Landsat tif files in R

Learning Objectives

After completing this tutorial, you will be able to:

- Calculate NDVI and NBR in R
- Describe what a vegetation index is and how it is used with spectral remote sensing data.

What you need

You will need a computer with internet access to complete this lesson and the data for week 6 of the course.

Download Week 5 Data (~500 MB){:data-proofer-ignore=" .btn }

About vegetation indices

A vegetation index is a single value that quantifies vegetation health or structure. The math associated with calculating a vegetation index is derived from the physics of light reflection and absorption across bands. For instance, it is known that healthy vegetation reflects light strongly in the near infrared band and less strongly in the visible portion of the spectrum. Thus, if you create a ratio between light reflected in the near infrared and light reflected in the visible spectrum, it will represent areas that potentially have healthy vegetation.

Normalized difference vegetation index (NDVI)

The Normalized Difference Vegetation Index (NDVI) is a quantitative index of greenness ranging from 0-1 where 0 represents minimal or no greenness and 1 represents maximum greenness.

NDVI is often used for a quantitate proxy measure of vegetation health, cover and phenology (life cycle stage) over large areas. Our NDVI data is a Landsat derived single band product saved as a GeoTIFF for different times of the year.

NDVI is calculated from the visible and near-infrared light reflected by vegetation. Healthy vegetation (left) absorbs most of the visible light that hits it, and reflects a large portion of near-infrared light. Unhealthy or sparse vegetation (right) reflects more visible light and less near-infrared light. Source: NASA

- More on NDVI from NASA

Calculate NDVI

Sometimes we are able to download already calculated NDVI data products. In this case, we need to calculate NDVI ourselves using the reflectance data that we have.

```
# load spatial packages
library(raster)
library(rgdal)
library(rgeos)
# turn off factors
options(stringsAsFactors = F)
```

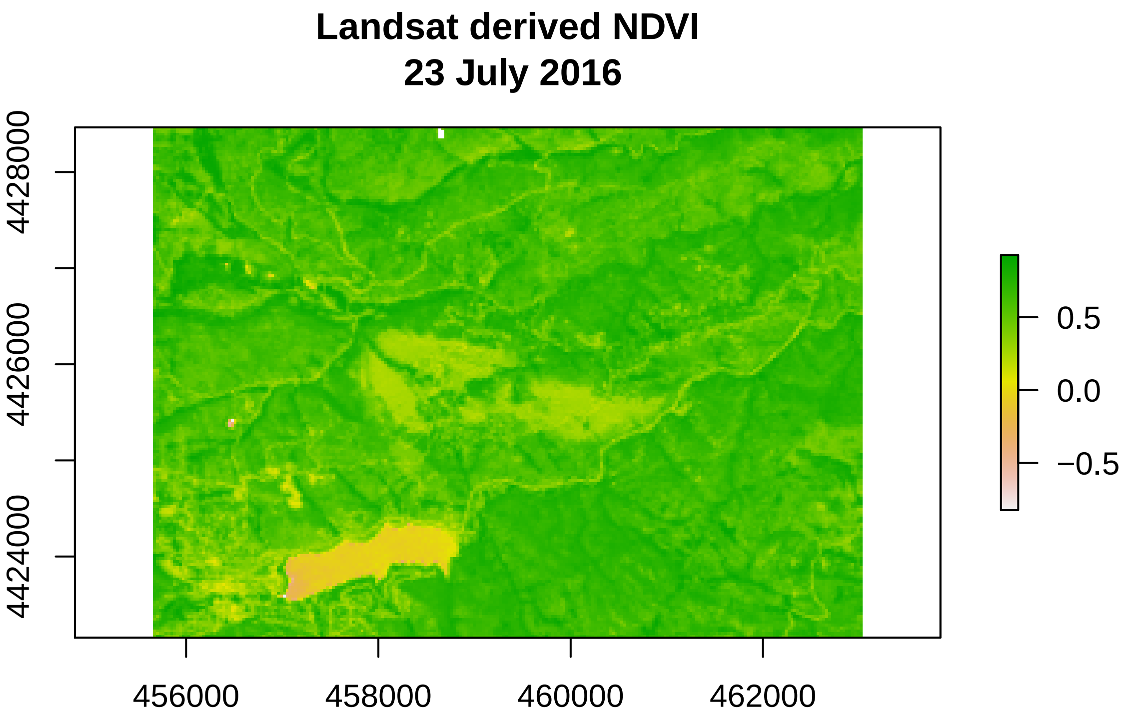

Figure 1: landsat derived NDVI plot

```
all_landsat_bands <- list.files("data/week6/Landsat/LC80340322016205-SC20170127160728/crop",
           pattern=glob2rx("*band*.tif$"),
           full.names = T) # use the dollar sign at the end to get all files that END WITH
all_landsat_bands
## [1] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band1_crop.t
## [2] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band2_crop.t
## [3] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band3_crop.t
## [4] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band4_crop.t
## [5] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band5_crop.t
## [6] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band6_crop.t
## [7] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band7_crop.t

# stack the data
landsat_stack_csf <- stack(all_landsat_bands)
```

Calculate NDVI

(NIR - Red) / (NIR + Red)

```
landsat_ndvi <- (landsat_stack_csf[[5]] - landsat_stack_csf[[4]]) / (landsat_stack_csf[[5]] + landsat_s

plot(landsat_ndvi,
     main="Landsat derived NDVI\n 23 July 2016")
```

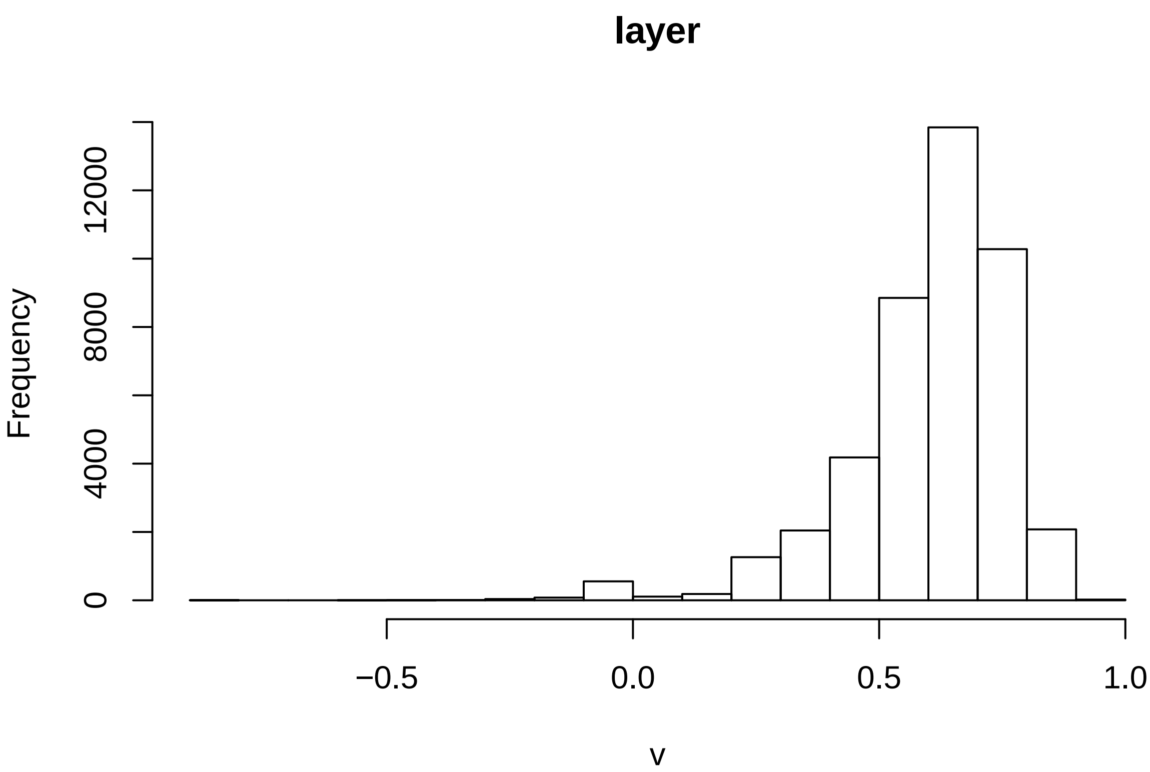

Figure 2: histogram

View distribution of NDVI values

```
# view distribution of NDVI values
hist(landsat_ndvi)
```

Export raster

When you are done, you may want to export your rasters so you could use them in QGIS or ArcGIS or share them with your colleagues. To do this you use the writeRaster() function.

```
# export raster
# NOTE: this won't work if you don't have an outputs directory in your week6 dir!
writeRaster(x = landsat_ndvi,
              filename="data/week6/outputs/landsat_ndvi.tif",
              format = "GTiff", # save as a tif
              datatype='INT2S', # save as a INTEGER rather than a float
              overwrite = T)  # OPTIONAL - be careful. this will OVERWRITE previous files.
```

Calculate NBR

This index highlights burned areas in large fire zones greater than 500 acres. The formula is similar to a normalized difference vegetation index (NDVI), except that it uses near-infrared (NIR) and shortwave-infrared (SWIR) wavelengths (Lopez, 1991; Key and Benson, 1995).

NBR = ((NIR - SWIR)/ (NIR + SWIR)) * 1000

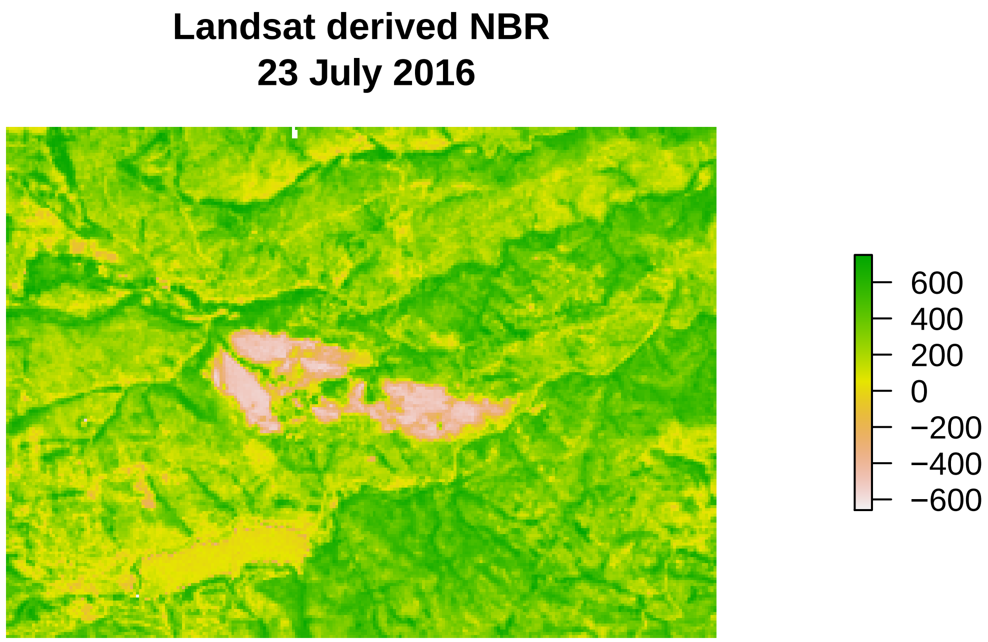

Figure 3: landsat derived NDVI plot

The NBR was originally developed for use with Landsat TM and ETM+ bands 4 and 7, but it will work with any multispectral sensor (including Landsat 8) with a NIR band between 0.76-0.9 µm and a SWIR band between 2.08-2.35 µm.

Look at the table. what bands do you need to calculate Nbr?

When you have calculated NBR - classify the output raster using the classify() function and the classes below.

SEVERITY LEVEL
Enhanced Regrowth
Unburned
Low Severity
Moderate Severity
High Severity

```
dev.off()
```

Additional Resources

- USGS Remote sensing phenology
- NASA Earth Observatory - Vegetation indices

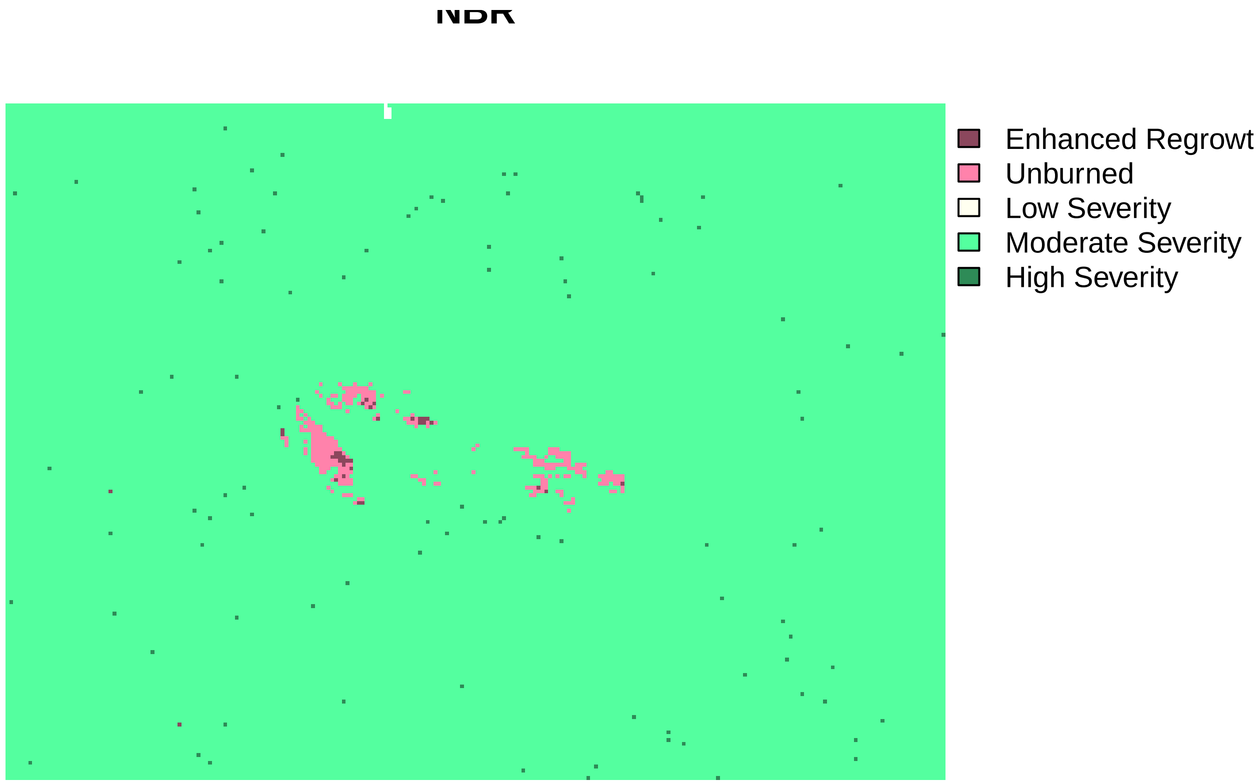

Figure 4: classified NBR output

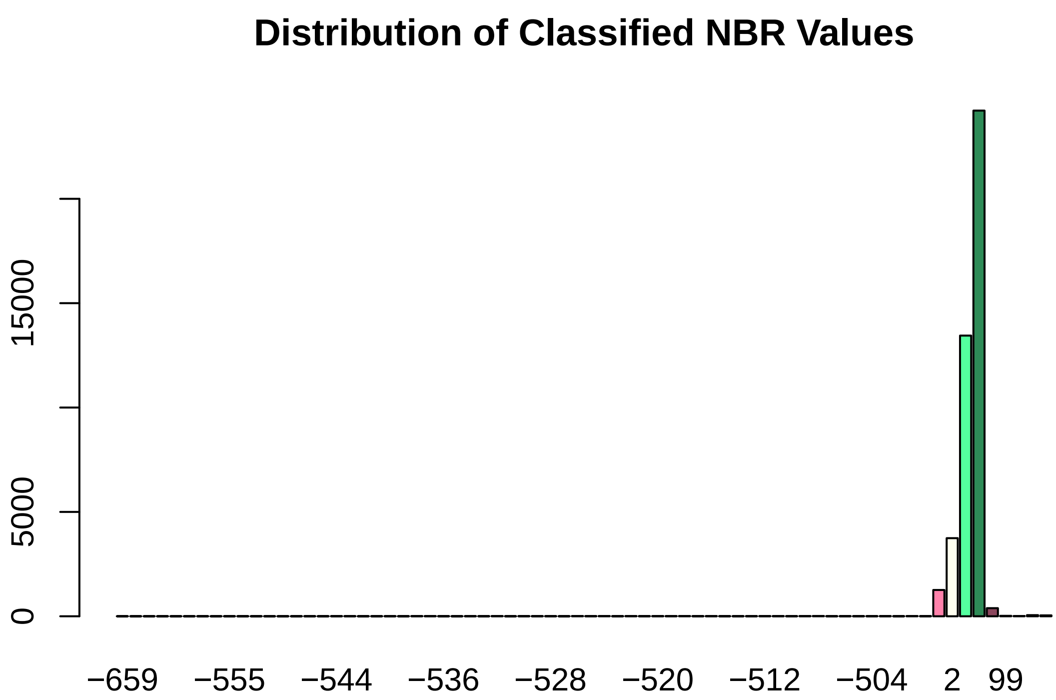

Figure 5: plot hist