Colorado View- Spring 2015'
Final Report- Eric Rounds

Project Theme: Grazing Lands
Project Team: Eric Rounds, Riley Ross and Mike Coughenour
Faculty Advisor: Mike Coughenour and Gonzalo Irisarri (Post doc researcher with USDA)

General Overview: The grazing lands project for Colorado View has aimed to fill gaps in the availability of spatial data on grazing lands in Colorado. Initial efforts to find any accurate, open source, and comprehensive spatial data on grazing lands in Colorado proved fruitless. Consequently, Mike Coughenour, the primary advisor for this project, stressed not only the importance of creating general grazing maps for Colorado, but also providing more detailed information on grazing intensity within grazing lands.

Objectives: The main objective of this project has been to utilize satellite imagery (landsat and MODIS) to map grazing lands and grazing intensity in parts of Eastern Colorado. Ideally, the methods we develop for mapping grazing lands at a smaller scale (e.g. Pawnee National Grasslands) will be useful at a larger scale (e.g. much of Eastern Colorado) in the future.

The main thing I was trying to do this semester was calibrate MODIS and landsat data with the field data provided by the USDA. The USDA field data is separated into 3 different grazing plots with each respectively representing light, medium and heavy grazing intensities. In order to utilize this data, we wanted to find and download corresponding data from MODIS that would be comparable to the ground data. However, MODIS data is at such a rough scale (250m – 1000m) that there is plenty of work to be done before we can directly compare MODIS satellite data to the ground data. This included transforming the MODIS NDVI data (250m) to fPAR using a formula provided by Gonzalo, a USDA researcher.

Lessons Learned: Unfortunately, we aren't at the point where we have any finished products for this grazing lands project. Much of what I have done this semester has been more preparatory and experimental. This is partially due to the amount of data I've been trying to work with but perhaps more due to the road blocks I have hit along the way in terms of trying to process some of the MODIS data. Gonzalo Irisarri, a post-doc researcher at the USDA in Cheyenne, provided some guidance on how to calibrate several types of MODIS data to ground data that the USDA has collected for several sample grazing plots. The idea was to download all the available MOD13Q1(NDVI/EVI-250m), MOD09A1 (surface reflectance- 500m), and MOD15A2 (LAI.fPAR- 1000m) data from 2000 to 2015 from this website:http://daac.ornl.gov/cgi-bin/MODIS/GLBVIZ_1_Glb/modis_subset_order_global_col5.pl . This website allows you to select a subset of a MODIS scene instead of the entire scene which is much larger than we needed.

The next step was to convert the MOD13Q1 NDVI data to fPAR (fraction of absorbed photosynthetically active radiation) using a formula that Gonzalo provided. Ideally, this would allow us to analyze fPAR at a finer scale, something that is necessary due to the relatively small size of the USDA grazing plots compared with MODIS pixels. However, I stalled on this portion of the project because I

was never able to successfully extract all of the MODIS pixels contained within the USDA grazing plots using the .shp files of the grazing plots. I spent a decent amount of time experimenting with different platforms trying to fix my issues, but to no avail. Whether I tried to extract by mask on ArcGIS or I tried to use the convert vector to ROI tool on ENVI, I could never successfully create a ROI or grid file that contained all of the MODIS pixels that were either within or overlapping the USDA grazing plots .shp file. I was never able to get significant help from Gonzalo on this part of the project, so I talked to Mike and moved on from it.

Mike suggested that I download Landsat scenes that correspond with the biomass ground data that the USDA had. Using http://espa.cr.usgs.gov/ordering/new , I ordered 67 Landsat landsat scenes corrected for surface reflectance. I narrowed this down to 67 by adding an additional 10% cloud cover filter, which allowed me to ignore the scenes that had too much cloud cover. Once the methods are nailed down, someone might go back and sift through more landsat scenes to increase the temporal resolution of the analysis. For each scene, I ordered the original input products, original input metadata, surface reflectance, top of atmosphere, EVI, MSAVI, NDMI, NDMI, and SAVI in geotiff format. Since you can't use the bulk download application for data ordered in this fashion, it took some time to download and file all of the landsat data. Although I have not started using the extract by mask tool to select the pixels from all of the Landsat NDVI files that overlap with the USDA grazing plots, I did try to do it with a few of the scenes and there were no problems. What needs to be done now is use the grazing plots .shp files to extract by mask the pixels overlapping with the plots. This needs to be done for quite a few Landsat scenes, so it will take some seriously tedious batch processing. Once that is done, the values from these pixels need to be extracted, organized, and put into table format so that excel can be used to punch in the NDVI to fPAR formula.

Major Products

--*Grazing lands CO view*

LandsatData_Colorado

-Extracted_NDVI

-NDVIs extracted by mask using the WGS84 grazing plot .shp files (ArcGIS)

-Unzipped Landsat Data

Modis Data (geotiff format)

- MOD09A1_Surf_Refl

-http://espa.cr.usgs.gov/ordering/new

-Data requested by Gonzalo

-MOD13Q1_NDVI_EVI

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-MOD15A2_LAI_fPAR

USDA Data

-GrazingPlots_Sinusoidal.

-Sinusoidal projection of grazing plots used to extract pixels from MODIS data

-GrazingPlots_wgs84

-WGS84 projection for landsat data

-CPER Spectral indices_grazing treatments

-excel file with grazing statistics (NDVI, EVI, and NDVI to fPAR conversion) for each of the three pastures from 2000 to 2014

-To see the formula needed to transform NDVI to fPAR, click in the H column and look in the dialog box. [=+MIN((((1+F2)/(1-F2))/(11.62-1.55))-(1.55/(11.62-1.55))*0.095)]

Final Reflection

Benefits to the society and other researchers: Once more work is done on this project I could see the results offering some beneficial methodologies for researchers and land managers alike.

Challenges I faced while conducting research: I faced several challenges while conducting this research. Ultimately, it was very difficult to try and carry out the instructions of Gonzalo because contact with him was so sparse and unpredictable. I faced a lot of minor processing problems that I couldn't get quick answers for from either Gonzalo or some other remote sensing folks, including my advisor Steve. This was rather discouraging and definitely limited my production for the spring. It was also difficult to wrap my head around dealing with this much data. Gonzalo had me download all the available MODIS data from 2000 to 2015 for three different types of data. Needless to say I have hundreds upon hundreds of downloaded files that will be difficult to manage.

Recommendations and limitations- One of the major limitations in this research is when trying to use MODIS data to identify relatively fine scale vegetation characteristics. MODIS data is nice because it provides a high temporal resolution, but it has a very low spatial resolution. Alternatively, Landsat data provides a finer spatial resolution, but a much more erratic temporal resolution due to the presence of clouds in so many scenes. These two types of data are going to have to help fill in where the other is weakest.