dNBR with MODIS in R

Learning Objectives

After completing this tutorial, you will be able to:

- Calculate `dNBR` in `R`
- Be able to describe how the `dNBR` index is used to quantify fire severity.

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 6 Data (~500 MB)](

As mentioned previously, we can use NBR to map the extent and severity of a fire. Let's explore using Landsat & MODIS data to calculate NBR. In the example below, we are using the MODIS product **mod09GA** which we downloaded from Earth Explorer. This product contains 7 bands including ones in the SWIR and NIR region of the spectrum which we require to calculate NBR.

Calculate dNBR using Landsat data

Let's get started with calculating dNBR using MODIS data. First, let's setup our spatial packages.

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

First, we open up our landsat data and create a spatial raster stack.

```
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.ti
## [2] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band2_crop.ti
## [3] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band3_crop.ti
## [4] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band4_crop.ti
## [5] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band5_crop.ti
## [6] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band6_crop.ti
## [7] "data/week6/Landsat/LC80340322016205-SC20170127160728/crop/LC80340322016205LGN00_sr_band7_crop.ti

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

Next we calculate NBR using the following steps:

1. Open up pre-fire data and calculate NBR
2. Open up the post-fire data and calculate NBR
3. Calculate dNBR (difference NBR) by subtracting post-fire NBR from pre-fire NBR.

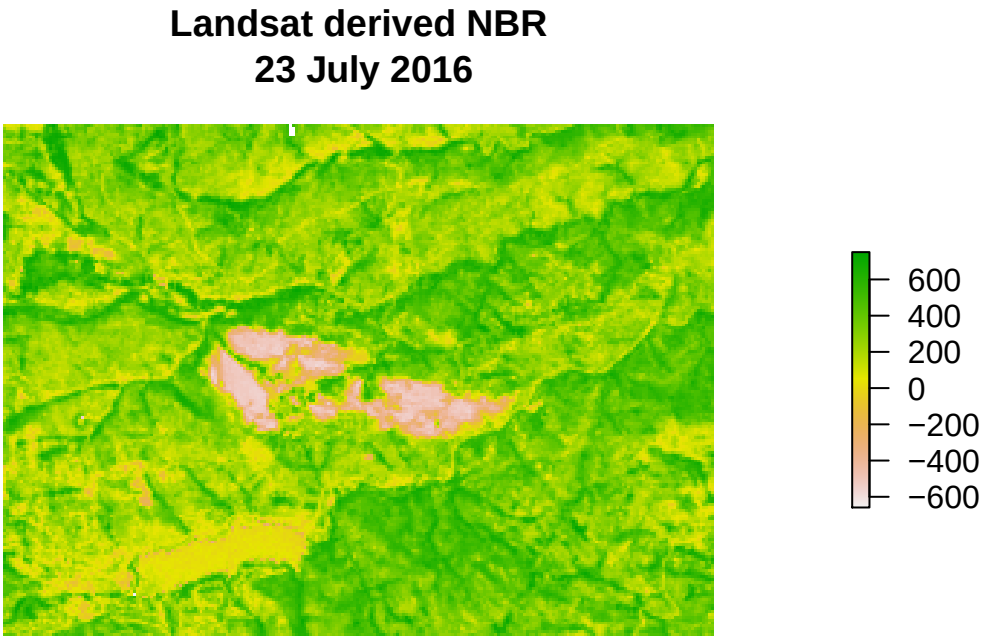

Figure 1: landsat derived NDVI plot

4. Classify the resultant dNBR raster.

Note the code to do this is hidden. You will need to figure out what bands are required to calculate NBR using Landsat.

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

NOTE: your min an max values for NBR may be slightly different from the table shown above! If you have a smaller min value (< -700) then adjust your first class to that smallest number. If you have a largest max value (>1300) then adjust your last class to that largest value in your data.

HINT: you can use

You can export the rasters if you want.

```
writeRaster(x = nbr_classified,
            filename="data/week6/outputs/nbr_classified.tif",
            format = "GTiff", # save as a tif
            datatype='INT2S', # save as a INTEGER rather than a float
            overwrite = T)

writeRaster(x = landsat_nbr,
            filename="data/week6/outputs/landsat_nbr",
            format = "GTiff", # save as a tif
            datatype='INT2S', # save as a INTEGER rather than a float
            overwrite = T)
```


Your classified map should look something like:

Compare to fire boundary

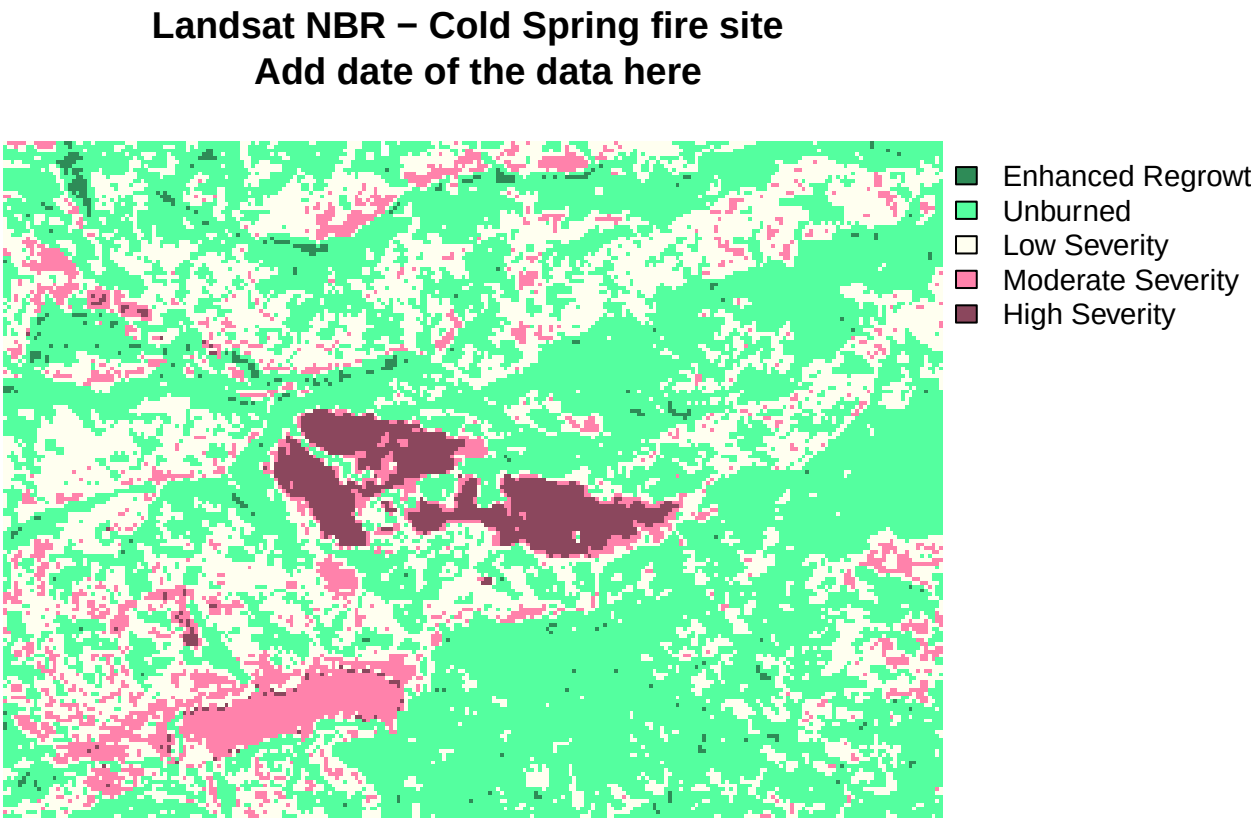

Figure 2: classified NBR output

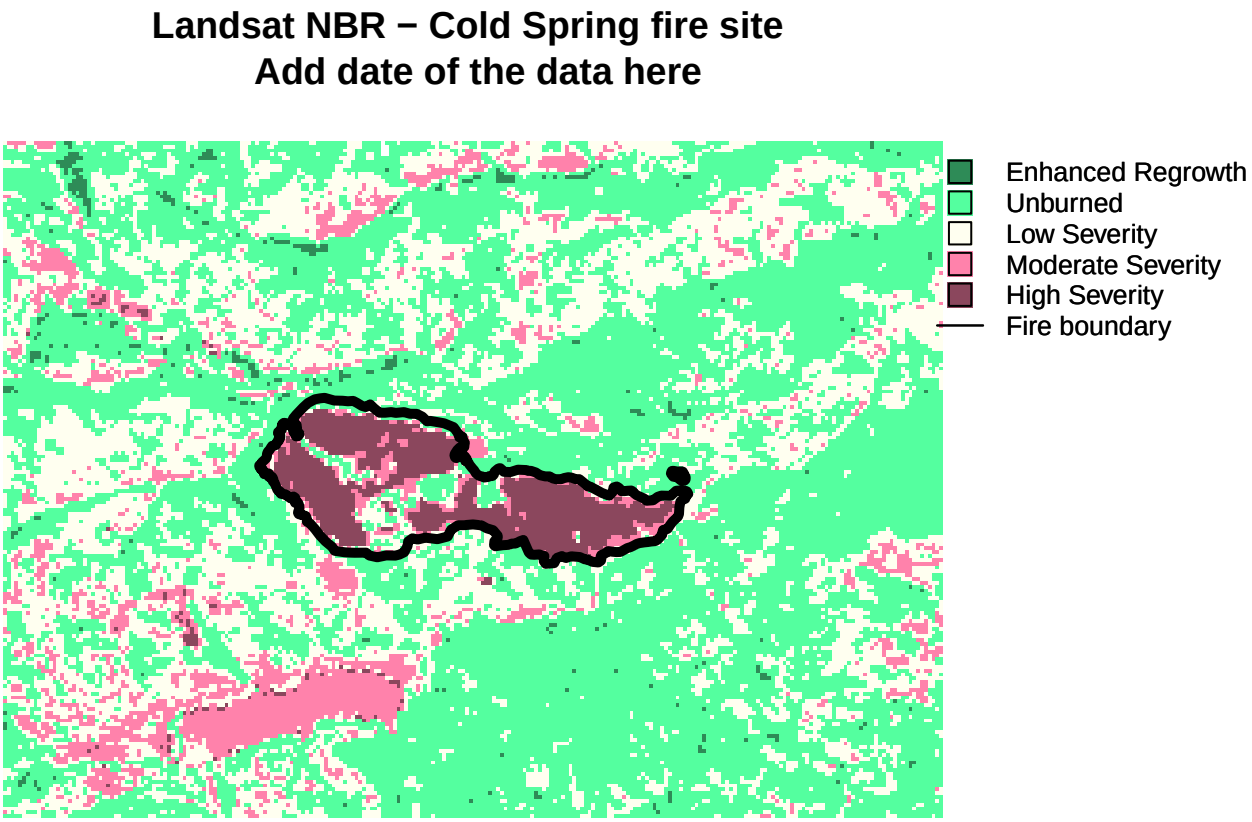

Figure 3: classified NBR output

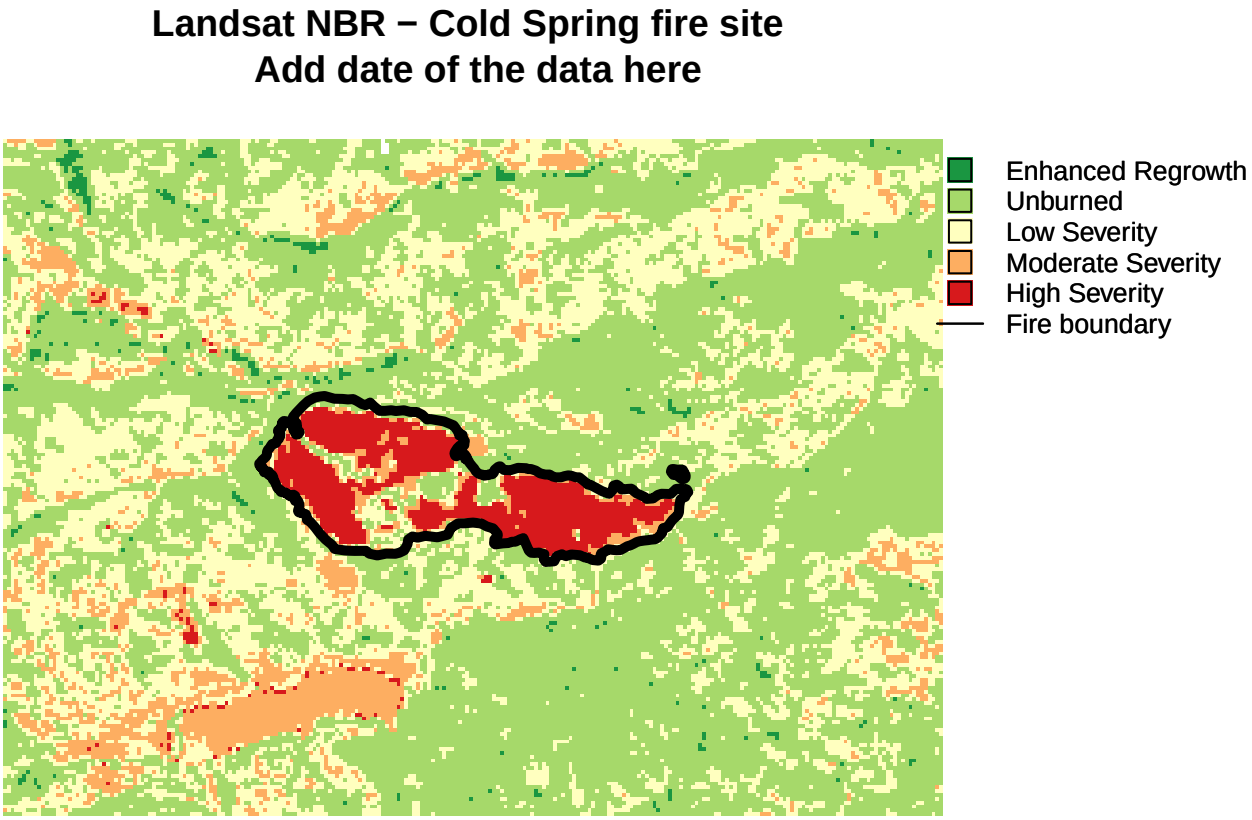

Figure 4: classified NBR output

```
       cex=.8,
       bty="n",
       pt.cex=c(1.75))
legend(nbr_classified@extent@xmax-100, nbr_classified@extent@ymax,
       c("Enhanced Regrowth", "Unburned", "Low Severity", "Moderate Severity", "High Severity", "Fire b
       col=c("black"),
       pch=c(22, 22, 22, 22, 22, NA),
       lty = c(NA, NA, NA, NA, NA, 1),
       cex=.8,
       bty="n",
       pt.cex=c(1.75))
```

Note that you will have to figure out what date these data are for! I purposefully didn't include it in the title of this map.

NBR & MODIS

Similarly the table below shows the band ranges for the MODIS sensor. What bands should we use to calculate NBR using MODIS?

Band	Wavelength range (nm)	Spatial Resolution (m)	Spectral Width (nm)
Band 1 - red	620 - 670	250	2.0
Band 2 - near infrared	841 - 876	250	6.0
Band 3 - blue/green	459 - 479	500	6.0

Band	Wavelength range (nm)	Spatial Resolution (m)	Spectral Width (nm)
Band 4 - green	545 - 565	500	3.0
Band 5 - near infrared	1230 – 1250	500	8.0
Band 6 - mid-infrared	1628 – 1652	500	18
Band 7 - mid-infrared	2105 - 2155	500	18

Additional Resources

- http://gsp.humboldt.edu/olm_2015/Courses/GSP_216_Online/lesson5-1/NBR.html

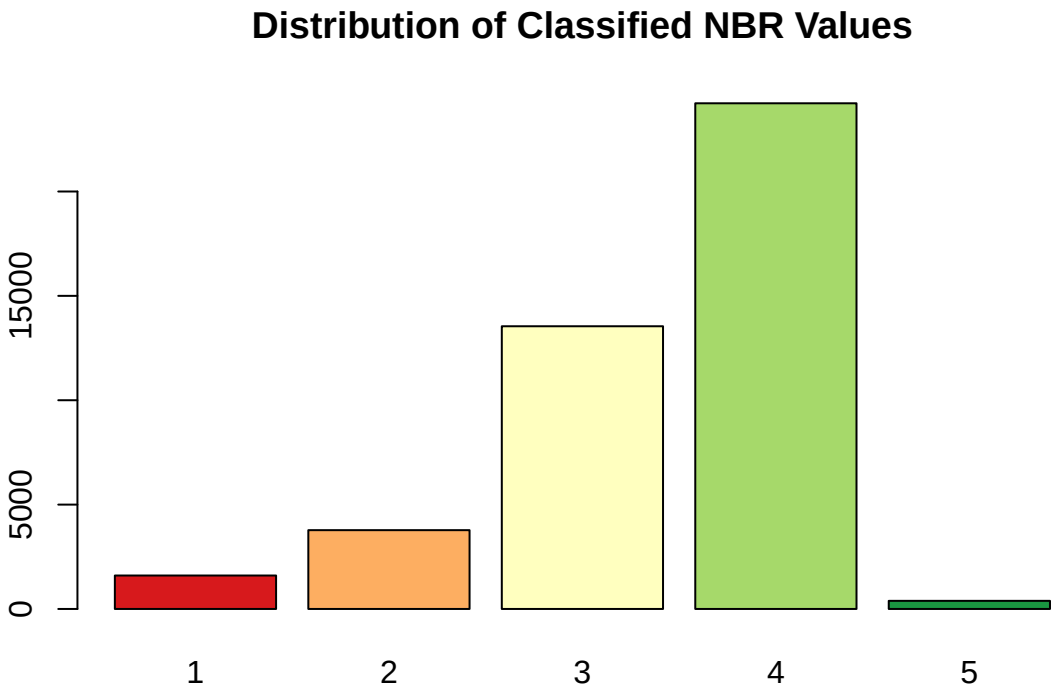

Figure 5: plot hist