Lights, Plants, Action

Radiometric Normalization and NDVI

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Geog 582
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Introduction

- Radiometric Correction
  - Addresses variations in the pixel intensities (DNs) that are not caused by the object or scene being scanned. These variations include:
    - differing sensitivities or malfunctioning of the detectors
    - topographic effects
    - atmospheric effects
  - In this case, normalizing a subject image to a reference image so they are comparable

Introduction

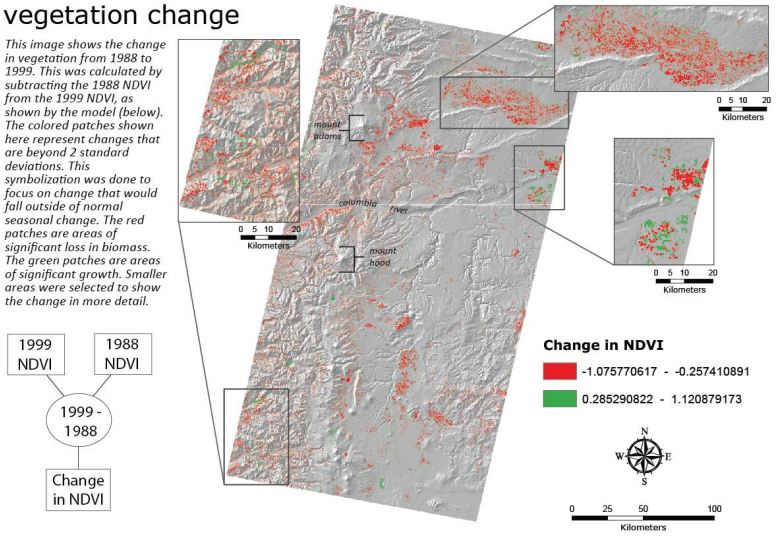
- Normalized Difference Vegetation Index (NDVI)
  - A ratio of the red visible and near infrared bands
    - used widely used as a measure of both the presence and health of vegetation
    - values range from -1 to +1
- NDVI Change
  - Subtracting the NDVI results from 2 time periods to show a change in NDVI

Does radiometric normalization impact the results of an NDVI?

Background – Winter Term Project

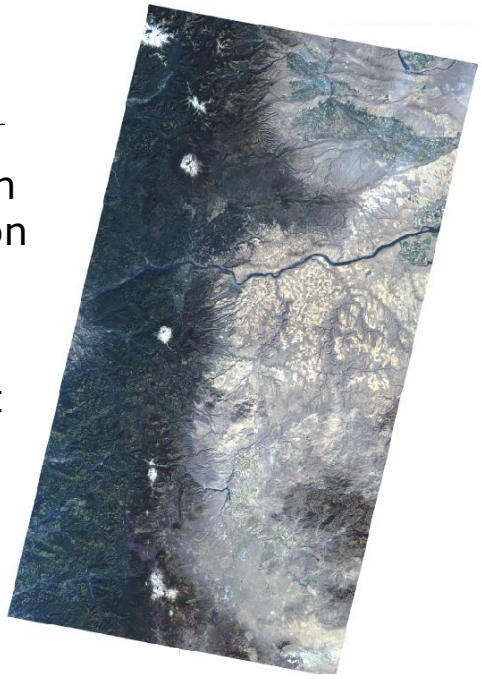
vegetation change

This image shows the change in vegetation from 1988 to 1999. This was calculated by subtracting the 1988 NDVI from the 1999 NDVI, as shown by the model (below). The colored patches shown here represent changes that are beyond 2 standard deviations. This symbolization was done to focus on change that would fall outside of normal seasonal change. The red patches are areas of significant loss in biomass. The green patches are areas of significant growth. Smaller areas were selected to show the change in more detail.



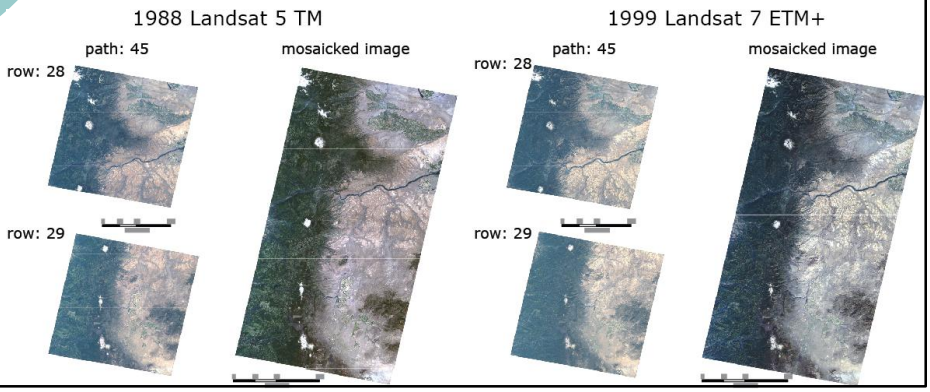
Study Area

- Eastern Oregon and Washington
- Cascade Mtns
- Eastern Desert
- Landsat
  - Rows 28 & 29
  - Path 45



Preprocessing

- Register and Mosaic the Landsat scenes from the two time periods

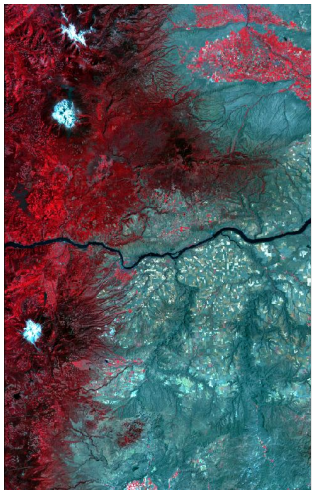


Preprocessing

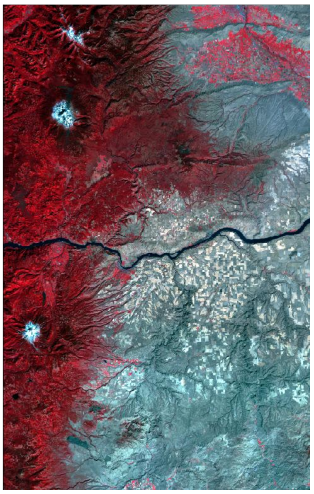
- Subset the imagery
  - Problem with radiometric normalization
  - Faster processing time
- Layer Stack for ease of use
  - Green, Red, NIR 1, NIR 2
  - 4 layers for each time

Preprocessing

1988 subset



1999 subset



Radiometric Normalization

- Followed Lab 3 in Erdas Imagine

Imagery before normalization:

Subject Image

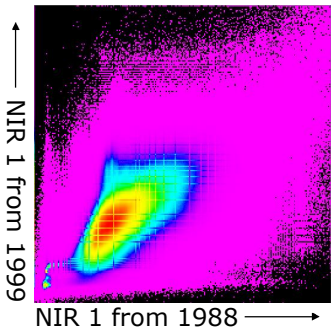
1988 Subset		
	Mean	Stdv
Green	41.214	14.759
Red	52.022	26.177
NIR 1	72.722	19.485
NIR 2	96.545	38.651

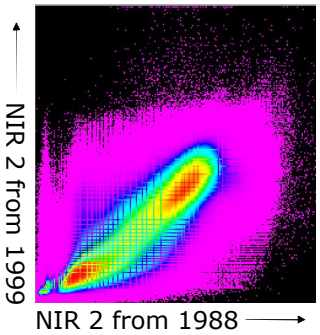
Reference Image

1999 Subset		
	Mean	Stdv
Green	55.577	18.727
Red	62.565	30.702
NIR 1	73.341	19.644
NIR 2	74.741	34.743

Radiometric Normalization

- Identified areas of No Change in feature space using the NIR 1 and NIR 2 Bands from both times
  - Found local maximums for water and land/surface





Radiometric Normalization

- Calculations
  - $a = (j_{umax} - j_{lmax}) / (i_{umax} - i_{lmax})$
  - $b = j_{lmax} - (a * i_{lmax})$

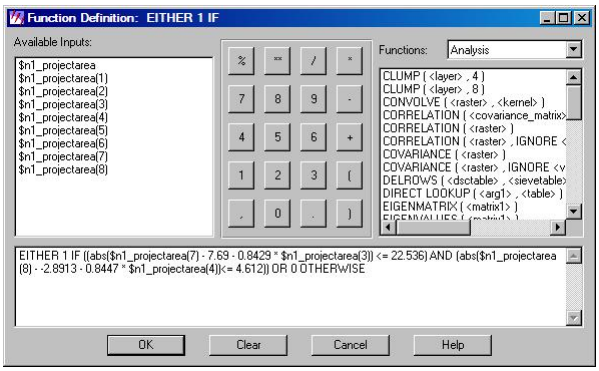
	land/surface max	water max	a	b
NIR 1's	81.68, 76.54	9.997,16.117	0.8429	7.69
NIR 2's	133.677, 110.024	37.21, 28.54	0.8447	-2.8913
	i_{umax}, j_{umax}	i_{lmax}, j_{lmax}		

  - $HVW_{NC} = \sqrt{(1 + a^2)} * 4$

HVW_{NC3}	5.2314
HVW_{NC4}	5.2361

Radiometric Normalization

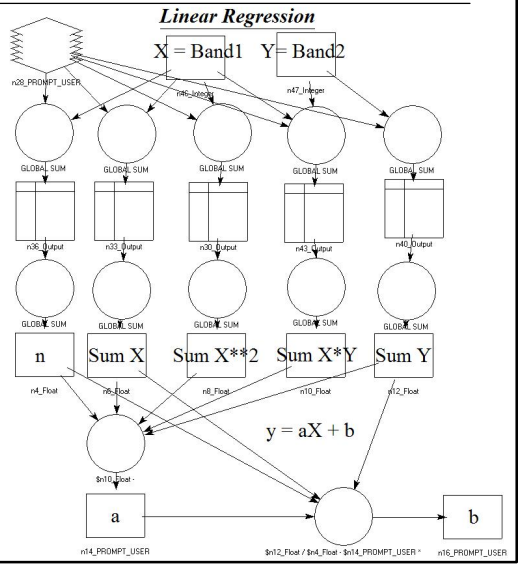
- Create an AOI of the No Change areas
- Use AOI to create No Change mask, to exclude these areas from normalization



Radiometric Normalization

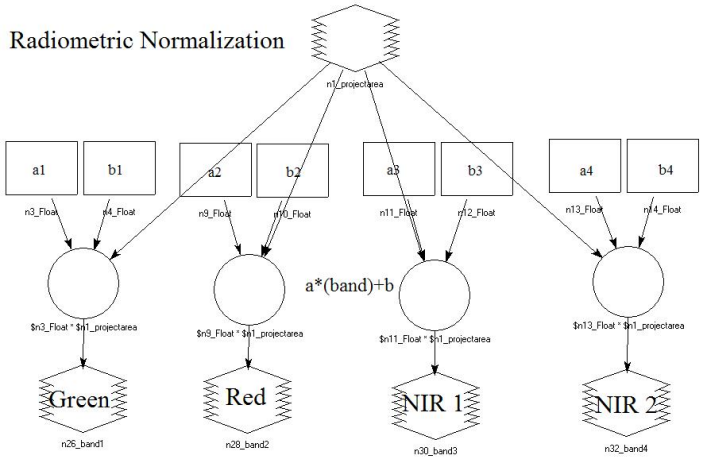
- Use model to determine coefficients for normalization
- Collect a's and b's for all bands

Band	a_k	b_k
Green	1.2953	3.1088
Red	1.118	5.3557
NIR 1	0.765	17.4292
NIR 2	0.8472	-3.4811



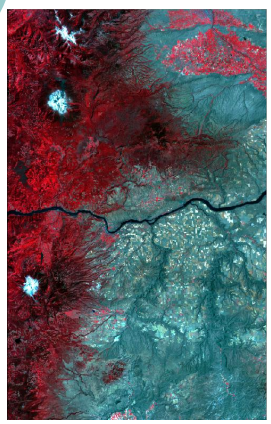
Radiometric Normalization

- Run Normalize Model and stack the resulting bands into a new image

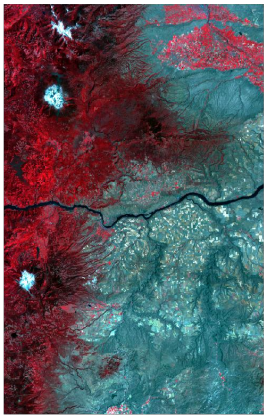


Normalization Results

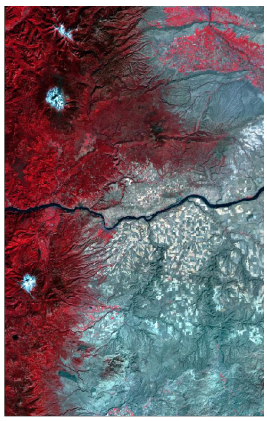
1988 subset



1988 normalized subset



1999 subset



Normalization Results

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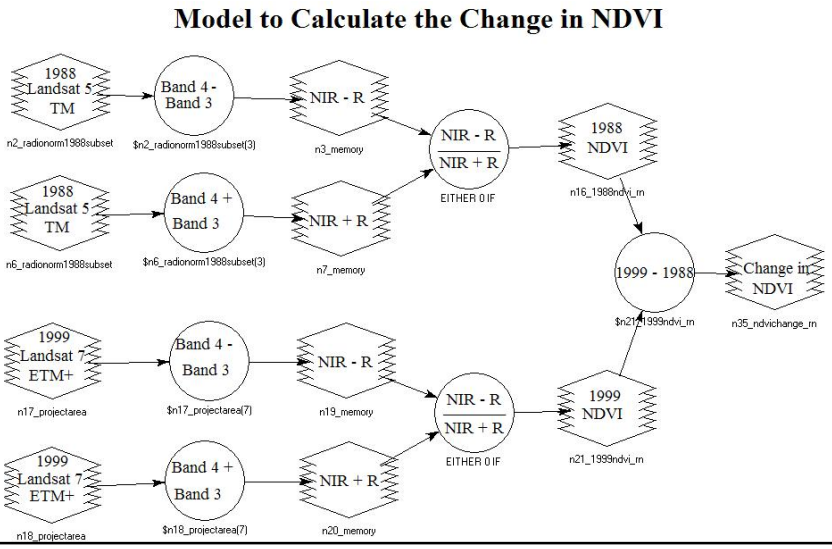
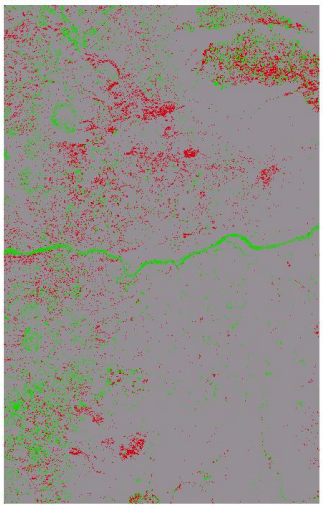
NIR 1	73.341	19.644
NIR 2	74.741	34.743

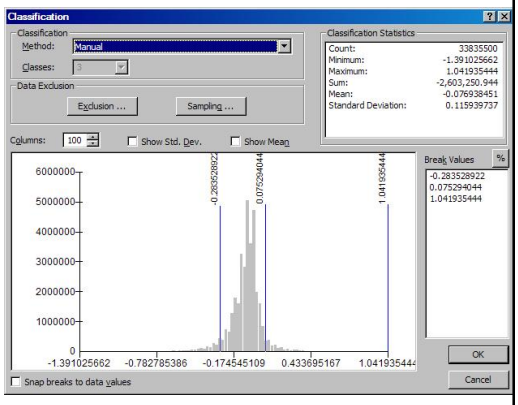
1988 Normalized Subset		
	Mean	Stdv
Green	56.495	19.117
Red	63.515	29.265
NIR 1	73.062	14.906
NIR 2	78.307	32.743

NDVI Change

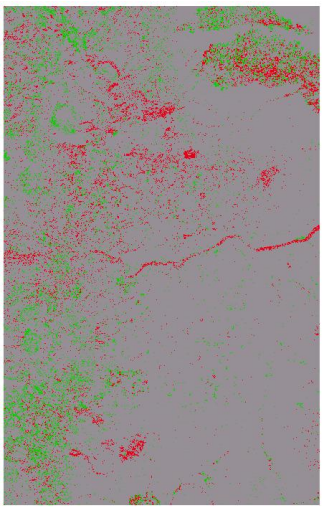


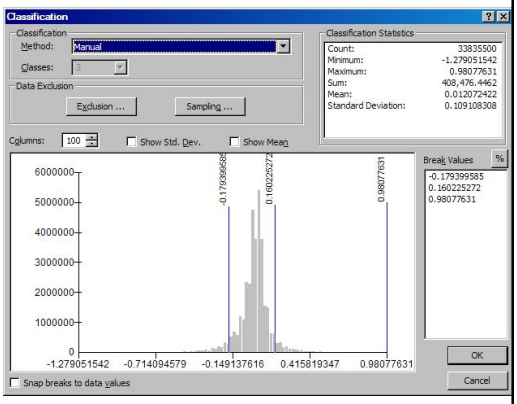
NDVI without Normalization





NDVI with Normalization



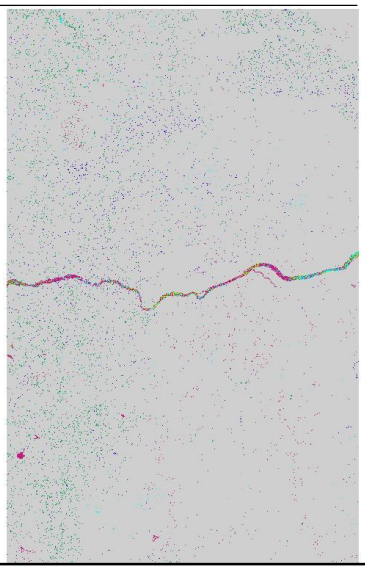


Post Processing

- Create a threshold for negative and positive change by isolating the top and bottom 5% of pixels
- Reclassified both images
- Ran the COMBINE command using Map Algebra to compare the two NDVI Change images.

COMBINE in ArcMap

- Gray: classified the same on both images
- Color: classified differently on both images
- River?



Removing the River

- The normalization model does not like zeros.
- Masking out the river before the NDVI analysis does not impact the results

Conclusions

- Radiometric normalization does impact the results of an NDVI analysis
- More differences between the NDVI change results are in the mountainous region
- Ground truth data is needed to confirm accuracy

Limitations

- Rerunning the model with different sized areas
- No ground truth data
- Trying different models

- Know your area

References

- Lab 3
- Elvidge, C.D. et al. 1995. Relative radiometric normalization of Landsat MSS data using an automatic scattergram-controlled regression. *PE&RS* 61(10):1255-1260.
- Erdas Field Guide Volume 2