Lesson 2. Basic image preprocessing
In which we learn:
- How to composite using the composite band tool
- How to represent composite images
- All about band combinations
- How to composite using raster functions
- How to subset data into a rectangle
- How to clip to a polygon

How to composite using the composite band tool

1. Activate the **Analysis** tab on the context ribbon and choose the red **Tool** icon to open the **Geoprocessing** pane.

2. Type the word *Composite* into the *Find Tools* box. The **Composite Bands** tool will likely appear at the top. Click on the tool to open it.

3. In the Composite Bands Geoprocessing Tool, for the ***Input Rasters*** parameter you can select the layers in the Landsat 8 Operational Land Imager group layer one by one OR you can navigate to the subfolder on disk to add the same 7 files at once. Make certain that the bands are ordered consecutively from band 1 to band 7 in the tool. You can use tools to reorder the files or layers in the list box. Consistency is important here because ArcGIS Pro will not retain band metadata.

4. The ***Output Raster*** parameter will be automatically populated with the base name **LC08_CU_012017_20190125_20191** and placed in the project geodatabase **C:\EO_SRS_ArcGISPro\ArcPro_RS_2019\ArcPro_RS_2019.gdb\.** Replace the end of the suggested file name after the underscore character (*20191*) with *b1234567*.

5. Click the **Run** button. The tool output will appear in the **Contents** pain and on the map. Bands 1, 2 and 3 will be automatically assigned to the Red, Green and Blue channels of your computer screen.

How to represent raster layer files

6. In the **Contents** pane, click on the layer named **LC08_CU_012017_20190125_ b1234567** to highlight it. Notice how a section above the context ribbon changes to burnt orange and is labeled Raster Layer. Click on the **Appearance** tab **under Raster Layer**. Notice the icons in the Rendering group: **Symbology**, **Stretch Type**, **DRA**, **Resample Ty**pe, **Band Combination**, and **Masking**. Click on the **Symbology** icon to open the **Symbology** pane.
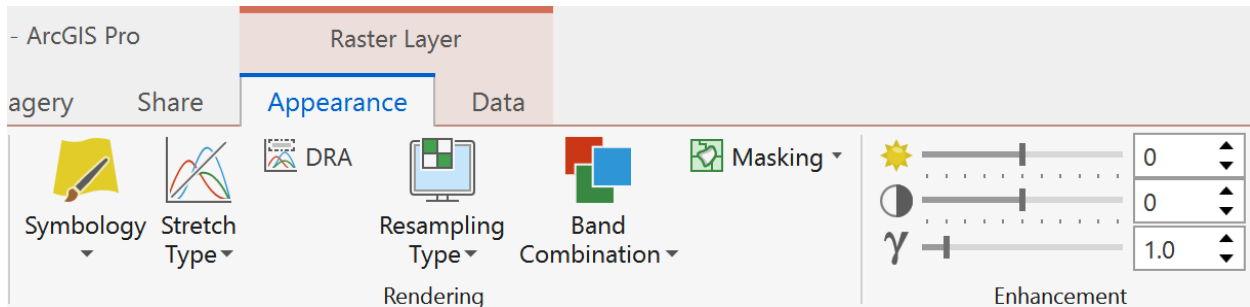
7. Your Landsat OLI data layer primary symbology will likely be set to RGB. Red, Green and Blue will be set to the layers shown in the Contents pane, although you can change them here. **Reassign Red to Band 4, Green to Band 3, and Blue to Band 2.** The default stretch type is Percent Clip with the Min and Max clipping amounts both set to 0.500. In many cases, this is a good starting point for color balancing.

8. Next, click on the **Stretch Type** icon pull down in the ribbon. Select *Standard Deviations* and watch the image re-render. Then change the stretch to *Histogram Equalize*. Next, change the stretch to *Minimum Maximum*. The image representation darkens. Finally, change the **Stretch Type** to one of your preference.

All about band combinations

9. Click on the **Band Combination** icon. The *Natural Color* and *Color Infrared* options were not designed for Landsat and other moderate resolution satellite datasets. Your instructor has already created two custom combinations: *Landsat 8 OLI Natural Color* and *Landsat OLI VNIR.* Choose each one in turn from the **Band Combination** options and notice the difference in image appearance.

10. Click on *Custom* to open the **Custom Band Combination** window and add the following options:
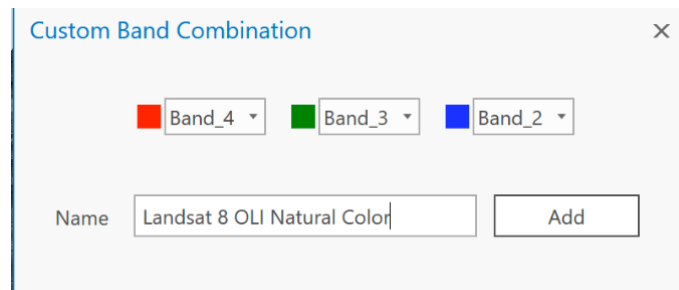
    - *OLI SWIR NIR Green* = R -> Band 7, G -> Band 5, B -> Band 3
    - *OLI SWIR + NIR* = 1 = R -> Band 7, G -> Band 6, B -> Band 5

11. Apply the new band combinations to your composite dataset and admire. To best represent multiband satellite images, it is important to understand a product's spectral band components. Keep track of band order while compositing. Best practice is to update or add metadata about band order as part of your process.

How to composite using raster functions

12. Next we will create a virtual raster layer of the Landsat 7 ETM+ data using the **Composite Bands** raster function. First, open the **Raster Functions Pane** by choosing the **Analysis** tab on the ribbon, and clicking on the **Raster Functions** icon in the **Raster** group at the right side of the ribbon.

13. Start typing *Composite Bands* in the *Find Raster Functions* search window.

14. Click on the *Composite Bands* icon to open the function window in the pane. Notice that the **Parameters** tab is highlighted and underlined in blue. Choose **LE07_*** map layers one by one using the pulldown arrow at the right of the *Rasters* box. Alternatively, you can use the Folders option to add rasters from disk. Don't create the new layer yet!

15. Now activate *General* tab, which is left of the **Parameters** tab in the pane. With the **General** tab active,

    - type in the name **L7 ETM+** and the description **All 30m bands 1,2,3,4,5,7**. A fuller description would include the source file name, the band order, a date and place name.

    - The *Output Pixel Type* is shown as unknown. In most cases, the raster function will correctly select the proper output pixel type – bit depth and sign, so you can leave as is. If you are curious, you can check the **Properties** (Source -> Raster Information) of one of the LE07 single bands in the **Contents** pane. Verify that *Pixel Depth* is 16 Bit. Note below that the *NoData Value* is-9999. Consequently, choose **16 Bit Signed** for *Output Pixel Type*.

16. Click the **Create new layer** button. Check the **Properties** (Source -> Band Metadata) of the new layer output in the **Contents** pane. In the case of Landsat ARD GeoTIFFs and Sentinel 2 JPEG 2000 files, Band Metadata will show the order and sources of input data used in the composite.

    - **WARNING**! The output of Raster Functions resides in your project file, not as an independent file on disk. Once you delete a layer from your map, that representation is gone. You can export to raster if you need to save an independent raster file.

How to subset data into a rectangle (raster function)

17. Expand or reopen the **Raster Functions** pane (see Step 12) if not already open. If the *Composite Bands* function is shown, click on the left pointing arrow to return to the *Search* view.

18. Type *Clip* in the *Find Raster Functions* search window.

19. Click on the *Clip* icon to open the function window in the pane.

20. This time, switch to the **General** tab and type in the name **Big Bend ETM+**. Switch back to the **Parameters** tab.

21. In the *Raster* box, pull down to replace <RasterFunctionVariable: Raster> with the new **L7 ETM+** layer.

22. Leave *Clipping Type* as *Outside*.

23. For *Clipping Geometry / Raster*, leave as *<Active-Map-View-Extent>*. You can adjust the map view to exclude parts of the source raster that you don't want to keep. Click on the map icon button at lower right of *Output Extent* numbers to capture or recapture the current map extents. Note that as you choose different clipping geometry feature classes or raster grids, the *Output Extent* adjusts. You can also manually type in map coordinates.

24. Click the **Create new layer** button to run the function.

How to clip to a polygon (Raster Clip geoprocessing tool)

25. If the Geoprocessing pan is not already available in the side bar, activate the **Analysis** tab on the context ribbon and choose the red **Tool** icon to open the **Geoprocessing** pane.

26. Type the word *Clip Raster* into the *Find Tools* box. The **Clip Raster** tool will likely appear at the top after you type *clip r*. Be sure to select the correct tool. The **Clip** and **Clip Layer** tools are for features, not raster files. Click on the **Clip Raster** tool to open it.

27. In the **Parameters** tab:
    - For *Input Raster*, choose **LC08_CU_012017_20190125_ b1234567**.
    - For *Output Extent*, choose the feature class **BigBend_NP_AEA**. This feature class should be the first option in the pull down list, if the **Contents** pane drawing order has not changed. The *Rectangle* coordinates will update.
    - Check the box next to **Use Input Features for Clipping Geometry**.
    - For *Output Raster Dataset*, change the file name to **BigBend_OLI**. In ArcGIS Pro, this parameter is prepopulated to write a file geodatabase raster to the project default geodatabase. We will accept this option. If you prefer to write to a different raster format, redirect the output to a folder, and add the appropriate file extension.
    - For *NoData Value*, change the value from **32767** to **-9999**. We do this to maintain consistency with the input product NoData value. If you forget and leave 32767, no harm is done.
    - Do not check *Maintain Clipping Extent* in order to preserve the input raster's cell alignment.

28. Click the **Run** button to execute. The resulting raster is written to disk and added to the **Contents** pane. Activate the **Appearance** tab and choose one of your custom **Band Combinations** to admire your output.