Seasonal Variation in NDVI

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Background

After the exploration of temporal patterns in the continuous environmental variables, it appears that there are noticeable changes over time. However, it's currently unclear the temporal scale at which these data should be aggregated to deduce patterns of resource use.

For each of the dynamic continuous variables that I have extracted based on Landsat 8 imagery, data are collected every 16 days, but often have missing data depending on cloud cover and which row/column of the satellite path covers the region of interest. Therefore, the finest time scale at which I explore these remotely sensed variables is per month.

While the some of the monthly data also have large gaps due to cloud cover, general patterns can still be discerned. However, it likely makes more sense to assess temporal patterns of resource selection on a seasonal rather than monthly scale due to limited available armadillo tracking data for any given month. Therefore, the questions becomes "how should seasons be defined?". Using the traditional four seasons (spring, summer, winter, fall) may not be appropriate if environmental patterns are not observable across these groupings of months, especially within tropical regions. Since there are predictable wet and dry seasons in tropical regions, it makes more sense to group based on these patterns.

The comparison of environmental variables aggregated into wet and dry seasons as defined by the start and end of the rain (October - March) appears to show minimal differences between these two seasons. It even appears that variables such as NDVI or Tasseled Cap Wetness are lower during the wet compared to the dry season. Since armadillos are likely to respond to flooded landscapes more strongly than periods of rain, it may be useful to aggregate months into dry or flooded seasons.

A single variable (NDVI) will be used to explore differences among months to determine the best groupings into wet and dry seasons.

Methods

As an example of the measurements for NDVI across the landscape, below is a series of maps on a monthly basis.

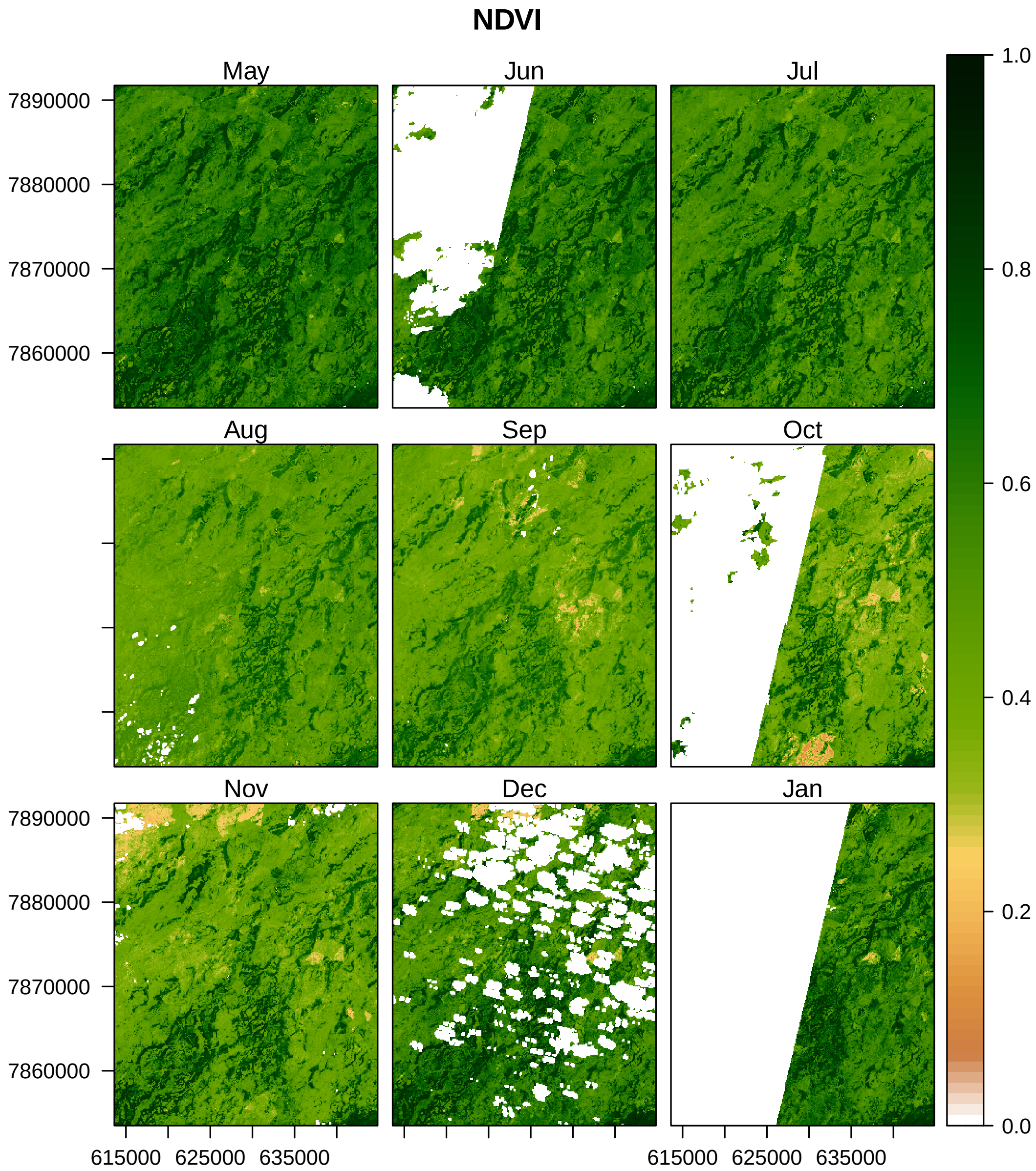


Figure 1: Monthly measures of NDVI based on mosaiced Landsat 8 imagery.

To see how these monthly measurements compare, I will display summary statistics across months to get a better sense of what is going on:

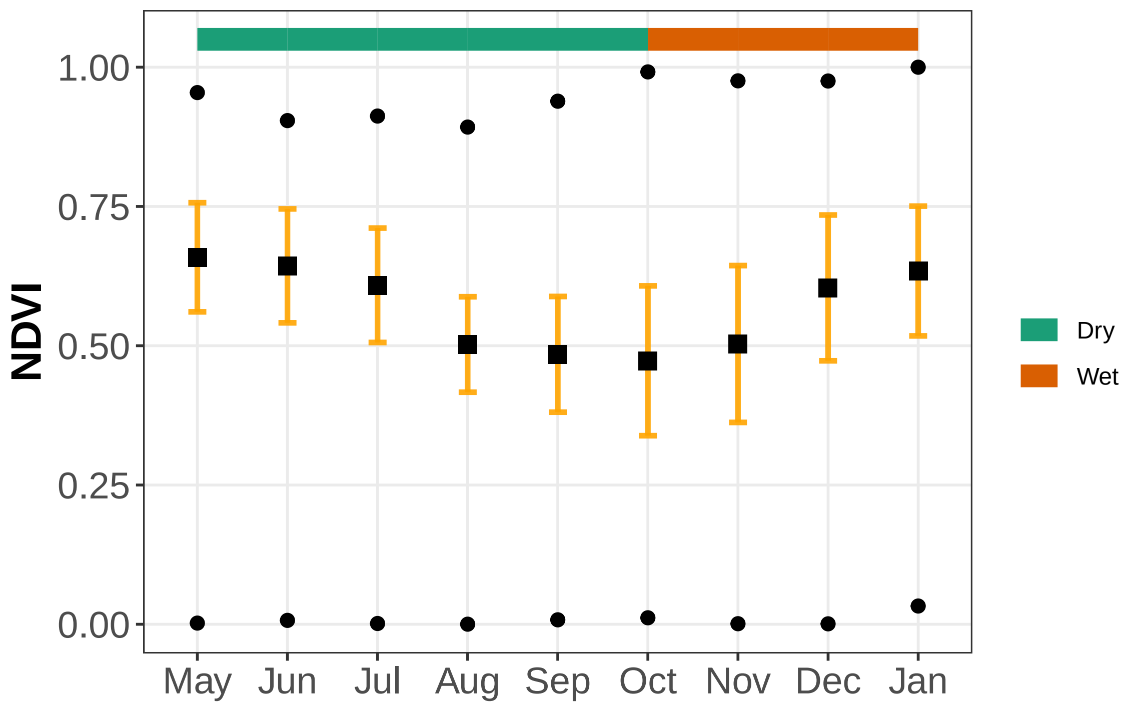
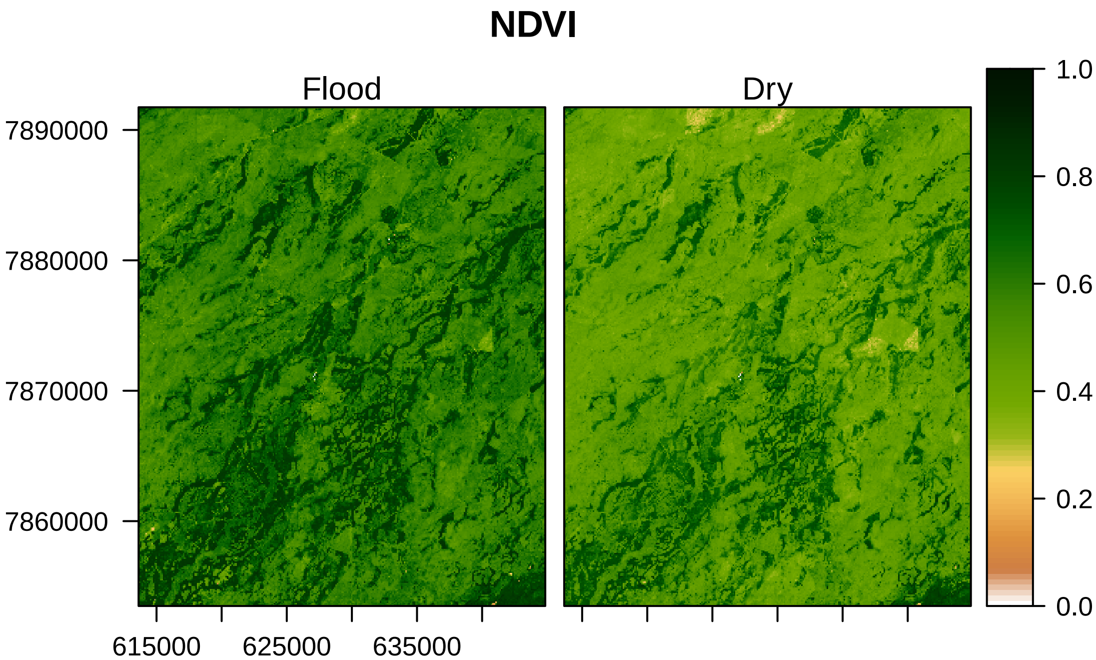


Figure 2: Plot of mean (squares), min/max (circles), and standard deviation (orange error bars) of monthly NDVI. Wet and dry seasons as defined using current definitions are indicated by the colored bar at the top of the plot.

There appears to be relatively minor differences among the minimum values of NDVI across months, while mean NDVI differs more notably. Mean NDVI is higher in May - July and December - January in comparison to August - November. The orange error bars show that there is little difference in the variability (standard deviation) of NDVI across months. Additionally, there is a slight trend in the maximum values of NDVI, which appears to be higher in October - January compared to May - September.

Based on this plot, average NDVI shows one set of months that group together and another different set when evaluating maximum NDVI. Since maximum NDVI appears to represent the forests based on visual comparisons of NDVI maps with land cover, average NDVI may be more representative of the whole study region.

Given these results, I propose that we group months together based on whether 1 SD away from the mean crosses NDVI = 0.5 or not. This would result in a "Flood" season defined by May, June, July, and January, whereas August - December would represent the "Dry" season. Below is an example of what those seasonal measures of NDVI would look like.


NDVI
Flood
Dry
7890000
7880000
7870000
7860000
615000
625000
635000
1.0
0.8
0.6
0.4
0.2
0.0