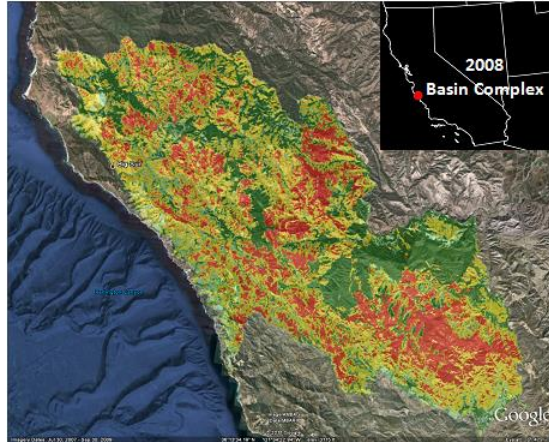


Exercise 2: Editing the BARC

Updated March 2018



Software Required

- ArcGIS 10.x

Required Data

For these exercises we will use BARC data from the **2008 Basin Complex** on the Los Padres National Forest in California. We also have field data collected by the BAER team which we will use to modify the BARC.

- CA3617912157820080621_20080801_I5_refl_utm.tif (postfire TM image)
- CA3617912157820080621_20050708_20080801_dnbr_bar4_utm.tif (BARC4)
- CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif (BARC256)
- basincomplex_perim_utm.shp (fire perimeter)
- basincomplex_GPS_utm.shp (soil burn severity field data collected by the BAER team)
- basincomplex_fielddedits_utm.shp (soil burn severity field data collected by the BAER team)

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Part 1: Load Data and Set up your ArcGIS Workspace and Raster Analysis Environment

Please make sure that the training data has been saved to your local machine. For consistency, create a folder called **BAER_workshop** on your C drive and put it in **C:\Temp**.

Let's get started by opening ArcMap and loading up the relevant data layers. Then we will set up your ArcGIS Workspace and Raster Analysis Environment. Doing this allows you to automatically save your data to the desired directory and maintain consistency in your output layers.

A. Start ArcMap

1. Start ArcMap by clicking on the Start button and navigating to **All Programs | ArcGIS | ArcMap**.
2. If prompted with a dialog box asking whether you would like to open an existing map or a new map using a template, choose to open a new empty map by clicking **Cancel**.

B. Add the Data

1. Click on the **Add Data** button and navigate to C:\Temp\BAER_Workshop\Training_Data:



Add Data button

NOTE: All of the exercises and data for this class should be downloaded and unzipped to C:\Temp\BAER_Workshop

- Add CA3617912157820080621_20050708_20080801_dnbr_barcode256_utm.tif.
 - Add CA3617912157820080621_20050708_20080801_dnbr_barcode4_utm.tif.
 - Add basincomplex_perim_utm.shp.
 - Add the pre and post-fire satellite imagery (CA3617912157820080621_20050708_I5_refl_utm.tif, CA3617912157820080621_20080801_I5_refl_utm.tif)
2. You can select multiple files simultaneously by holding down the **Control** key (**Ctrl**) while clicking on each file.
 3. If you are unable to find these data files you may need to connect to the Training Data folder in ArcMap.
 - Click the Connect to Folder button.
 - Navigate to C:\Temp\BAER_Workshop\Training_Data
 - Click **OK**. Now select the data sets from step 1.

C. Enable the Spatial Analyst Extension

1. If necessary, enable the **Spatial Analyst** extension:
 - Click **Customize | Extensions...** from ArcMap's main menu.
 - Place a checkmark next to **Spatial Analyst** listed in the **Extensions** dialog.
 - Click Close to dismiss the **Extensions** dialog.

D. Set up your ArcGIS Workspace and Raster Analysis Environment

1. Click **Geoprocessing | Environments...** from the ArcMap's main menu.
2. From the **Environment Settings** window expand **Workspace**.
3. Set the **Current Workspace** and **Scratch Workspace** to your **Outputs** folder (C:\Temp\BAER_Workshop).
4. Scroll down and expand **Raster Analysis**.
5. Set the **Cell Size** to "Same as layer \CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif".
6. Set the **Mask** to **basincomplex_perim_utm**.
7. Click **OK** to close the **Environment Settings** window.
8. Save your ArcMap project as **BAER_training.mxd** in the BAER workshop folder.



Note: Always set up your raster analysis environment before proceeding with any raster spatial analysis!

Part 2: Compare the BARC with your Burned Area Observations

Now you are ready to proceed. First, let's compare the BARC4 and the BARC256 with our field observation data to decide if we need to do any editing at all. You can view the BARC data along with the pre and post-fire imagery as well, to help interpret the burned area.

A. Symbolize your layers

1. Make **basincomplex_perim_utm** hollow by clicking on the symbol (color) under this layer in the **Table of Contents**. Choose **Hollow** from the Symbol Selector, select **Black** as your Outline Color and **2** for the Outline Width. Click **OK** to close.
2. Right-click **CA3617912157820080621_20050708_20080801_dnbr_bar4_utm.tif** and select **Properties...** from the context menu.
3. Select the **Symbology** tab in the **Layer Properties** dialog and select **Unique Values** in the **Show** window.
4. Select the **NODATA** class (usually a value of zero) in the main symbology window and click **Remove Values**.
5. Select the data classes 5-255 in the same symbology window from the previous step and click **Remove Values** as well.
6. Notice the BARC4 only has four classes and should be color-coded as follows:
 - Value 1 = Unburned/Very Low (**Fir Green**)
 - Value 2 = Low (**Tourmaline Green**)
 - Value 3 = Moderate (**Solar Yellow**)
 - Value 4 = High (**Mars Red**)

7. Click **Apply** to apply the symbology change and then click **OK** to close the Layer Properties dialog.
8. Right click the **CA3617912157820080621_20050708_20080801_dnbr_bar4_utm.tif** layer and **Save As Layer File** in your outputs folder. Make sure the file saves to your output folder and keep the default name. This step will allow you to import this symbology on subsequent steps.
9. The **CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif** layer should already be symbolized similarly to the BARC4.

B. Add and symbolize field observations data

1. Click on the **Add Data** button.
 - Add **basincomplex_GPS_utm.shp**.
2. Right click **basincomplex_GPS_utm.shp** and select **Properties...** from the pop-up menu.
3. Select the **Symbology** tab in the **Layer Properties** dialog. Then select **Categories** and **Unique Values** in the **Show** column.
4. In the **Value Field** select **Soil_BS** from the drop-down menu.
5. Click the **Add All Values** button in the **Symbology** tab
6. Right-click the line **Unburned/Very Low** select **Properties for Selected Symbol(s)...** from the drop-down menu.
7. Symbolize each of the points with colors to match the four Burn Severity classes used in the BARC. Try the Circle 2 or Circle 3 symbol (see graphic below). You may want to reduce the size of the circles slightly as well.
8. Click **Apply** and **OK** in the **Layer Properties** dialog when finished symbolizing **basincomplex_GPS_utm.shp**.



C. Visually compare the BARC and the field data points

1. Using the **BARC256** layer, visually inspect the locations where the GPS points fall.
 - i. Zoom in and pan around where your GPS points are located to get a feel for how the BARC and the field observations compare to one another.
 - ii. Be sure to zoom in closer than 1:5000 so you can see the BARC256 values; this will help you develop a sense of where the break points are.

D. Extract BARC values to the field data points

1. In order to more accurately investigate the relationship of the BARC data to the field data points, let's extract the BARC values to those same points.
2. Open the **Extract Multi Values to Points** tool, either by searching for it, or opening it from the **Spatial Analyst/Extraction** toolset.
3. For the Input point features, use the **basincomplex_GPS_utm** layer and for the raster layer, use **CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif**.
4. Change the **Output field name** to '**BARC256**'.
5. Click **OK**. The values will be added as a new field to the GPS data points.

Part 3: Adjust the BARC256 if necessary

The **BARC256** has up to 256 classes that are grouped into the four colors we see in the BARC4. The actual reflectance values are still in 256 classes. It is the breakpoints between colors that you can adjust to refine the BARC for your burned area. In this exercise, we will adjust the breakpoints to represent **Soil Burn Severity** based on GPS observation points.

A. Adjust the BARC 256 to match field observations

1. Right-click **CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif** and select **Properties** from the pop-up menu.
2. Select the **Symbology** tab in the **Layer Properties** dialog. Then select **Unique Values** in the **Show** column.
3. Using the **<Value>** column, find the **existing** breakpoints between classes and **write them down**. They should be close to the following:
 - 0-75 = unburned/very low.
 - 76-109 = low.
 - 110-187 = moderate.
 - 188-255 = high.
4. The **basincomplex_GPS_utm.shp** layer contains field-collected soil burn severity based on the BAER team's observations. It also now has the extracted BARC256 values at those points. Open the **Attribute table** and sort the **BARC256** field. Now look at the **Soil_BS** field and compare the two.
 - What do the extracted values indicate? How should the BARC256 thresholds be adjusted?
 - If the field observations indicate that the BARC is showing higher severity (red) than there actually is on the ground, try adjusting the colors to better represent the field data. Look for natural areas in the distribution of the values that can act as thresholds or cut-offs for the different burn severity classes.
5. To change the symbol color, expand the full symbology of the BARC256 layer and right click on the value that you want to adjust. You can then select the color from the pop-up window. Alternatively, you can double click on the BARC256 layer to bring up the properties window. Select **'Symbology'** and then **'Unique Values'**. From this window you can select multiple values to symbolize.
6. Modify the colors to best match the given field data points and based on the extracted values. Do one class at a time.
 - **In most cases, it will not be a perfect fit with all the GPS points**, so the goal is to match as many as possible for the best possible fit based on the data.



Why can't I just adjust the BARC4? The BARC4 cannot be edited since the dnbr values have already been classified into four classes. As a result, we have to use the BARC256 to make any adjustments. Sometimes the BARC4 is ready to go as-is, without any further editing. This is more common in densely forested ecosystems since the ground fuels in such areas are sufficient that if the canopy is consumed and black sticks remain, usually the Soil Burn Severity is high as well.

Part 4: Reclassify the adjusted BARC 256

Once you are satisfied with your new breakpoints in the BARC256 we need to create a new product that will represent the final soil burn severity of the fire.

A. Reclassify the adjusted BARC256 to a four-class Soil Burn Severity

1. After you've made sufficient adjustments, **write down the new breakpoint values** (where the colors change). These breakpoints will vary with each fire and whether you are mapping Soil or Vegetation Burn Severity. Your specific breakpoints might be different based on how you adjusted the color classes in the BARC256. Example breakpoints for this fire might be:
 - 0-107 = Unburned/Very low (**Fir Green**).
 - 108-141 = Low (**Tourmaline Green**).
 - 142-219 = Moderate (**Solar Yellow**).
 - 220-255 = High (**Mars Red**).
2. Open **ArcToolbox** and expand the **Spatial Analyst Tools | Reclass** toolset.
3. Open the **Reclassify** tool.
4. Set the **Input Raster** to **CA3617912157820080621_20050708_20080801_dnbr_bar256_utm.tif**.
5. Set the **Reclass Field** to **Value**.
6. Click the **Classify** button.
7. Set the Number of **Classes** to **4**. If this option is grayed out, set the method to **Equal Interval**.
8. Change the **Break Values** to the BARC breakpoints you determined. Start with the number at the top of the list, and replace it with your new highest value for unburned/very low (Fir Green). Go to the next number down in the **Break Values** list, and replace it with your highest value for low (Tourmaline Green), then the next with the highest value for moderate (Solar Yellow), and the last number with your highest value for high (Mars Red). 255 should always be the highest value.
9. Click **OK** in the **Classification** dialog.
10. Set the **Output Raster** to **basin_sbs_temp.tif** and click **Save**. We are calling this temp because we know we have more editing to do and we will replace this layer at a later stage.
11. Be sure to add the **'.tif'** extension to make the output a TIFF.
12. Click **Save** on the Output Raster dialog.
13. Place a **checkmark** next to **Change missing values to NoData** in the **Reclassify** dialog (you may need to scroll down a bit).
14. Click **OK** in the **Reclassify** dialog to reclassify your BARC.

15. Before proceeding to the next step, **symbolize** your new SBS layer with the standard color scheme and make sure that the reclass worked successfully. You should now see **better alignment** between the GPS field points and the SBS layer.



The above steps produce a new 4-class raster with your adjustments that represents Soil Burn Severity. The new grid is also clipped to your fire perimeter (which is done automatically because we have the analysis mask set to our fire perimeter).

Part 5: Convert from Raster to Feature

Now that you have a field-validated SBS product you'll likely need to use this layer for additional GIS analysis. In our case, we also need to perform some vector editing as well, so we will now convert the raster layer into a vector layer (shapefile).

A. Convert the updated burn severity raster to a polygon shapefile

1. Open **ArcToolbox** and expand the **Conversion Tools | From Raster** toolset.
2. Open the **Raster to Polygon** tool.
3. Set the **Input raster** to **basin_bs1.tif**.
4. Set the **Field** to **Value**.
5. Set the **Output polygon features** to **basin_SBS_poly_temp.shp** and click **Save**.
6. **Uncheck** the **Simplify polygons** box.
7. Click **OK** to perform the conversion (the new layer is automatically added to your map).
8. Right click on the new layer and go to **Properties** in the pop-up.
9. Select the **Symbology** tab in the **Layer Properties** dialog. Then select **Categories** and **Unique Values** in the **Show** column.
10. In the **Value Field** drop down select '**GRIDCODE**'.
11. Right-click on the symbol in the list and choose **Properties for All Symbols...** For the **Outline Color** choose '**No Color.**' Click **OK**. This step removes the border lines between severity classes.
12. Click the **Add All Values** button and adjust the colors to reflect the 4 severity classes.
13. Click **OK** to close the **Properties** window

Part 6: Add Vector edits from the field

You now have a Soil Burn Severity Layer in vector (shapefile) format but there are additional edits that need to be made. The BAER team also mapped some larger (non-point) areas in the field and you have a polygon data layer of them. Let's go ahead and add those to our SBS shapefile.

A. Add the field edits to your ArcMap document and integrate them into your updated SBS.

1. Add the **basincomplex_fieldedits_utm.shp** shapefile to your ArcMap document.

- This file represents some field mapping done by BAER team members throughout the burn area that need to be patched in to your burn severity layer. This time we'll do our edits in a vector environment.
2. From the **Geoprocessing** tab, select the **Union** tool.
 - Select the **Input Features** to union (you can drag these into the tool): **basin_SBS_poly_temp.shp** and **basincomplex_fieldedits_utm.shp**.
 - Make sure the **basin_SBS_poly_temp.shp** is on top of the list. The top layer determines the projection of the output. Use the arrows on the right to change the layer order if necessary
 - Set the **Output Feature Class** to **basin_SBS_field_union.shp** and click **Save**
 3. Click **OK** to perform the Union.

B. Update the attribute fields to reflect the appropriate severity

1. Open the attribute table of **basin_SBS_field_union.shp** and examine it. You have a **GRIDCODE** field with all the original burn severity calls. You also have a **Soil_BS** field with data that carried over from the **basincomplex_fieldedits.shp**.
2. Update the **GRIDCODE** field to properly reflect the field edits. You can do this in several ways. One is with the **Select by Attributes** tool.
 - In the attribute table, click the **Select by Attributes** button (if text exists in the bottom pane of the **Select by Attributes** window click **Clear** at the bottom).
 - Double-click "**Soil_BS**" from the top window.
 - Single-click the '=' button and click on the **Get Unique Values** button.
 - Double-click '**Unburned/Very low**' value from the middle window.
 - Your expression in the bottom window should read "**Soil_BS**" = '**Unburned/Very low**'.
 - Click **Apply**, now all of the features that have an '**Unburned/Very low**' designation should be selected.
 - In the attribute table, right click on **GRIDCODE** and choose "**Field Calculator**".
 - Click **Yes** if you are prompted to acknowledge you are working outside and edit session.
 - Enter **1** into the window below **GRIDCODE =** and click **OK**.
 - Now, all of your Unburned/Very Low severity values have the appropriate associated GRIDCODE of **1**.
3. Repeat the steps above for 2 above for the '**Low**' attribute, but give it a **GRIDCODE =** value of **2**.
4. This process just overwrote the **GRIDCODE** value from **basin_SBS_field_union.shp** with the severity calls in **basincomplex_fieldedits.shp**. The **GRIDCODE** field is now your master burn severity field.
5. Next, update the **Soil_BS** field using the same steps above, so that it contains the correct soil burn severity category ('**unburned / very low**', '**low**', '**moderate**', '**high**').
 - Use **Select by Attributes** to select for "**GRIDCODE**" = 1 and then use the field calculator to set **Soil_BS** to "**unburned / very low**".
 - Do the same for "**GRIDCODE**" = 2 and "**low**", etc.

6. At this point, we can do some field management. Delete any unnecessary fields from the attribute table.
 - The fields you need to keep are: FID, Shape*, GRIDCODE, Notes_1, Method and Soil_BS.
 - Delete fields by right-clicking the field heading and choosing **Delete Field**.
7. Using the **Soil_BS** field, symbolize the Shapefile with the appropriate colors for the final burn severity layer.

C. Rename your final Soil Burn Severity Shapefile

1. To make the name of our shapefile meaningful to other users, let's rename it.
2. To rename files it is better to first remove the layer from your ArcMap document.
 - Right-click **basincomplex_bs_field_union.shp** in the ArcMap **Table of Contents** and choose **Remove**.
3. Open the **ArcCatalog** window and navigate to your **Outputs** folder.
4. Right click on **basin_sbs_field_union.shp** and choose **Rename**
5. Rename the file **basin_SoilBurnSeverity.shp**.

Part 7: Convert from Feature to Raster

Now that we have a final product, let's convert it to a raster. It's a good idea to be familiar with converting your data layers from feature to raster and vice versa.

A. Convert the final Soil Burn Severity layer to a Raster

1. Add **basin_SoilBurnSeverity.shp** to your ArcMap document.
2. Open **ArcToolbox** and expand the **Conversion Tools | To Raster** toolset
3. Open the **Feature to Raster** tool.
4. Set the **Input Features** to **basin_SoilBurnSeverity.shp**.
5. Set the **Value Field**: GRIDCODE.
6. Set the **Output Raster** to **basin_sbs.tif** (be sure to use the extension). Click **Save**.
7. Set the **Cellsize** to **30** (bottom field).
8. Click **OK** to perform the conversion.



The above steps produce a final 4-class raster with all of your field edits integrated that represents field-validated soil burn severity. This is the product that should be used in all analyses and also that will be shared with the public. It is therefore important that it gets submitted to GTAC for distribution.

Part 8: Create Metadata and Post SBS

Document your work by creating metadata and post the final soil burn severity for GTAC to host on a publicly available website.

A. Create Soil Burn Severity Metadata

1. Using Windows Explorer, navigate to the Training_Data folder (C:\Temp\BAER_Workshop\Training_Data)
2. Open the text file **Soil_Burn_Severity_metadata_template.txt** with a text editor.
3. Populate all of the fields to the best of your knowledge.
 - i. Provide the name of the fire and a short description of the product (make sure to include soil burn severity)
 - ii. Provide contact names
 - iii. Provide the updated SBS thresholds
 - iv. Indicate if systematic or manual edits, or both, were applied. Systematic edits refers to adjusting the threshold values for the entire fire. Manual edits refers to modifying portions of the SBS only, such as when we performed a union to incorporate the edits shapefile.
 - v. Provide a brief narrative describing how the thresholds were adjusted. Include info on how the data were collected, if possible (with a GPS, a phone, etc.).
 - vi. Add additional comments if desired. This might reference some caveats with the data such as “snow was present when the field work was completed”, or “limited areas were field validated due to inaccessible terrain.”
4. Post the Soil Burn Severity and metadata to the T-drive for GTAC to pick up:
 - T:\FS\NFS\WOEngineering\GMO-RSAC\RDAS\BAER_FINAL_SoilBurnSeverity
5. Let GTAC know you have posted the data by sending an email to: baerimagery@fs.fed.us or jepting@fs.fed.us

Congratulations! You have successfully completed this exercise.