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Activity 6

Question 1:
Look up the projection and datum. What does zone mean? Describe the projected coordinate system and the properties that it maintains. What spatial scale is this projected coordinate system meant for?

The projection this spatial file is in is Universal Transverse Mercator. NAD83 is the horizontal and geometric control datum for this spatial file, as it is located in the United States. The zone refers to 1 of the 60 slices of the Earth created with the UTM projection. These slices start and end at each pole, with 6 degrees of separation between each. For each slice (zone), it is flattened onto a secant cylinder. This makes measurements become inaccurate the further from the central meridian line the zone is mapped onto.

Scale is constant north/south along the meridians, but is warped east/west. This coordinate system is meant for the scale of within each zone. If you have to analyze an area that spans more than one zone, another projection may work better.

Question 2:
Why do you want to work with glacier data in an equal area projection rather than the UTM projection?

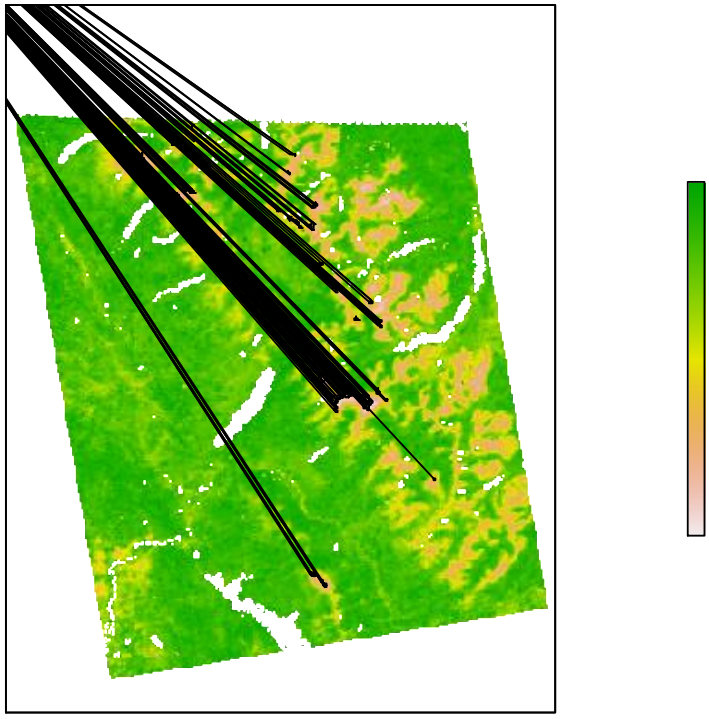
We want to work with the glacier data in the equal area projection for two reasons. First, the NDVI data is in this projection, so we need to align the two data sets for analysis. Furthermore, the equal are projection does not skew the geographical distances, meaning everything we look at properly spaced.

Question 3:
What happens if you try to plot NDVI with the 1966 glacier polygons? Make a plot of the 2003 NDVI data side by side with the 1966 glacier extent. Explain why you can't put both data files on the same map.

You cannot plot the NDVI data with the 1966 glacier polygons as they don’t have the same projection. The coordinates (as seen on the axes) are different, so the maps will not line up.

Question 4:
Make a map with both the maximum NDVI and the glaciers in 2015. Don't show the axes labels with the x and y coordinate system values. Make the 2015 glacier polygon with no fill color and a black border. What are the patterns in NDVI in the map and around glaciers?

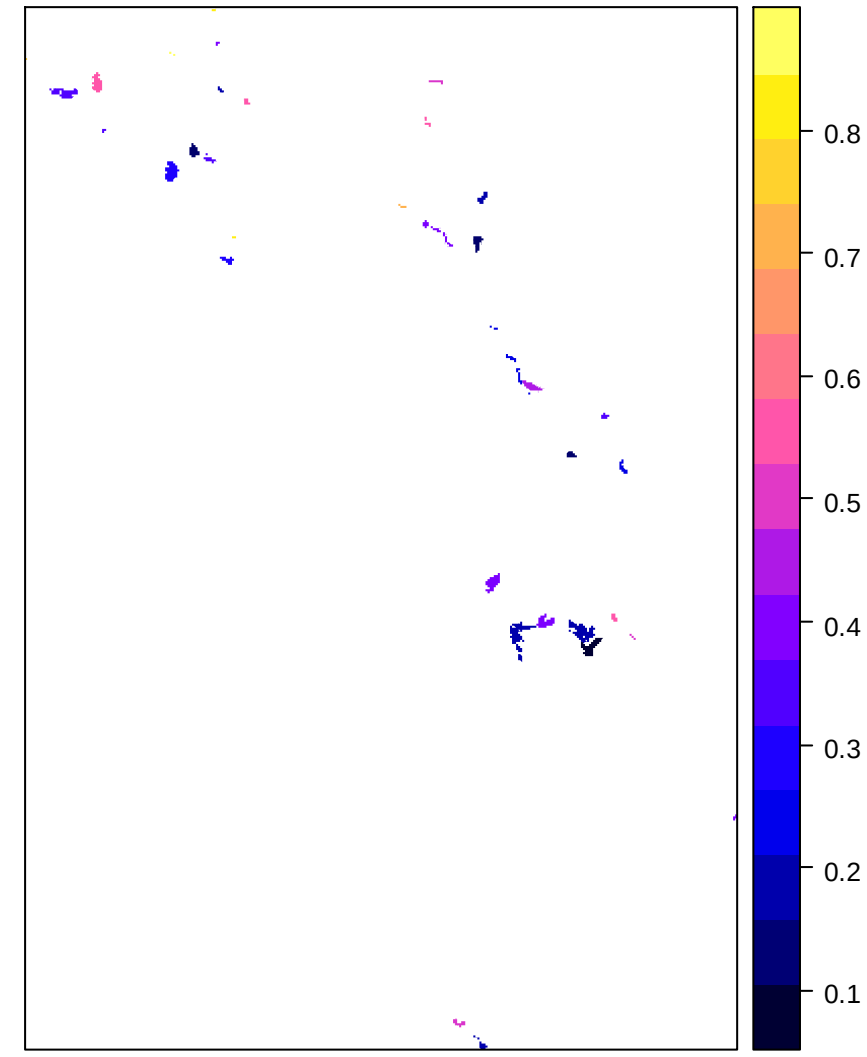
Levels of Vegetation compared to 2015 Glaciers



Greener indicaties more vegetation, Glaciers in black

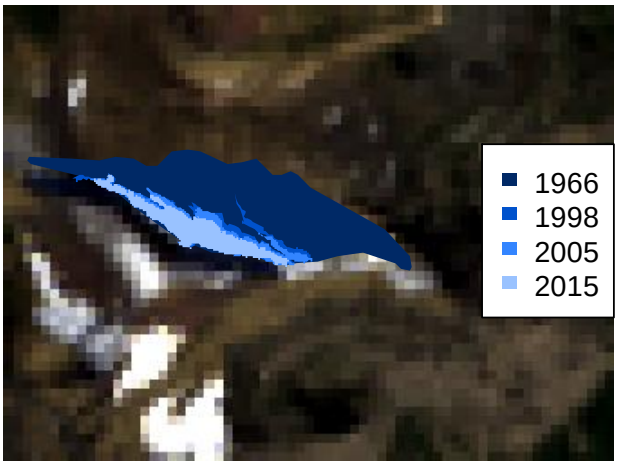
There are clearly lower levels of vegetation around the areas where the glaciers are.

Question 5:
Calculate the % change in area between 1966 and 2015. Make a spplot of the glaciers in 2015 showing the % change that each glacier has experienced.



Question 6:
Find the glacier with the largest % loss. Make a map that best displays the glacial extent for all years for that glacier with the highest % loss. Include background imagery. You can use the original data for the map to match with the imagery. Add a map title that includes the % loss and glacier name. The subset function will be helpful here.

Boulder Glacier



84.72% Area Loss since 1966

Question 7:
What are the patterns in maximum NDVI change across the park? Although this type of quick assessment is helpful, what additional information for the regression would you need to more accurately assess this question?

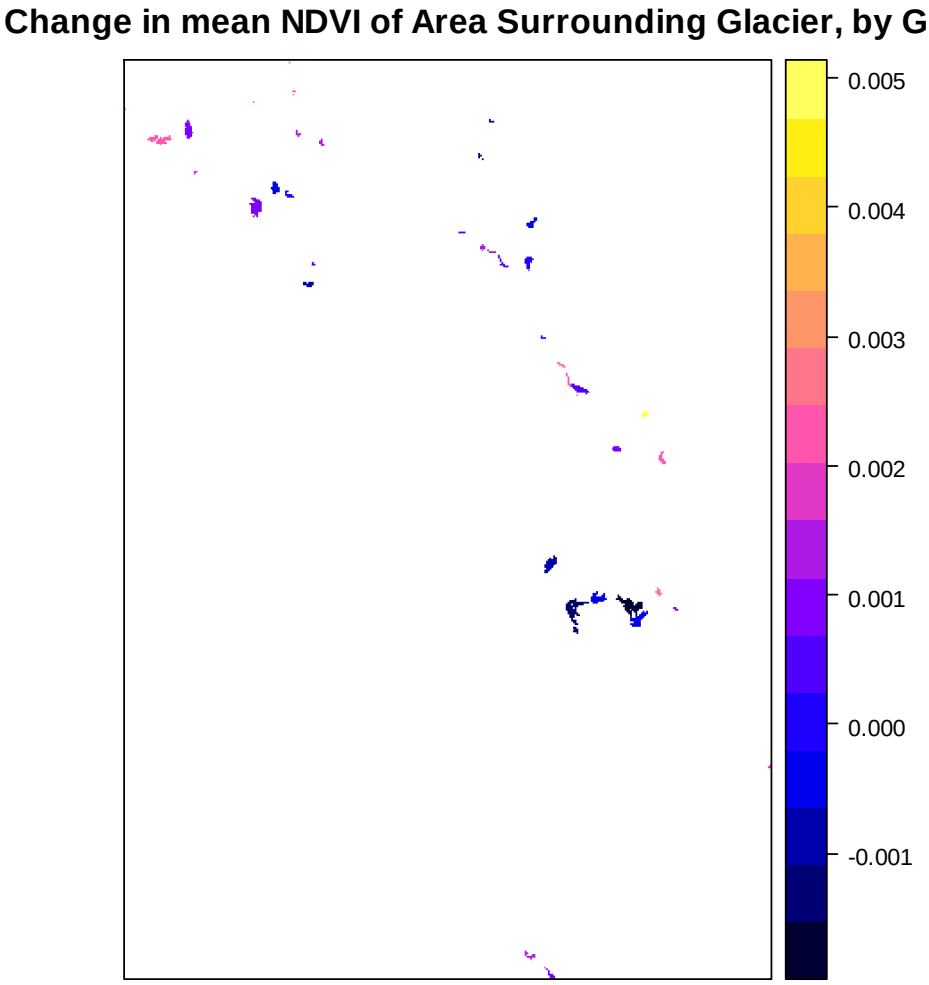
It appears that there is the highest level of change of maximum NDVI around areas with already high NDVI. I believe these are in lower elevations but I cannot tell for sure.

Question 8:
Describe what glacZones looks like. How did the raster math accomplish removing the glaciers from the zones. What are the similarities and differences between this raster operation and gDifference?

glacZones is the area surrounding each glacier by 500 meters, not including the glaciers themselves.

An object is created the expands the size of the glaciers by 500 meters in each direction, then the shape of the glacier is subtracted from this new shape. The raster is different than the gDifference operation because rasters are a matrix of cells, while the gDifference applies to polygon shapes.

Question 9:
Add the mean change in NDVI per year into the 2015 glacier polygons. Make a map where the mean change in vegetation is color coded within the 2015 glacier polygons. Does there seem to be any patterns?



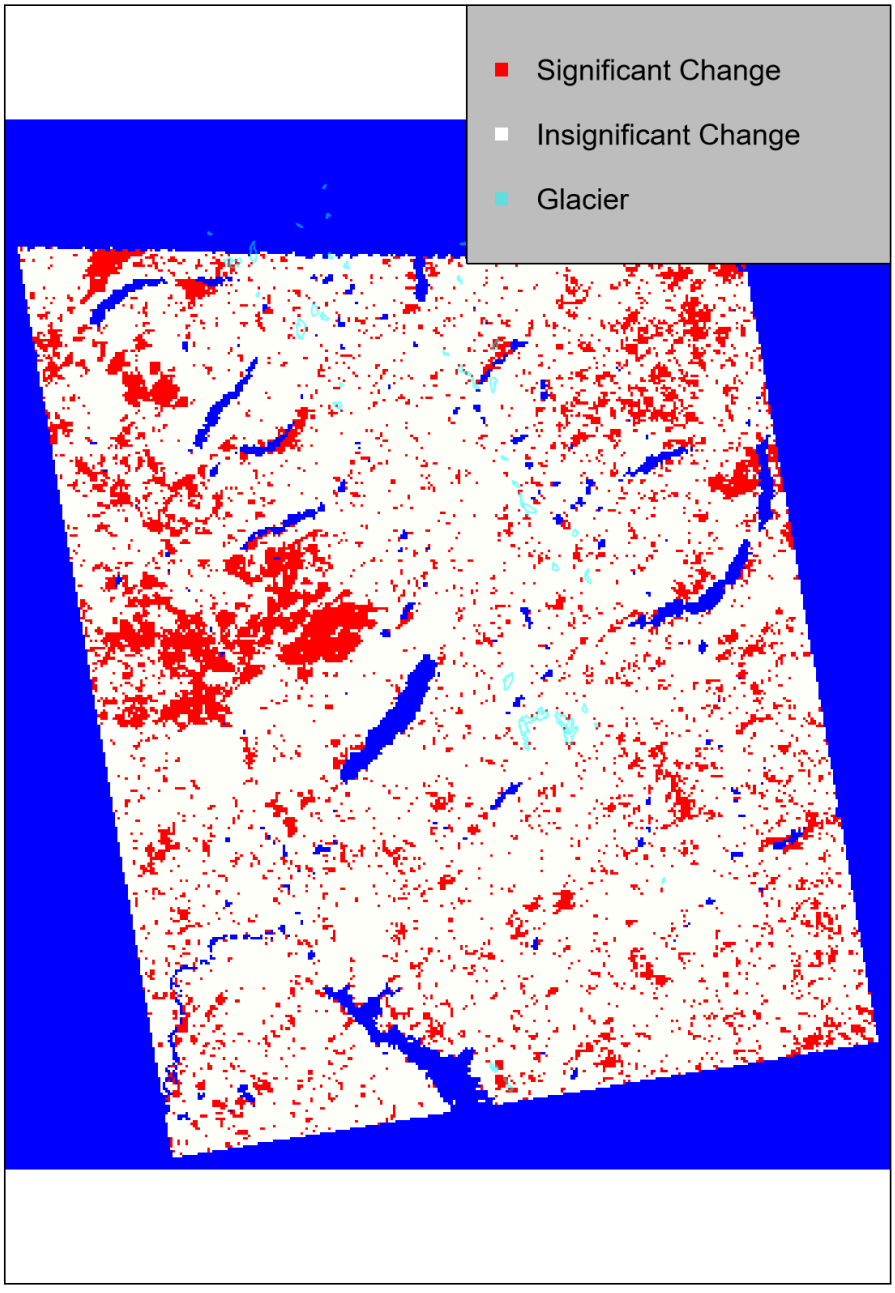
It seems larger glaciers tend to have a smaller amount of NDVI change. Also there is more change the further North the glacier is.

Question 10:
Do you think is changing as glaciers recede and why? Are the values of yearly change substantial? Hint: consider the range of NDVI and also consider the magnitude of change over a 10 or 15 year period.

Do you think vegetation is changing as glaciers recede and why? Is the change in NDVI per year (slope) substantial? Hint consider the range of NDVI and the magnitude of change over a 10-15 year period.

The effect of vegetation increasing as the glaciers recede is minimal.

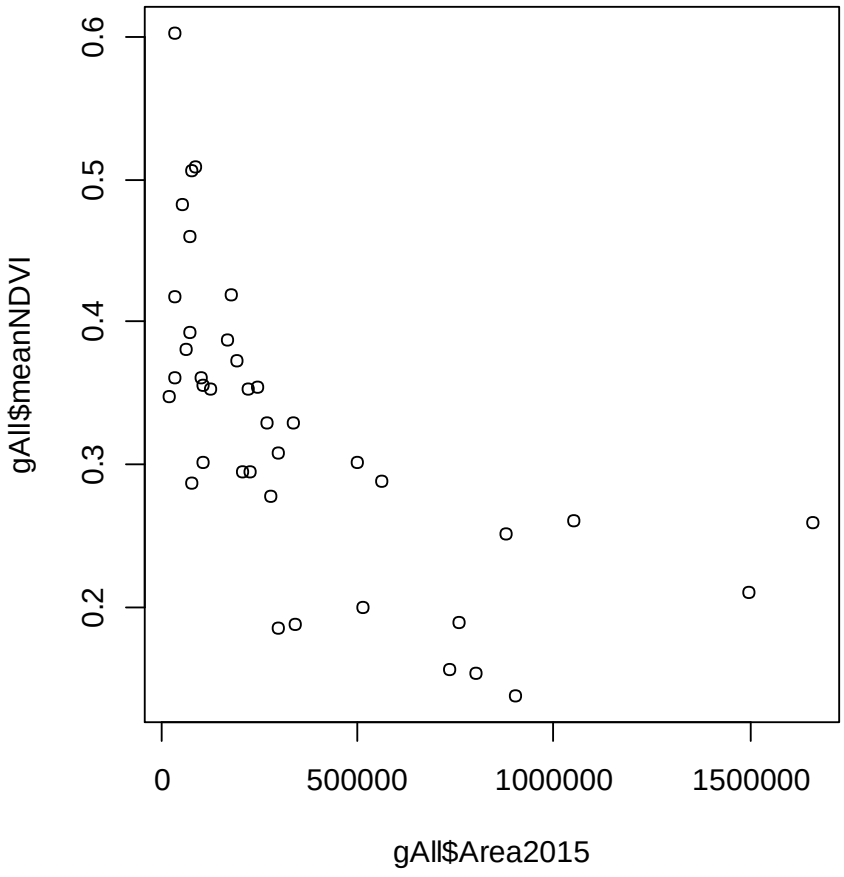
Signifigance of NDVI Change



As we see from this graph, only so much of the area of Glacier National Park experienced statistically significant change in vegetation from 2003 to 2016, at a 95% confidence level. This area seldom aligns with where the glaciers lay, so it is hard to infer that their receding affected vegetation growth.

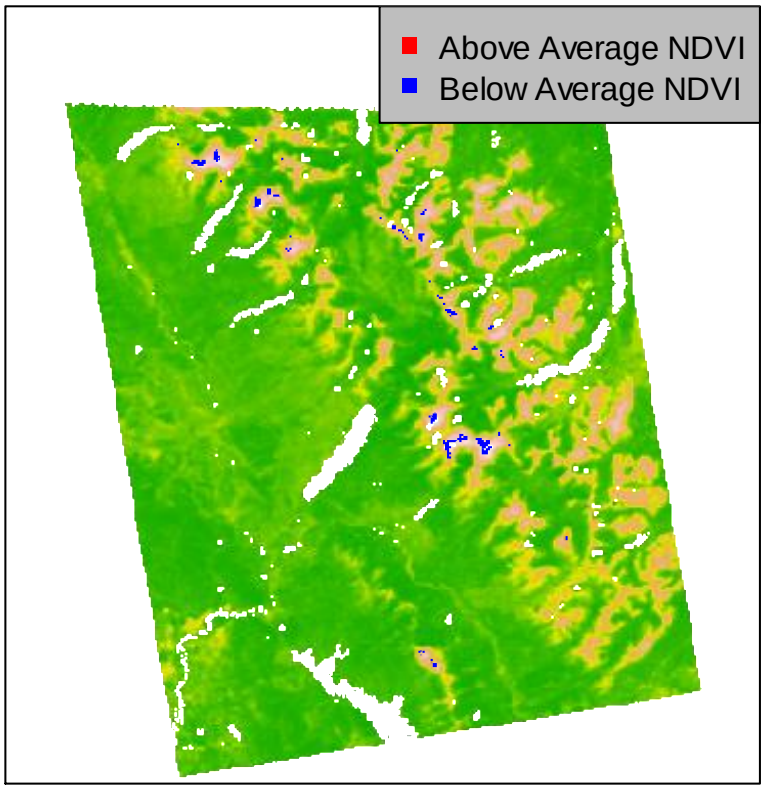
Question 11:
What is the average maximum NDVI across all years within the Glacier National Park? Is there a pattern between glacier size and NDVI within 500m? Make a map that shows both the recent glacier extent color coded with the maximum NDVI range, and the raster of average maximum NDVI.

The average maximum NDVI across all years is 0.7439836.



It does appear that there is a correlation between smaller glaciers and more vegetation.

Glaciers by if they have above average NDVI or not



Question 12:
Using the Carlson and Anderson paper, what kinds of data would you need to validate what is happening with vegetation as glaciers recede? What might be the next steps in making a more accurate analysis of vegetation change for research?

If we had data on elevation, we may be able to uncover the full story of what is happening with the glaciers and vegetation. I assume that glaciers are more likely to form and be larger at higher elevations, as the temperatures are cooler. Furthermore, I know that there is less vegetation at higher elevations. This makes sense as to why there is little change in vegetation as the glacier recedes. Also, it shows why smaller glaciers have higher levels of vegetation surrounding them; they are at lower altitudes. As a next

step, I would like to run regressions for maximum NDVI and glacier size by elevation to see how these variables change for each additional meter of elevation.

Question 13:
Copy and paste the link to your GitHub code.

https://github.com/chuemmler/GEOG331/blob/master/activity6/act6script.R