Tasseled Cap Transformation on Lake Tahoe to Observe Shoreline Alteration

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GEOG 342 Final Project

Summary:

Due to the drought Lake Tahoe had nearly record breaking low water levels in 2015. In 2017 due to the amount of rain and spring snowfall in the Sierra's Lake Tahoe's water levels were near capacity for time in over a decade. For my project I wanted to observe and compare Lake Tahoe's shoreline in 2015 and 2017. To do this I decided to utilize the Tasseled Cap Transformation (TC) function in ArcGIS Pro.

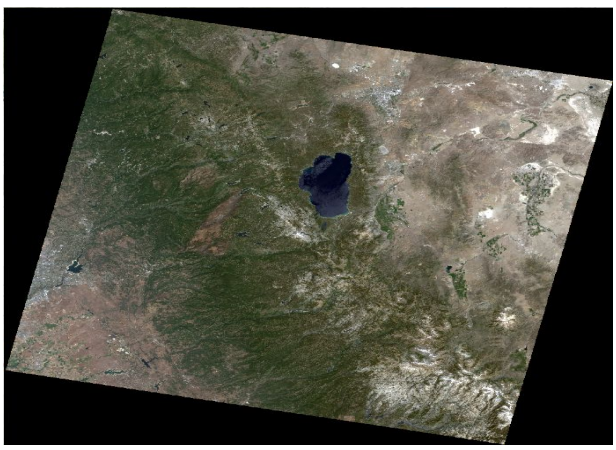
Methodology:

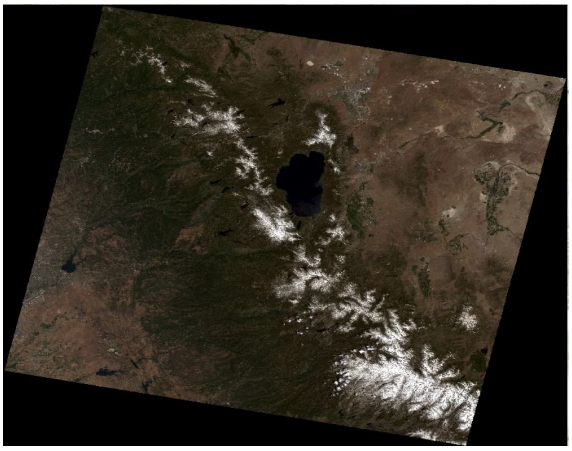
The first step of this project was to obtain clear images https://earthexplorer.usgs.gov/ was used to find imagery. Image search criteria consisted of:

- Place: Lake Tahoe (Path 43/Row 33)
- Date:June 1- June 30, 2015 and 2017
- Data Set: Landsat 8 OLI (Operational Land Imagery) and TIRS (Thermal Infrared Sensor) C1 Level 1

In order to download data that could be utilized for the project a login had to be created. Once logged in data could be downloaded freely. The first image sets I tried to use for my project were from June 18, 2015 and June 23, 2017:

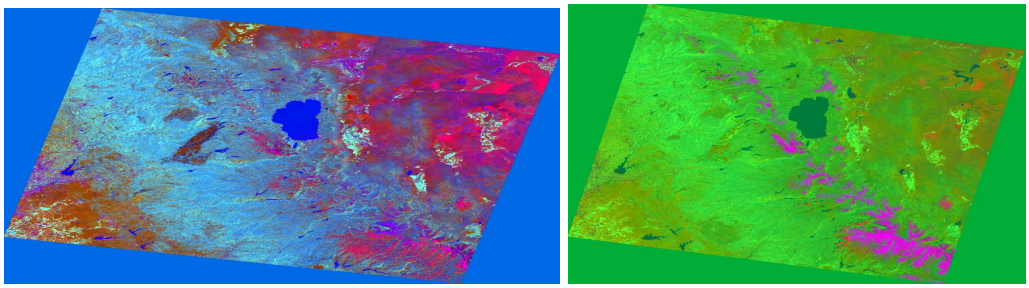
2015 2017





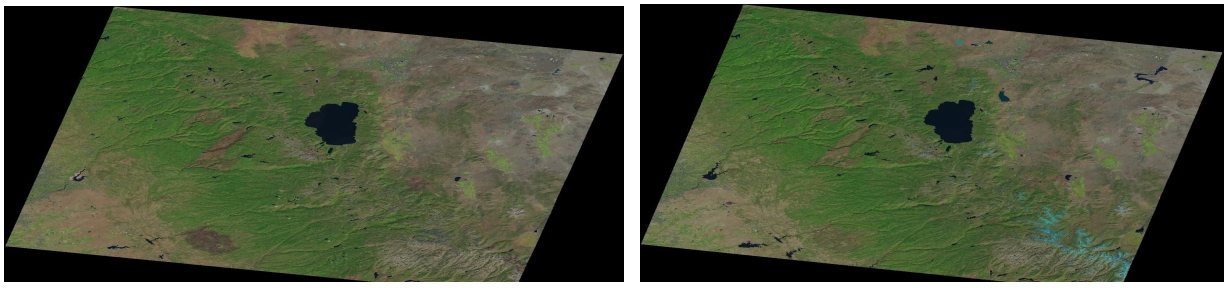
For both images the Level-1 Geo TIFF Data Product was downloaded. Once the Geo TIFF was downloaded WinZip was used to extract the files so the MTL.txt files could be accessed in ArcGIS Pro. After the datasets were obtained the next step was to perform the TC on the images as done in the Band Ratios and Transformations lab. After TC was ran on the obtained images the following images were obtained:

2015 2017



From the above images it's clear that the data obtained would not be suitable for the project. Upon further research I learned that in order for TC to run properly the image needs to be clear and cannot be "extended" by ice or snow. I searched for image data sets in July, August, and September with the same criteria as previously used for June. After observing data sets from each of those months I decided the best image sets that fit the criteria for the project were from September 22, 2015 and September 27, 2017.

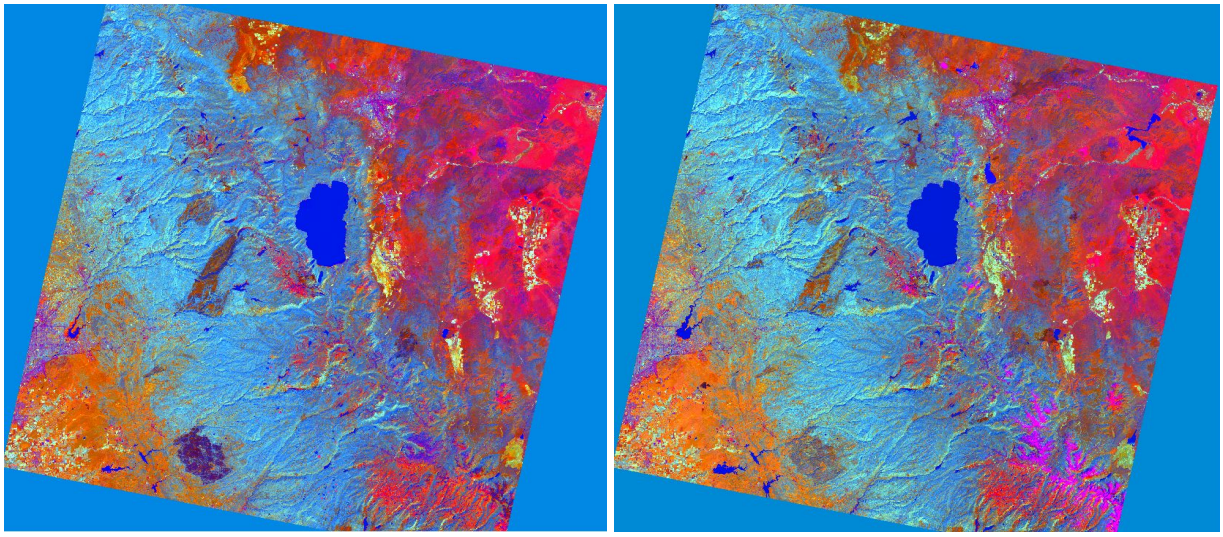
2015 2017



Once again I downloaded the Level-1 Geo TIFF Data Product for the September images and used WinZip to the extract the files so the MTL.txt file could be accessed. After the datasets

were obtained the TC function was ran once again on the September MTL.txt files. After TC was ran on the obtained images the following images were obtained:

2015 2017



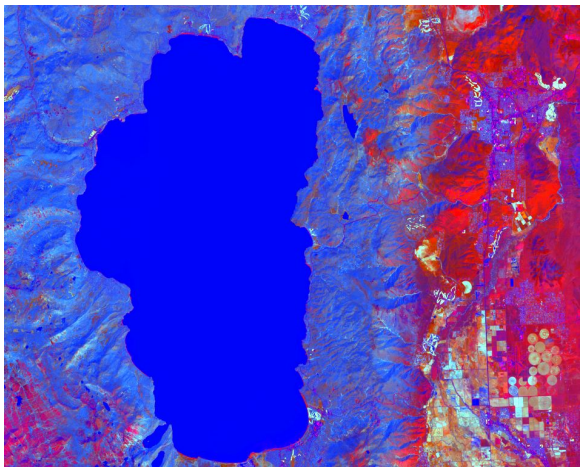
The above images are the desired result for running TC. To confirm that the datasets were appropriate I also checked the band statistics which are shown below:

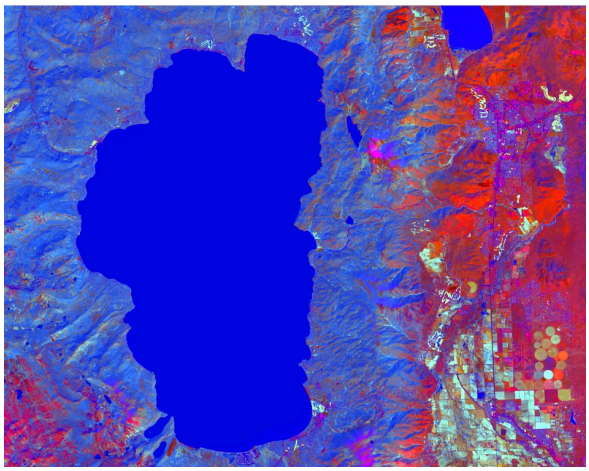
	Min	Max	Mean	Std. dev
Red	12924.4052734375	82922.4765625	21008.030051954585	4779.45457441518 92
Green	-7369.76416015625	11353.6611328125	-918.403389894904 76	1824.1515767080787
Blue	-39649.47265625	6272.76025390625	-1552.671967154105	1786.7846387361437

	Min	Max	Mean	Std. dev
Red	12643.0234375	87010.109375	20475.896123651284	4611.9385701144229
Green	-14952.7255859375	10681.1279296875	-850.783399076087	1822.7986144770323
Blue	-38184.21484375	28497.61328125	-1277.4342675448404	1762.5069451563286

The band statistics were obtained from the symbology menu: Red represents band 1/brightness band, Green represents band 2/greenness band, and Blue represents band 3/wetness band.
From the TC images the next step was clip the image so the image processing was more focused on Lake Tahoe. The following images and band statistics were obtained:

2015 2017



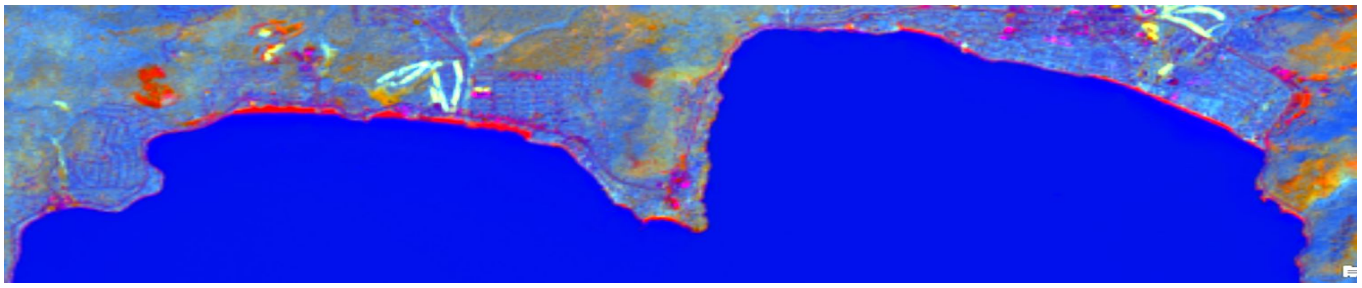


	Min	Max	Mean	Std. dev
Red	12733.7373046875	70274.2421875	21682.708990262785	6811.2617122786769
Green	-11667.8916015625	12993.09375	-1676.90529375504 27	2018.9418525681406
Blue	-27014.615234375	8154.3603515625	-2233.4513438923836	2529.9618992445007

	Min	Max	Mean	Std. dev
Red	12514.384765625	70042.03125	20878.63269074152	6228.2446220875936
Green	-11488.4794921375	11391.818359375	-1446.387457290389	2008.8301523671969
Blue	-21719.92578125	18332.43359375	-1772.424257613 62	2208.8875856269606

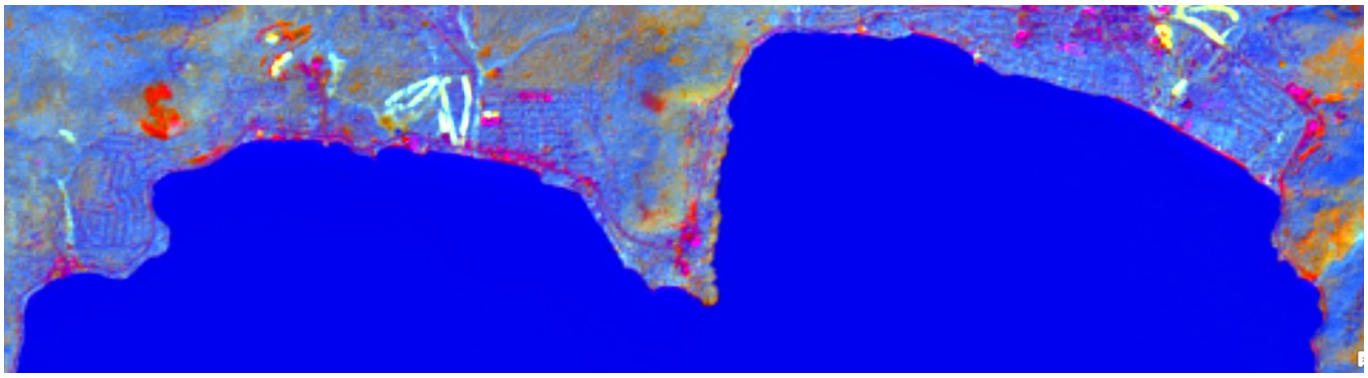
While the above images do show some differences in Lake Tahoe's shoreline I decided to zoom in closer and crop sections of the shoreline. Lake Tahoe's shoreline was divided into: North, North-East, Mid-East, South-East, South, South-West, Mid-West, and North-West. Below are the images and band statistics of the clip images of the shorelines:

North shoreline 2015



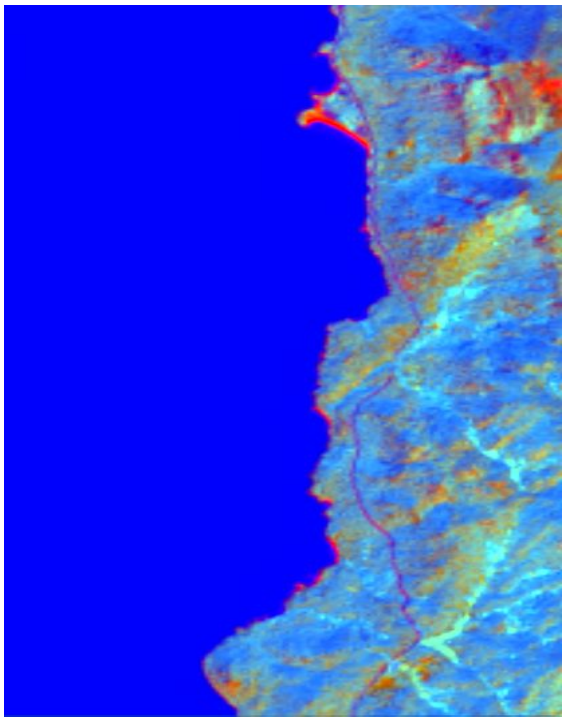
	Min	Max	Mean	Std. dev
Red	13221.3662109375	56493.72265625	18712.148780849831	3901.13847231368
Green	-8040.39990234375	11879.2783203125	-1008.445580781374	1893.8523424477
Blue	-9871.060546875	3673.068115234375	-663.93494826425865	1051.83573502128

North shoreline 2017



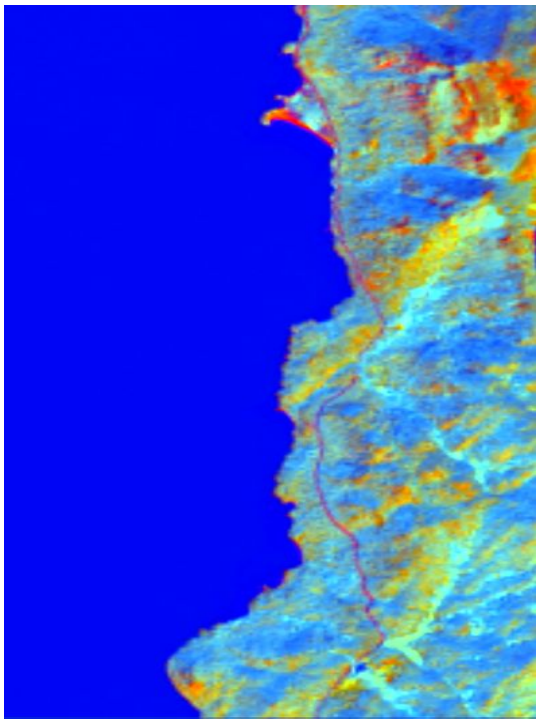
	Min	Max	Mean	Std. dev
Red	13170.05078125	52174.1640625	18313.165121251226	3723.5163366043635
Green	-7341.884765625	11897.36328125	-917.66154161770316	1877.3613416365058
Blue	-24705.12890625	3378.837890625	-548.326710355084	970.54230041844232

North-East shoreline 2015



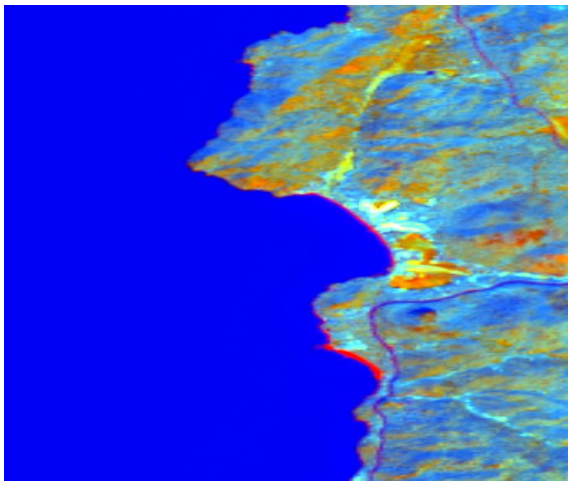
	Min	Max	Mean	Std. dev
Red	12733.7373046875	45617.01171875	16161.4299188658	4482.47722172529
Green	-6694.2509765625	5326.79345703125	-2428.6468924041651	1583.18614575263
Blue	-10760.7978515625	2301.825927734375	-570.22991246194727	1469.75027123309

North-East shoreline 2017



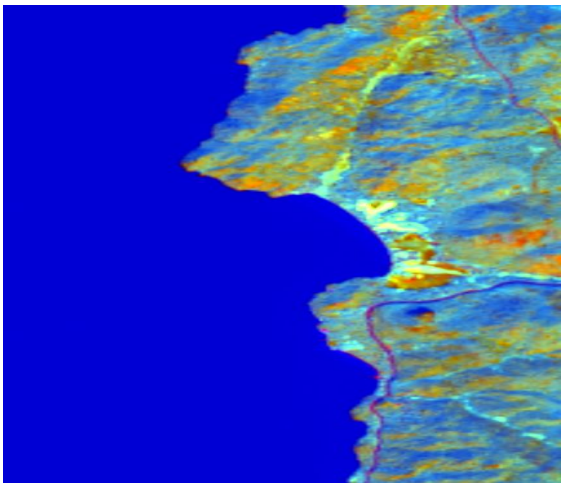
	Min	Max	Mean	Std. dev
Red	13149.4033203125	38212.06640625	14669.028593462523	3077.62874466104
Green	-5881.38330078125	4322.1220703125	-2801.1352354201472	1325.09018390504
Blue	-7891.5283203125	3453.70947265625	-137.85959475437525	875.9591429531132

Mid-East shoreline 2015



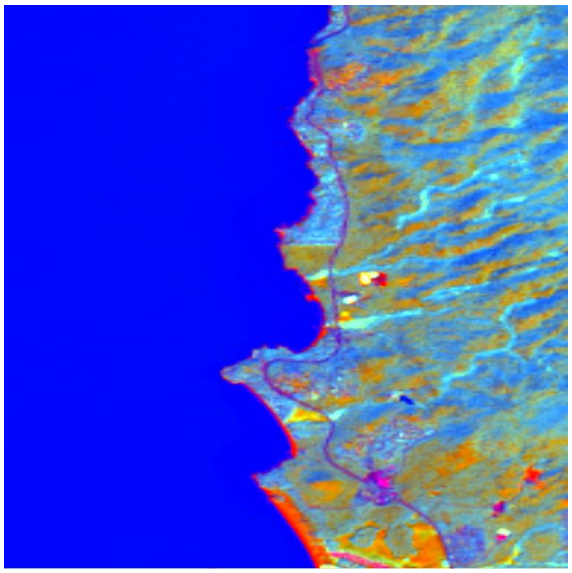
	Min	Max	Mean	Std. dev
Red	13202.265625	40722.29296875	16395.348454172788	4145.693428937619
Green	-5302.3134765625	10897.3544921875	-2159.0838629663	1715.6433727758581
Blue	-9232.8896484375	1774.94189453125	-499.11891622395484	1186.2793106389881

Mid-East shoreline 2017



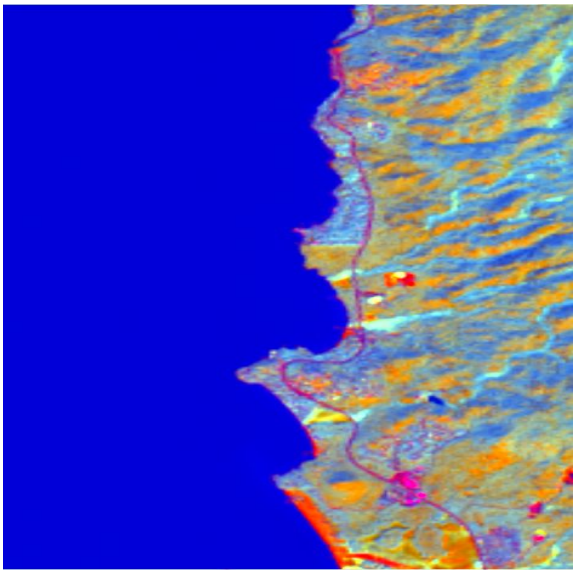
	Min	Max	Mean	Std. dev
Red	13146.8505859375	39348.18359375	16101.318115552189	3879.854078286991
Green	-4852.30712890625	10338.009765625	-2059.90716274111081	1763.2432351303112
Blue	-8986.875	4549.03857421875	-349.353746175266651	1031.7414442238366

South-East shoreline 2015



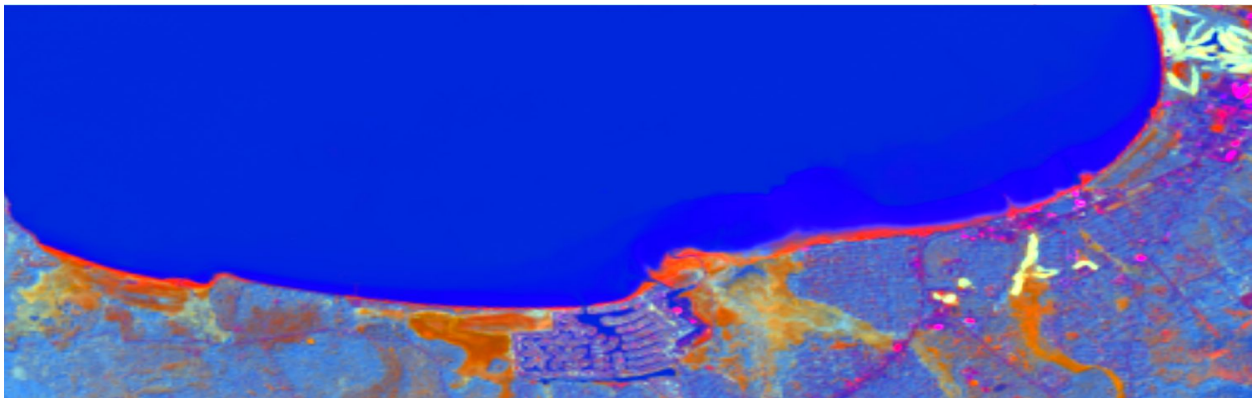
	Min	Max	Mean	Std. dev
Red	13198.9560546875	67244.9453125	16039.836111214767	3863.0279150901997
Green	-9068.796875	10774.2080078125	-2345.8820800709991	1636.1315417079009
Blue	-27014.615234375	2528.248046875	-421.96612596340134	1109.4361245976547

South-East shoreline 2017



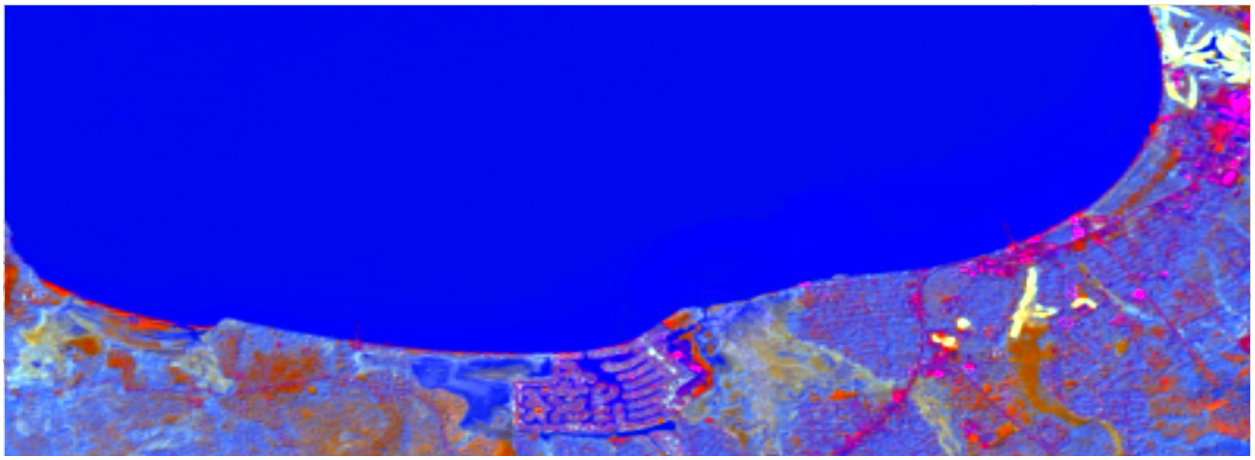
	Min	Max	Mean	Std. dev
Red	13032.818359375	59698.46875	15754.357436726792	3573.8258263058419
Green	-6322.6328125	8132.43701171875	-2250.0177926070446	1668.245469736527
Blue	-21719.92578125	6504.75537109375	-275.81976772959956	937.05653796156275

South shoreline 2015



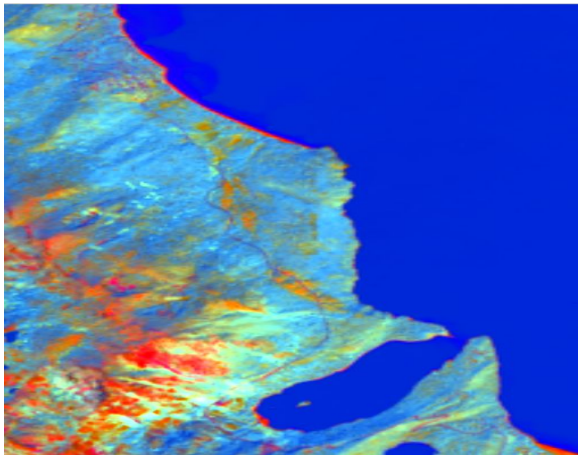
	Min	Max	Mean	Std. dev
Red	12926.4560546875	63963.9765625	17234.832572657342	4698.28832982608
Green	-7953.0986328125	11179.888671875	-2393.0555981707312	1932.6476718844169
Blue	-11956.3095703125	5354.296875	-572.77104540838786	1675.9088736022845

South shoreline 2017



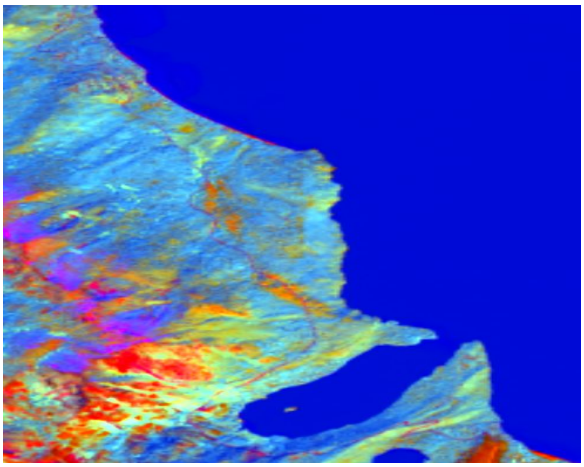
	Min	Max	Mean	Std. dev
Red	12514.384765625	62924.48046875	16340.712917536985	4000.26670559106
Green	-8174.12548828125	11391.818359375	-2208.2632158910797	1902.4083169185715
Blue	-10360.0234375	4808.20947265625	-284.23984831309991	992.5911599602257

South-West shoreline 2015



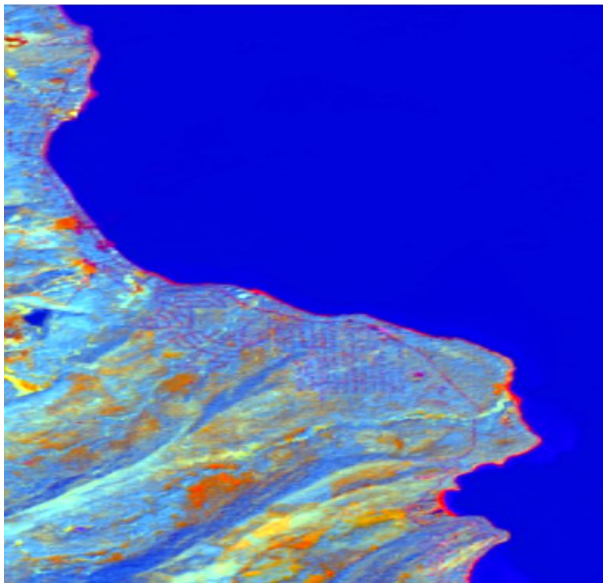
	Min	Max	Mean	Std. dev
Red	12996.6103515625	39854.62890625	17476.615599621367	4846.99812304380
Green	-6169.72509765625	10511.4365234375	-1996.7078652639225	1906.7102537789444
Blue	-8623.298828125	2703.33837890625	-605.18128853106316	1350.8204351826277

South-West shoreline 2017



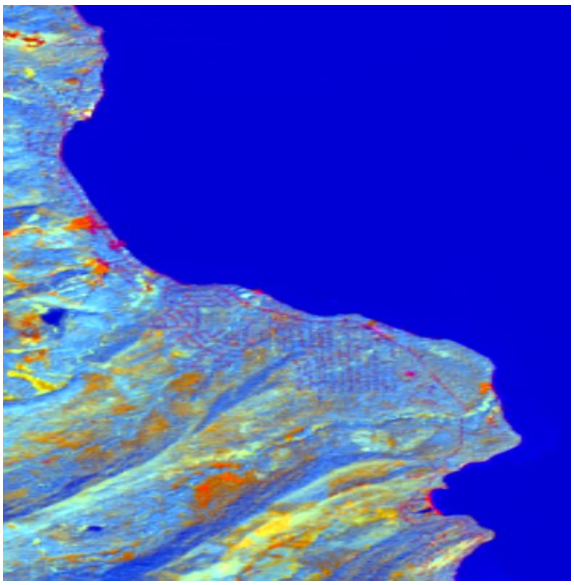
	Min	Max	Mean	Std. dev
Red	13032.818359375	59698.46875	15754.357436726792	3573.8258263058419
Green	-6322.6328125	8132.43701171875	-2250.0177926070446	1668.245469736527
Blue	-21719.92578125	6504.75537109375	-275.81976772959956	937.05653796156275

Mid-West shoreline 2015



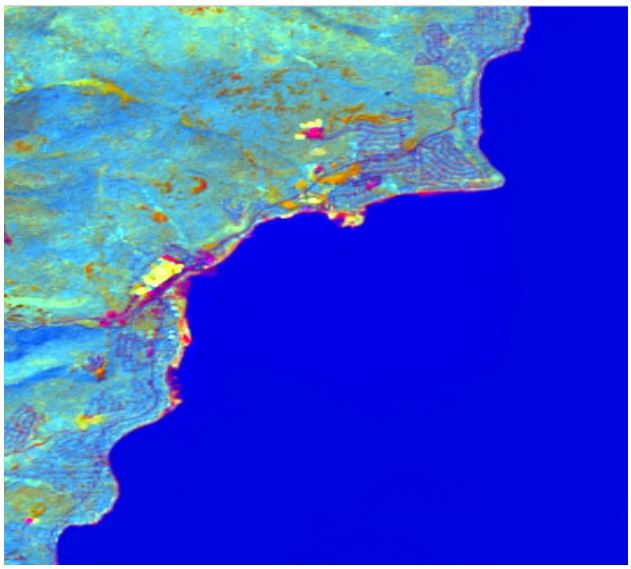
	Min	Max	Mean	Std. dev
Red	13202.265625	40722.29296875	16395.348454172788	4145.693428937619
Green	-5302.3134765625	10897.3544921875	-2159.0838629663	1715.6433727758581
Blue	-9232.8896484375	1774.94189453125	-499.11891622395484	1186.2793106389881

Mid-West shoreline 2017

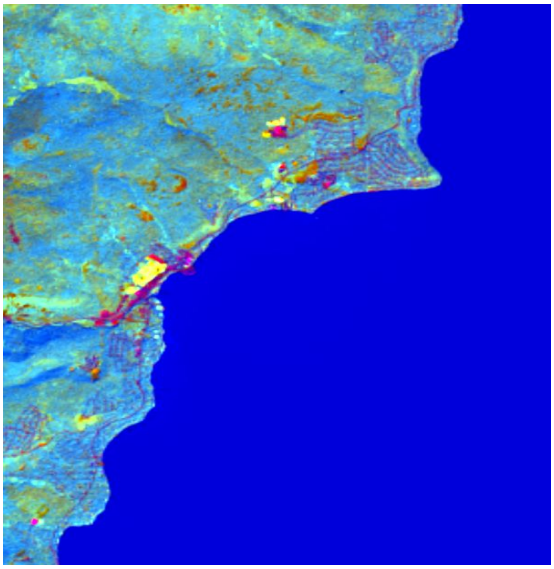


	Min	Max	Mean	Std. dev
Red	13146.8505859375	39348.18359375	16101.318115552189	3879.85407828699
Green	-4852.30712890625	10338.009765625	-2059.9071627411081	1763.2432351303112
Blue	-8986.875	4549.03857421875	-349.353746175266 51	1031.7414442238 36

North-West 2015



North-West 2017



	Min	Max	Mean	Std. dev
Red	13208.828125	61716.95703125	16162.34298034011	3660.8201701090834
Green	-7127.72509765625	10539.619140625	-2014.4425448656302	1920.5969150920509
Blue	-8321.849609375	4567.640625	-135.68469184744731	860.5917502448875

	Min	Max	Mean	Std. dev
Red	13153.77734375	73788.7890625	15829.082006922939	3424.1943128019161
Green	-7122.3623046875	10134.083984375	-1973.1073288564992	1883.7022229873357
Blue	-11143.17578125	4112.77880859375	-76.787775469086 27	729.03616224600148

From the images and band statistics it was observed that the brightness band had lower values in 2017 than in 2015 and the greenness and wetness bands had higher values.

Conclusion:

If clear imagery of Lake Tahoe can be obtained then Tasseled Cap could be utilized to observe alterations of its shoreline. Comparing Lake Tahoe's shores from 2015 and 2017 there is clear difference in the shoreline.

References:

https://earthexplorer.usgs.gov/

http://pro.arcgis.com/en/pro-app/help/data/imagery/tasseled-cap-transformation.htm#ESRI_SECTION1_CB5212F9B1AC48549E6DC4526F24A7BD

https://pubs.usgs.gov/of/2003/0272/OFR03-272.pdf