lahmed_jupyter_exercise

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0.1 ## Week 3: Documentation with Jupyter Notebooks

Labeeb Ahmed

In [71]:
```
# import modules
import sys
import gdal
import numpy as np
import matplotlib.pyplot as plt
%matplotlib inline
import warnings
warnings.filterwarnings('ignore')

# check versions
sys.version # confirm running python 3.5.x
gdal.VersionInfo()
```

Out[71]:
```
'2020200'
```

RGBraster2array() function can read and convert raster images to numpy array

In [72]:
```
def RGBraster2array(RGB_geotif):
    """RGBraster2array reads in a NEON AOP geotif file and returns
    a numpy array, and header containing associated metadata with spatial information
    --------
    Parameters
        RGB_geotif -- full or relative path and name of reflectance hdf5 file
    --------
    Returns
    --------
    array:
        numpy array of geotif values
    metadata:
        dictionary containing the following metadata (all strings):
            array_rows
            array_cols
            bands
            driver
```

```
        projection
        geotransform
        pixelWidth
        pixelHeight
        extent
        noDataValue
        scaleFactor
--------
Example Execution:
--------
RGB_geotif = '2017_SERC_2_368000_4306000_image.tif'
RGBcam_array, RGBcam_metadata = RGBraster2array(RGB_geotif) """

metadata = {}
dataset = gdal.Open(RGB_geotif)
metadata['array_rows'] = dataset.RasterYSize
metadata['array_cols'] = dataset.RasterXSize
metadata['bands'] = dataset.RasterCount
metadata['driver'] = dataset.GetDriver().LongName
metadata['projection'] = dataset.GetProjection()
metadata['geotransform'] = dataset.GetGeoTransform()

mapinfo = dataset.GetGeoTransform()
metadata['pixelWidth'] = mapinfo[1]
metadata['pixelHeight'] = mapinfo[5]

metadata['ext_dict'] = {}
metadata['ext_dict']['xMin'] = mapinfo[0]
metadata['ext_dict']['xMax'] = mapinfo[0] + dataset.RasterXSize/mapinfo[1]
metadata['ext_dict']['yMin'] = mapinfo[3] + dataset.RasterYSize/mapinfo[5]
metadata['ext_dict']['yMax'] = mapinfo[3]

metadata['extent'] = (metadata['ext_dict']['xMin'],metadata['ext_dict']['xMax'],
                      metadata['ext_dict']['yMin'],metadata['ext_dict']['yMax'])

raster = dataset.GetRasterBand(1)
array_shape = raster.ReadAsArray(0,0,metadata['array_cols'],metadata['array_rows']
metadata['noDataValue'] = raster.GetNoDataValue()
metadata['scaleFactor'] = raster.GetScale()

array = np.zeros((array_shape[0],array_shape[1],dataset.RasterCount),'uint8') #pr
for i in range(1, dataset.RasterCount+1):
    band = dataset.GetRasterBand(i).ReadAsArray(0,0,metadata['array_cols'],metadat
    band[band==metadata['noDataValue']]=np.nan
    band = band/metadata['scaleFactor']
    array[...,i-1] = band

return array, metadata
```

0.1.1 Define RGB_geotif path and run RGBraster2array()

```
In [73]: RGB_geotif = 'C:/Users/CBPStaff/Neon_Data/2017_SERC_2_368000_4306000_image.tif'
         SERC_RGBcam_array, SERC_RGBcam_metadata = RGBraster2array(RGB_geotif)

         SERC_RGBcam_array.shape # print array dim
```

```
Out[73]: (10000, 10000, 3)
```

```
In [74]: print (sorted(SERC_RGBcam_metadata.keys())) #Print array metadata keys
```

```
['array_cols', 'array_rows', 'bands', 'driver', 'ext_dict', 'extent', 'geotransform', 'noDataVa
```

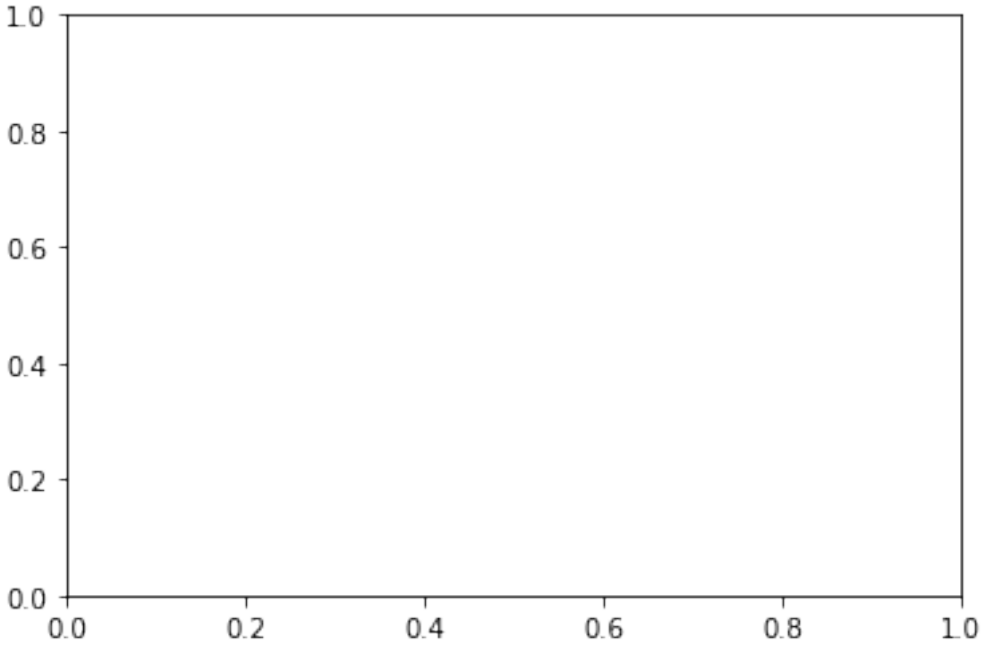
0.1.2 Plotting RGB Camera Image

Using plot_band_array(), we'll plot the array data

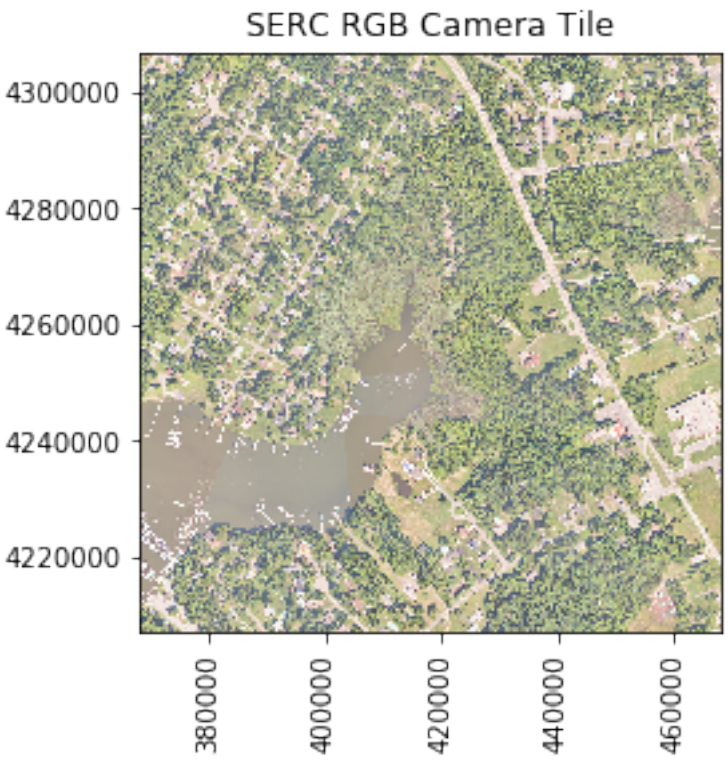
```
In [75]: def plot_band_array(band_array,
                            refl_extent,
                            colorlimit,
                            ax=plt.gca(),
                            title='',
                            cbar ='on',
                            cmap_title='',
                            colormap='spectral'):

             '''plot_band_array reads in and plots a single band or an rgb band combination of
             --------
             Parameters
             --------
                 band_array: flightline array of reflectance values, created from h5refl2array
                 refl_extent: extent of reflectance data to be plotted (xMin, xMax, yMin, yMax)
                 colorlimit: range of values to plot (min,max). Best to look at the histogram
                 ax: optional, default = current axis
                 title: string, optional; plot title
                 cmap_title: string, optional; colorbar title
                 colormap: string, optional; see https://matplotlib.org/examples/color/colorma
             --------
             Returns
                 plots array of single band or RGB if given a 3-band
             --------
             Example:
             --------
             plot_band_array(SERC_RGBcam_array,
                             SERC_RGBcam_metadata['extent'],
                             (1,255),
                             title='SERC RGB Camera Tile',
                             cbar='off')'''
```

```
    plot = plt.imshow(band_array,extent=refl_extent,clim=colorlimit);
    if cbar == 'on':
        cbar = plt.colorbar(plot,aspect=40); plt.set_cmap(colormap);
        cbar.set_label(cmap_title,rotation=90,labelpad=20)
    plt.title(title); ax = plt.gca();
    ax.ticklabel_format(useOffset=False, style='plain'); #do not use scientific notat
    rotatexlabels = plt.setp(ax.get_xticklabels(),rotation=90); #rotate x tick labels
```



In [78]:
```
# display the array
plot_band_array(SERC_RGBcam_array,
                SERC_RGBcam_metadata['extent'],
                (1,255),
                title='SERC RGB Camera Tile',
                cbar='off')
```

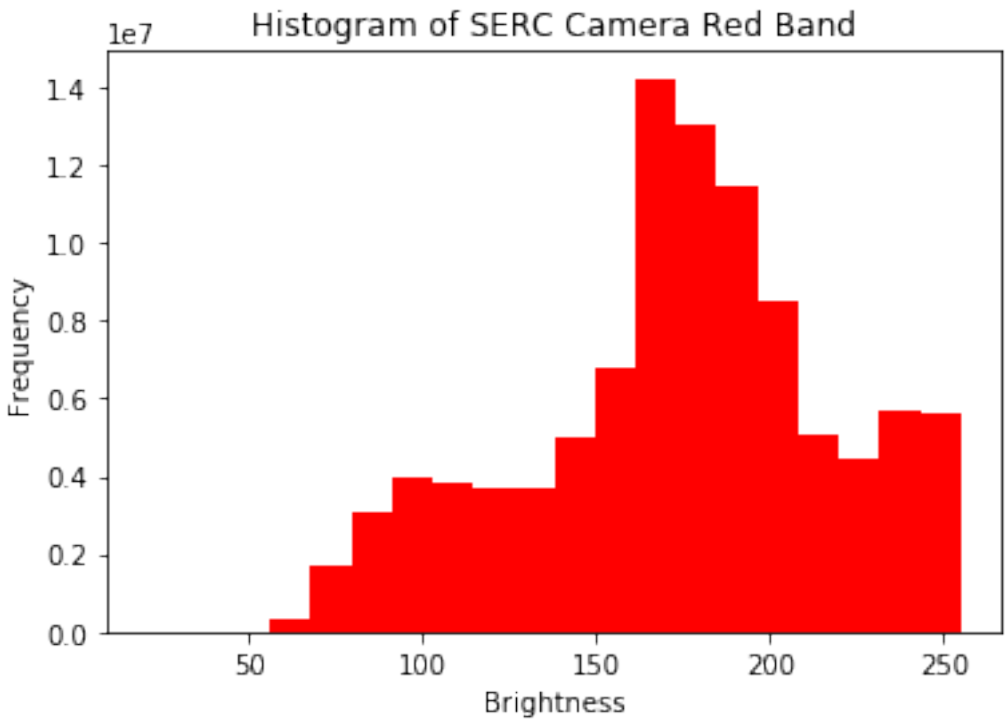


0.1.3 Plot histogram of red band

```
In [84]: # plot the histogram
         """ Note: [:,:,0] is band 1 or red,
                   [:,:,1] is band 2 or blue and etc"""

         plt.hist(np.ravel(SERC_RGBcam_array[:,:,0]), 20, color='red');
         plt.title('Histogram of SERC Camera Red Band')
         plt.xlabel('Brightness'); plt.ylabel('Frequency')

Out[84]: Text(0,0.5,'Frequency')
```

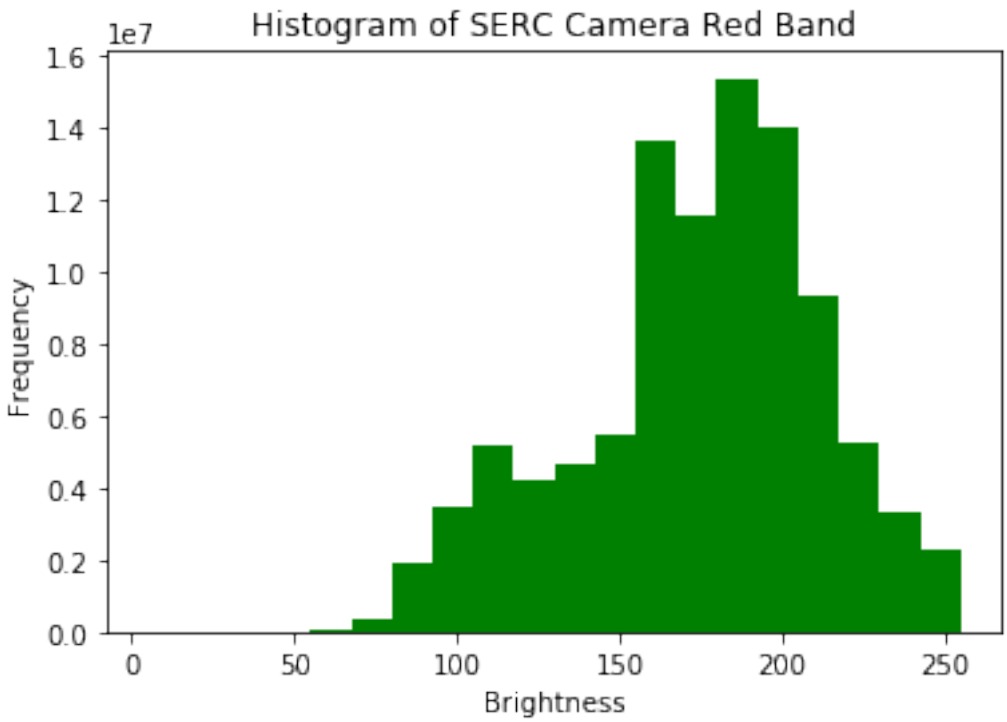


0.2 # Challenge Exercises

(1) Plot histograms of green and blue bands

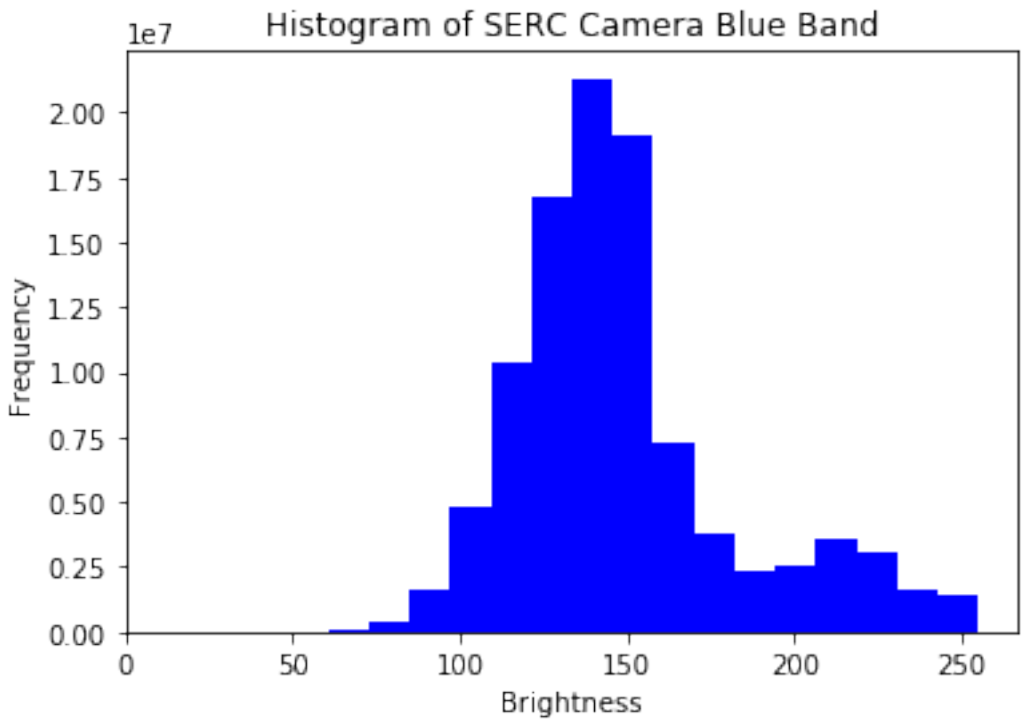
```
In [85]: # Plot green band
         plt.hist(np.ravel(SERC_RGBcam_array[:,:,1]), 20, color='green');
         plt.title('Histogram of SERC Camera Red Band')
         plt.xlabel('Brightness'); plt.ylabel('Frequency')

Out[85]: Text(0,0.5,'Frequency')
```




```
In [86]: # Plot blue band
         plt.hist(np.ravel(SERC_RGBcam_array[:,:,2]), 20, color='blue');
         plt.title('Histogram of SERC Camera Blue Band')
         plt.xlabel('Brightness'); plt.ylabel('Frequency')

Out[86]: Text(0,0.5,'Frequency')
```



(2) Data exploration

```
In [106]: # (a) get array min & max values
          def get_mn_mx(array, band):
              a = np.ravel(array[:,:,band])
              return np.amin(a), np.amax(a)

          for band in range(3):
              mn, mx = get_mn_mx(SERC_RGBcam_array, band)
              print ("Band #{}: min={}; max={}".format(band, mn, mx))

          # (b) raster projection
          SERC_RGBcam_metadata['projection']
```

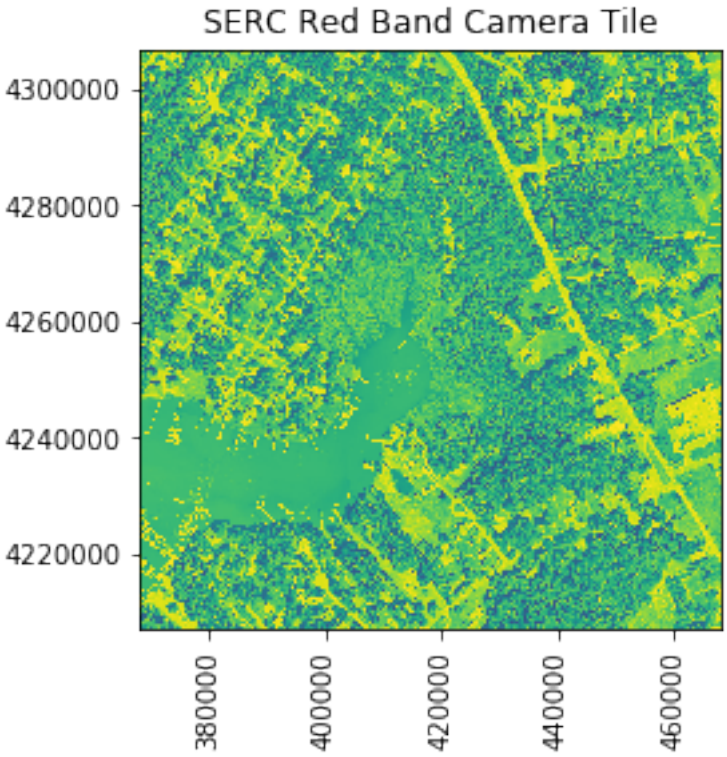
```
Band #0: min=21; max=255
Band #1: min=5; max=255
Band #2: min=12; max=255
```

```
Out[106]: 'PROJCS["WGS 84 / UTM zone 18N",GEOGCS["WGS 84",DATUM["WGS_1984",SPHEROID["WGS 84",63
```

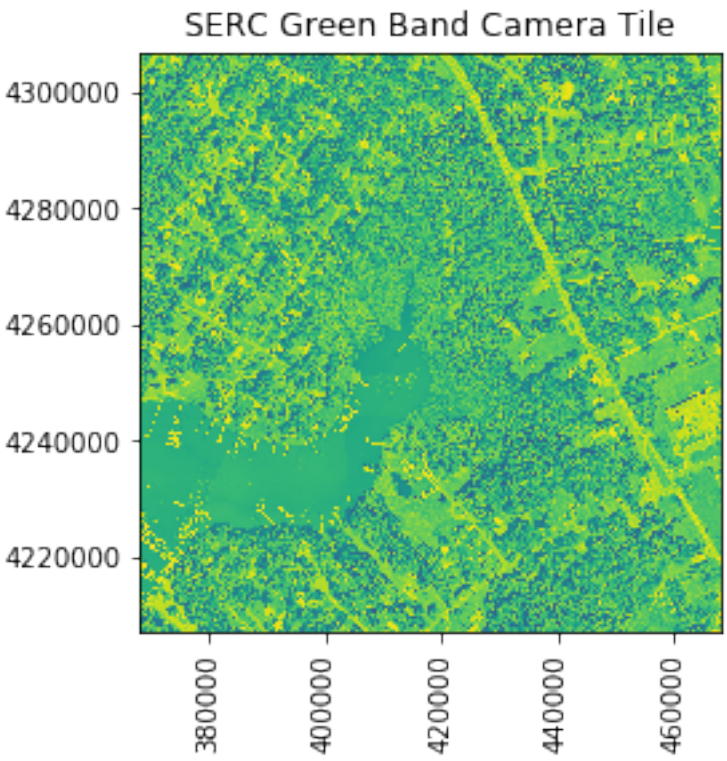
```
In [108]: # (c) plot_band_array to plot all three bands separately

          # Red band
```

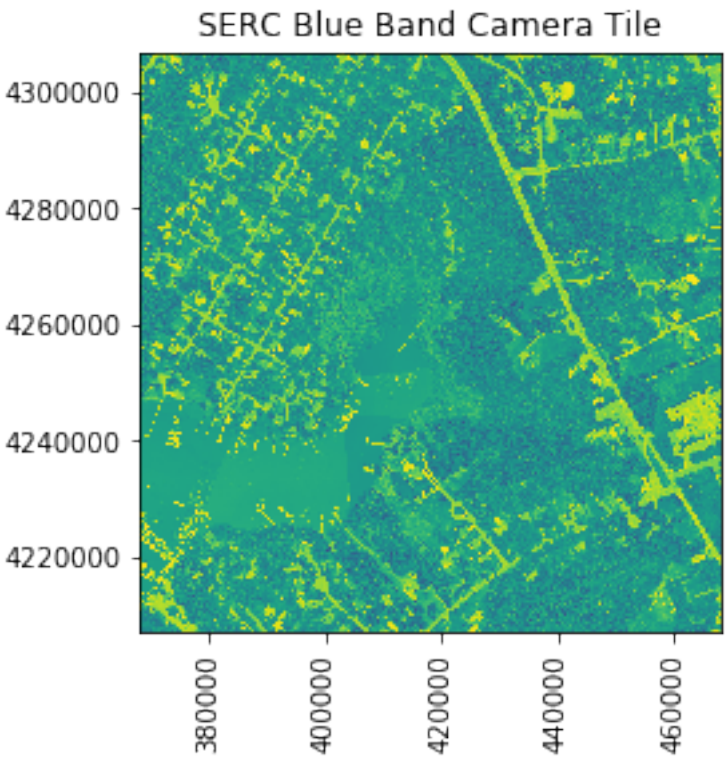
```
plot_band_array(SERC_RGBcam_array[:,:,0],
                SERC_RGBcam_metadata['extent'],
                (1,255),
                title='SERC Red Band Camera Tile',
                cbar='off')
```



In [109]:
```
# Green band
plot_band_array(SERC_RGBcam_array[:,:,1],
                SERC_RGBcam_metadata['extent'],
                (1,255),
                title='SERC Green Band Camera Tile',
                cbar='off')
```



In [110]:
```
# Blue band
plot_band_array(SERC_RGBcam_array[:,:,2],
                SERC_RGBcam_metadata['extent'],
                (1,255),
                title='SERC Blue Band Camera Tile',
                cbar='off')
```


SERC Blue Band Camera Tile
4300000
4280000
4260000
4240000
4220000
380000
400000
420000
440000
460000