cfm?fa=seminars.recordedSeminars&WT.mc_id=EmailCampaigna34705

For written and video VirginiaView Tutorials on Image Analysis within an ArcGIS 10.X Environment:

http://virginiaview.cnre.vt.edu/education.html#RSinArcGIS10

---

i Any K-12 institution in the United States is eligible for a free ArcGIS Online for Organizations Account via Esri’s ConnectEd initiative. For more information about this program, go here (http://connected.esri.com).