Coordinates

Polygon Coordinates

Lat: -2.318169152494475

Lon: -60.1446533203125

Radius: 50,000

Fishbone Coordinates

Path: 231
Row: 059

Lat: 0.9859742824625409

Lon: -60.02655029296875

Radius: 50,000

OLI

Bands= 2,3,4,5,6,7

ETM+=1,2,3,4,5,7

Poster details

Slide 1:Introduction to Study Area:

- Project description,
- Objective

Map (insert location)

Slide 2: Data Description

- Scene (picture of our data set)
- Include true composite
- Radiometic, spatial, and spectral, and geometric characteristics
- Number of bands and which ones.

Slide 3: Image Enhancement

- Define image enhancement and why it is is important to your project

Slide 4:” Image Transformation

- NDVI, NDSI, water content
- Classification: transition, separability

    a. Transformation
        - Map time1
        - Map time 2
        - Difference
    b. Classification
        - Training; sig file, AOI, spectral prole

Slide 5: Classification Algorithms

- Map 1
- Map 2
- Change (in the form of a table/pie chart)

Slide 6: Accuracy Assessment (optional/EC)

Slide 7: Conclusion

- Dew results
- Wat it shows
- How the spectral analysis helps

Location- sao luis, sao luiz and sa joa da baliza

Classes for signature editor:

1. **Dirt RoadsX**
2. **Clouds X**
3. **Cloud Shadow X**
4. **Water/ River in the top left of the image X**
5. **Forest X**
6. **Urban Area X**
7. **Cut DownX**

Project Description

We are looking at deforestation in the Brazilian Amazon, a place covered by thick forest. In particular, we would like to see how much of the forest has been cut down to so make room for industrial development. In the Amazon, many areas that were once covered by forest have been converted to mainly agriculture land. Our study area covers an area of (INSERT SQUARE AREA) and contains mainly agricultural land surrounded by forest. We are looking at Landsat 7 ETM+ and Landsat 8 OLI images from May 2013, May 2017, May 2022. Our data utilized 6 bands (2-7): Blue, Green, Red, NIR, SWIR1, and SWIR2. With the region being very big, we cropped our images specifically to North of Manaus, along Hwy 174. The area is located in the centroid of the towns Sao Luis, Sao Luiz, and Sao Joao Da Baliza.

Radiometric Correction

The initial dataset we utilized lacked standardization and error correction. During the collection of reflectance data by sensors, the raw information is influenced by atmospheric absorption and scattering, causing electromagnetic radiation distortion as it travels from ground objects to the sensor. To address this, we perform radiometric corrections to adjust for these effects and convert the reflectance values to top of atmosphere (TOA) reflectance. These corrections involve applying a formula to each pixel, represented as $p(\lambda) = (M_p Q_{cal} + A_p)/\sin(\theta_{SE})$, where $p(\lambda)$ represents TOA reflectance. M_p and A_p are band-specific multiplicative and additive rescaling factors obtained from metadata, respectively, and θ_{SE} denotes the solar zenith angle retrieved from metadata. Applying this formula to each pixel yields a standardized image with TOA reflectance values ranging from 0 to 1. For Landsat 7 EMT+ images, a different formula is required to convert digital number (DN) values to reflectance. To calculate radiance, the formula $L = [(Lmax - Lmin)/255]DN + Lmin$ is employed, where L represents radiance for each pixel. To convert radiance to reflectance, the formula $p_p = (\pi * \lambda * d^2) * ESUN_\lambda * \cos(\theta)_s * p_p$ is used, where p_p signifies unitless planetary reflectance, L is radiance obtained from the previous equation, d denotes the Earth-Sun distance in astronomical units, ESUN represents the mean solar irradiance varying by wavelength, and θ indicates the solar

zenith angle in degrees. Implementing these radiometric corrections ensures standardized reflectance values in the images, enhancing accuracy and facilitating data comparison across sensors.

$p_p = (\pi * \lambda \ * d^{2}) * ESUN_{\lambda} * \cos(\theta)_s * p_p$

$p(\lambda) = (M_p Q_{cal} + A_p)/\sin(\theta_{SE})$

$[(Lmax - Lmin)/255]DN + Lmin$

Image Enhancement (VEGETATION INDEX)

The goal for image enhancement is to improve the appearance of the images so that it is easier to work with, understand, and even visualize. For the image enhancement we used a combination of the SWIR1, NIR, and green bands (Bands 5,4,2). Healthy vegetation has higher values of reflectance in the infrared wavelengths, so it was important we used infrared bands so that the vegetation would stand out. The SWIT1, NIR, and Green band composite allows us to see the vegetation and crops as green and soil and other agriculture as bright purple/ pink. Lastly, we used a histogram equalization to distribute the reflectance values of our images across the full spectrum of available values, resulting in a sharper and more defined image that is easier to work with. The gaols was to clearly see any changes between the 15 year tenure, as well as being able to see the landscape clearly, more specifically being able to clearly see how vegetation is being impacted with deforestation effects.

2013

2017

2022

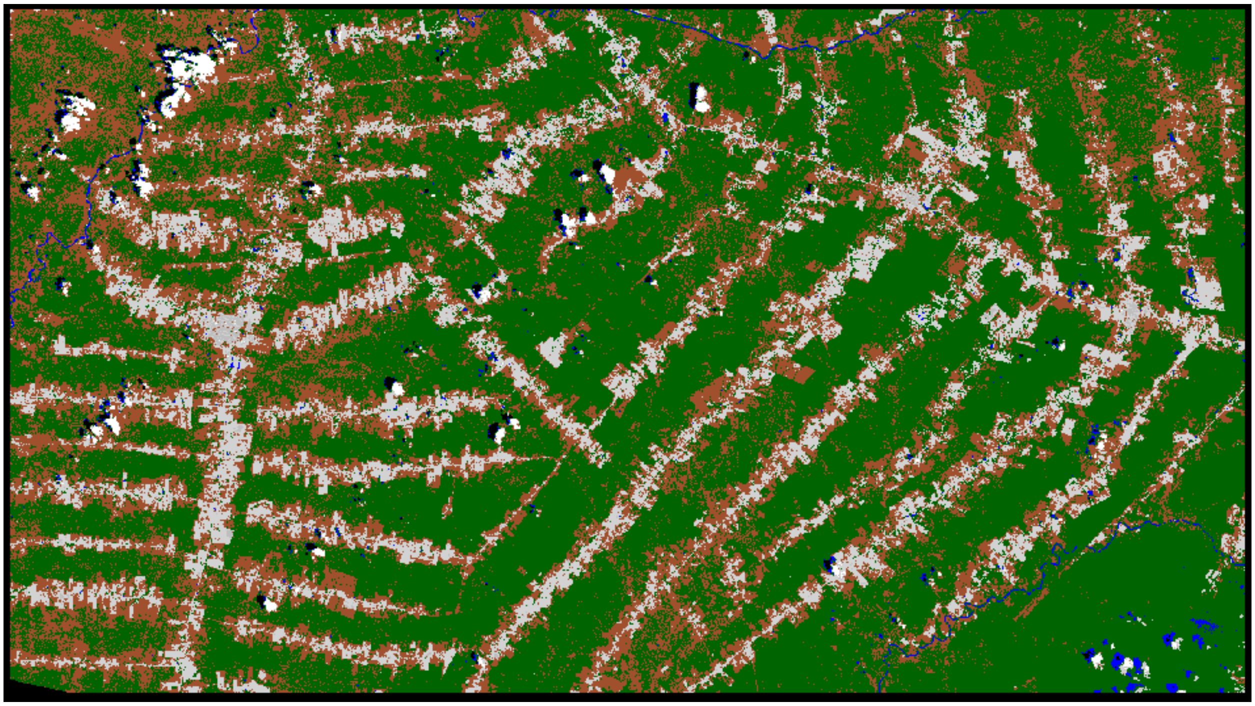
Image Classification (ASSIGNMENT 4 THINGY)

To be able to more effectively understand and visualize the area of study we performed a supervised classification using the minimum distance algorithm.

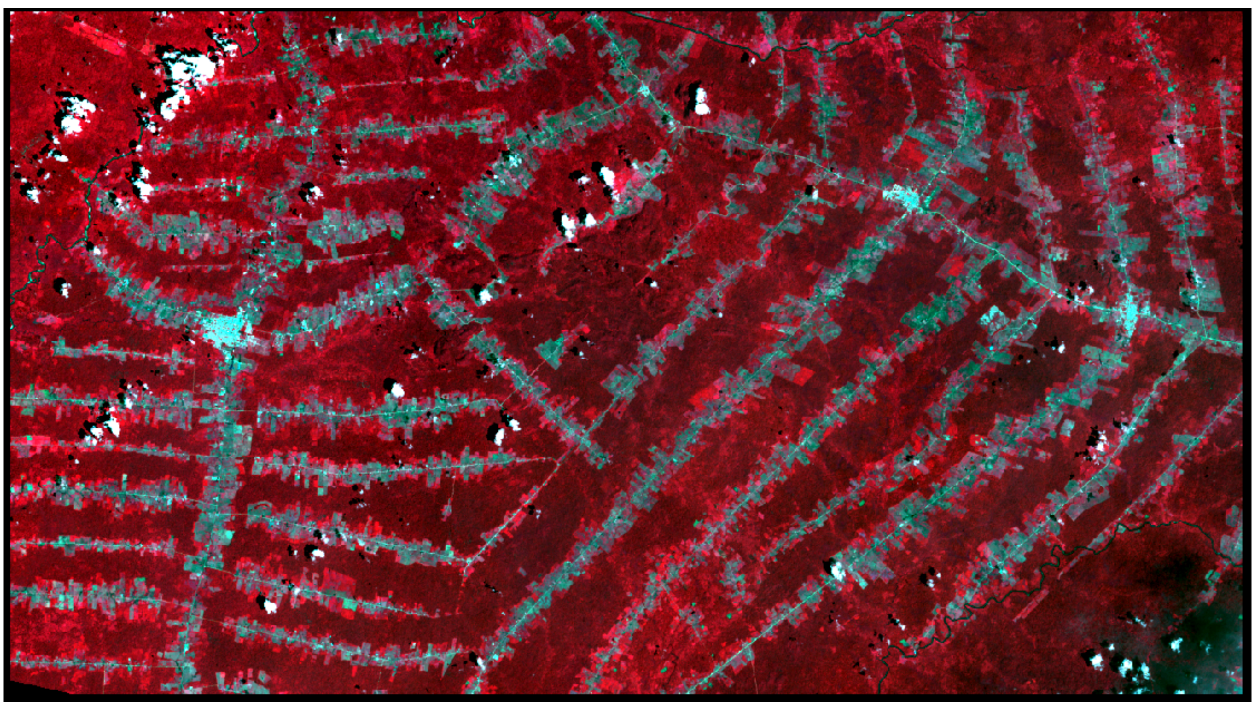
We chose the minimum distance instead of the maximum likelihood because of precise minimum distance came out to be. When we tried maximum likelihood the output was not what we expected because most areas turned out to be water or urban when it was the opposite. We chose to have seven different classes: Water, Clouds, Cloud Shadows, Urban, Roads, Cutdown, Forest. For our training sites we chose 2 forests, 4 clouds, 4 Shadows, 4 waters, 4 Urban, and 4 roads. In total, we had approximately 28 training sites for 2013, 26 for 2017, and 35 for 2022 data. Using these training sites we were able to group pixels form our image into our 7 classes to create an supervised classification. Our Classification allowed us to more easily visualize the landscape, and

identify the effects of deforestation and urban sprawl in the Amazon from May 2013 to May 2017 to May 2022.

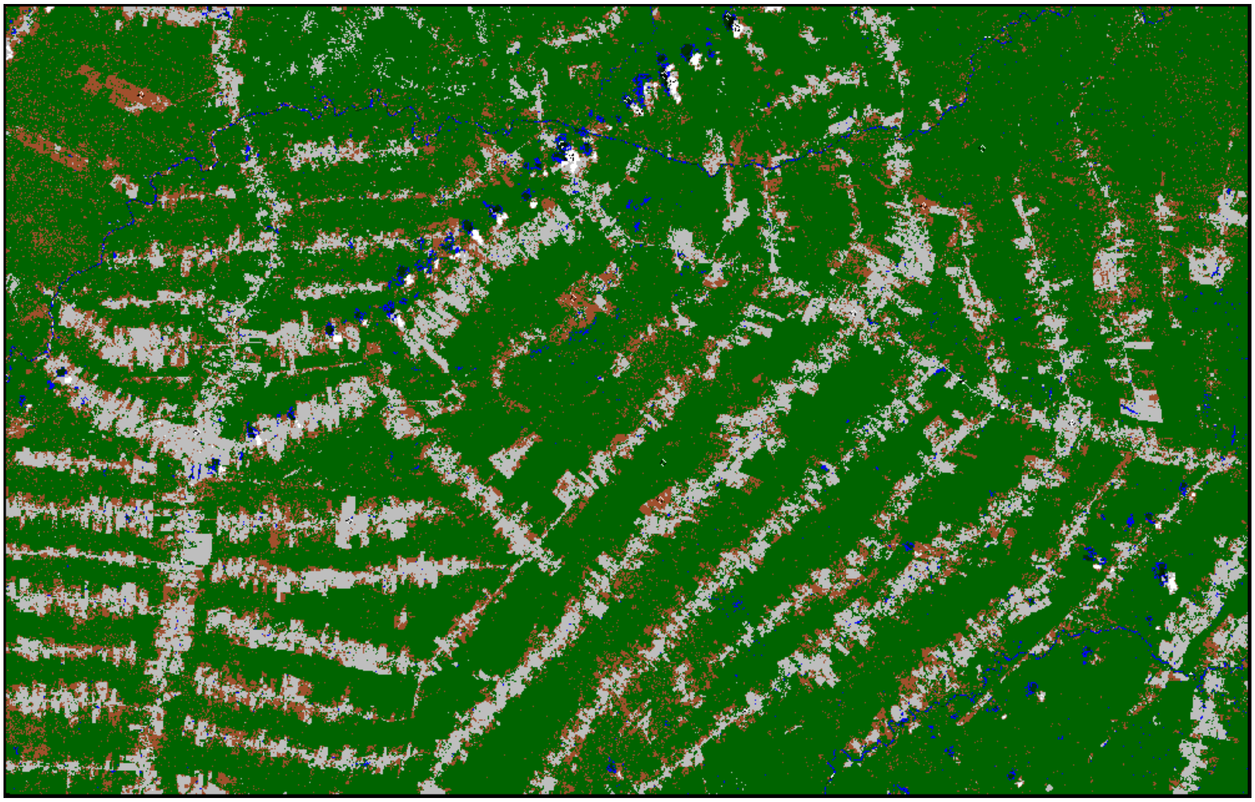
1. **2013 - alex**



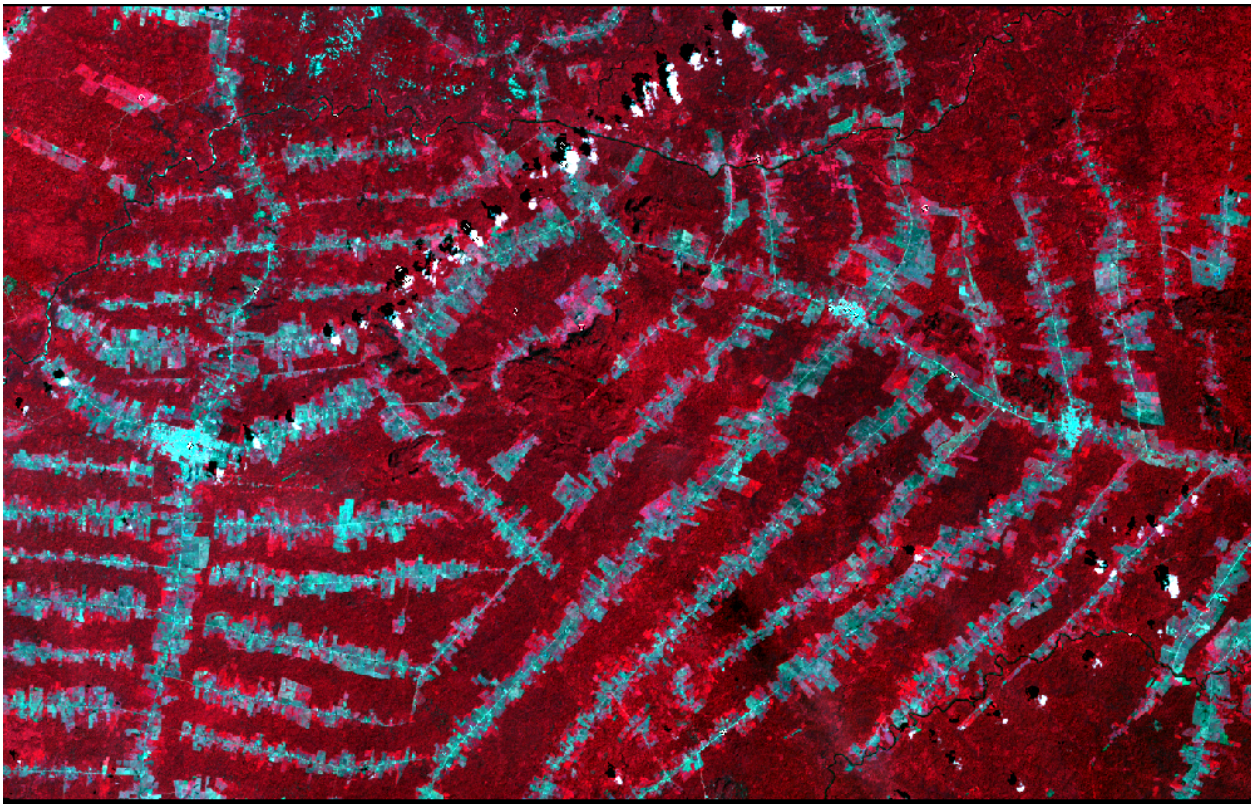
Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob.	P	I	H	A	FS
1	▶	Urban		0.753	0.753	0.753	1	1	100	1.000	✔	✔	✔	✔	
2		U2		0.753	0.753	0.753	2	2	100	1.000	✔	✔	✔	✔	
3		U3		0.753	0.753	0.753	3	3	100	1.000	✔	✔	✔	✔	
4		U4 C2		0.753	0.753	0.753	4	4	100	1.000	✔	✔	✔	✔	
5		U5 C3		0.753	0.753	0.753	5	5	100	1.000	✔	✔	✔	✔	
6		Cloud		1.000	1.000	1.000	6	6	100	1.000	✔	✔	✔	✔	
7		Cl2		1.000	1.000	1.000	7	7	100	1.000	✔	✔	✔	✔	
8		Cl3		1.000	1.000	1.000	8	8	100	1.000	✔	✔	✔	✔	
9		Cl4		1.000	1.000	1.000	9	9	100	1.000	✔	✔	✔	✔	
10		Cloud Shadow		0.000	0.000	0.000	10	10	100	1.000	✔	✔	✔	✔	
11		CS2		0.000	0.000	0.000	11	11	100	1.000	✔	✔	✔	✔	
12		CS3		0.000	0.000	0.000	12	12	100	1.000	✔	✔	✔	✔	
13		Water		0.000	0.000	1.000	13	13	100	1.000	✔	✔	✔	✔	
14		Water2		0.000	0.000	1.000	14	14	100	1.000	✔	✔	✔	✔	
15		Water3		0.000	0.000	1.000	15	15	100	1.000	✔	✔	✔	✔	
16		Water4		0.000	0.000	1.000	16	16	73	1.000	✔	✔	✔	✔	
17		Forest		0.000	0.392	0.000	17	17	100	1.000	✔	✔	✔	✔	
18		Forest2		0.000	0.392	0.000	18	18	100	1.000	✔	✔	✔	✔	
19		Forest3		0.000	0.392	0.000	19	19	100	1.000	✔	✔	✔	✔	
20		Forest4		0.000	0.392	0.000	20	20	100	1.000	✔	✔	✔	✔	
21		Forest5		0.000	0.392	0.000	21	21	100	1.000	✔	✔	✔	✔	
22		Road		0.827	0.827	0.827	22	22	51	1.000	✔	✔	✔	✔	
23		Road 2		0.827	0.827	0.827	23	23	13	1.000	✔	✔	✔	✔	
24		Cutdwon		0.627	0.322	0.176	24	24	100	1.000	✔	✔	✔	✔	
25		CD2		0.627	0.322	0.176	25	25	100	1.000	✔	✔	✔	✔	
26		CD3		0.627	0.322	0.176	26	26	100	1.000	✔	✔	✔	✔	
27		CD4		0.627	0.322	0.176	27	27	100	1.000	✔	✔	✔	✔	



2. 2017 - vick

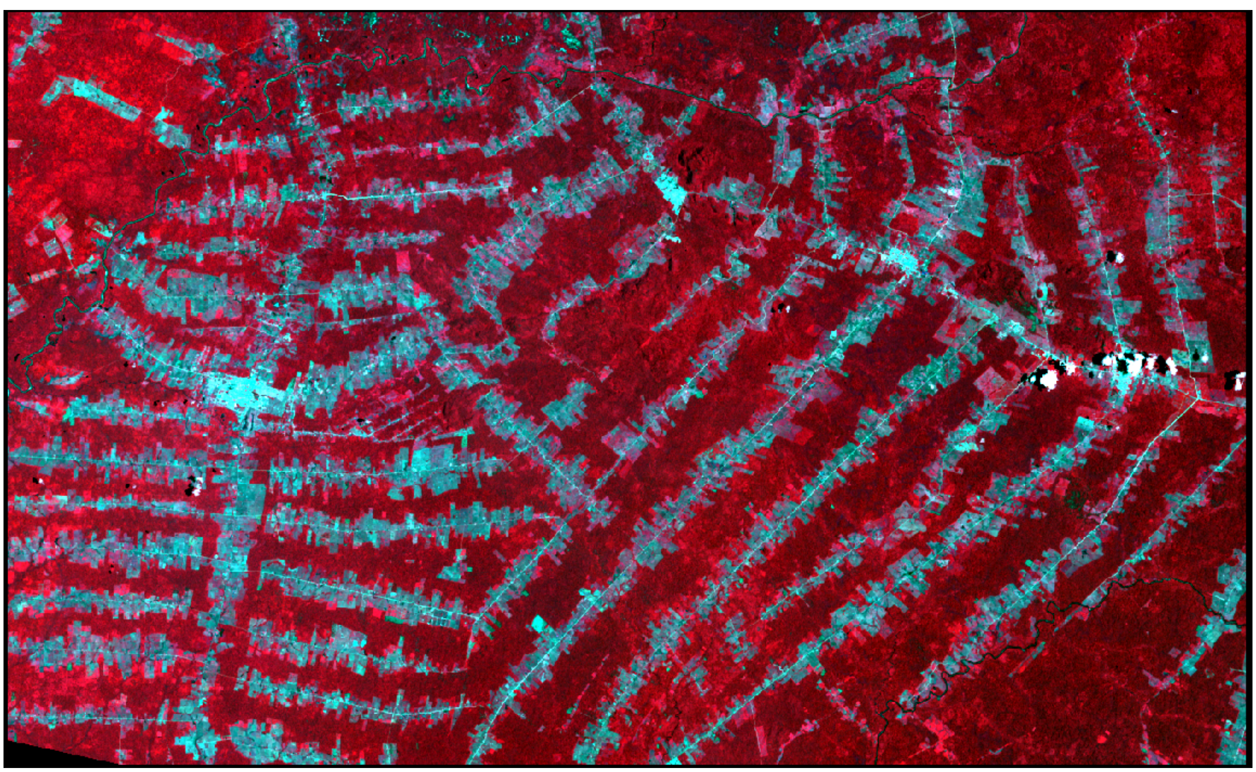


Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob.	P	I	H	A	FS
1	▶	CloudShadow1		0.000	0.145	0.000	1	1	108	1.000	✔	✔	✔	✔	
2		CloudShadow2		0.000	0.214	0.045	2	2	100	1.000	✔	✔	✔	✔	
3		Cloud Shadow 3		0.000	0.056	0.000	3	3	100	1.000	✔	✔	✔	✔	
4		CloudShadow4		0.000	0.206	0.009	4	4	100	1.000	✔	✔	✔	✔	
5		Cloud4		1.000	1.000	1.000	5	5	95	1.000	✔	✔	✔	✔	
6		Cloud3		1.000	1.000	1.000	6	6	100	1.000	✔	✔	✔	✔	
7		Cloud2		1.000	1.000	1.000	7	7	100	1.000	✔	✔	✔	✔	
8		Cloud1		1.000	1.000	1.000	8	8	100	1.000	✔	✔	✔	✔	
9		Cutdown1		0.627	0.322	0.176	9	9	100	1.000	✔	✔	✔	✔	
10		Cutodwn2		0.627	0.322	0.176	10	10	100	1.000	✔	✔	✔	✔	
11		Cutodwn3		0.627	0.322	0.176	11	11	100	1.000	✔	✔	✔	✔	
12		Cutdown4		0.627	0.322	0.176	12	12	100	1.000	✔	✔	✔	✔	
13		Forest1		0.000	0.392	0.000	13	13	100	1.000	✔	✔	✔	✔	
14		Forest2		0.000	0.392	0.000	14	14	100	1.000	✔	✔	✔	✔	
15		Urban1		0.753	0.753	0.753	15	15	100	1.000	✔	✔	✔	✔	
16		Urabn2		0.753	0.753	0.753	16	16	100	1.000	✔	✔	✔	✔	
17		Urban3		0.753	0.753	0.753	17	17	100	1.000	✔	✔	✔	✔	
18		Urban4		0.753	0.753	0.753	18	18	100	1.000	✔	✔	✔	✔	
19		road1		0.753	0.753	0.753	19	19	53	1.000	✔	✔	✔	✔	
20		road2		0.753	0.753	0.753	20	20	50	1.000	✔	✔	✔	✔	
21		road3		0.753	0.753	0.753	21	21	38	1.000	✔	✔	✔	✔	
22		road4		0.753	0.753	0.753	22	22	61	1.000	✔	✔	✔	✔	
23		Water1		0.000	0.000	1.000	23	23	30	1.000	✔	✔	✔	✔	
24		Water2		0.000	0.000	1.000	24	24	16	1.000	✔	✔	✔	✔	
25		Water3		0.000	0.000	1.000	25	25	31	1.000	✔	✔	✔	✔	
26		Water4		0.000	0.000	1.000	26	26	30	1.000	✔	✔	✔	✔	



3. **2022 - Anish**

Class #	>	Signature Name	Color	Red	Green	Blue	Value	Order	Count	Prob.	P	I	H	A	FS
1		Urban Area		0.753	0.753	0.753	1	1	100	1.000	✔	✔	✔	✔	
2		Urban 1		0.753	0.753	0.753	2	2	100	1.000	✔	✔	✔	✔	
3		Urban 2		0.753	0.753	0.753	3	3	100	1.000	✔	✔	✔	✔	
4		Urban 3		0.753	0.753	0.753	4	4	100	1.000	✔	✔	✔	✔	
5		CS1		0.000	0.000	0.000	7	7	100	1.000	✔	✔	✔	✔	
6		CS2		0.000	0.000	0.000	8	8	100	1.000	✔	✔	✔	✔	
7		CS3		0.000	0.000	0.000	9	9	100	1.000	✔	✔	✔	✔	
8		CS4		0.000	0.000	0.000	10	10	100	1.000	✔	✔	✔	✔	
9		Clouds		1.000	1.000	1.000	11	11	100	1.000	✔	✔	✔	✔	
10		C1		1.000	1.000	1.000	12	12	54	1.000	✔	✔	✔	✔	
11		C2		1.000	1.000	1.000	13	13	100	1.000	✔	✔	✔	✔	
12		C3		1.000	1.000	1.000	14	14	41	1.000	✔	✔	✔	✔	
13		C4		1.000	1.000	1.000	15	15	72	1.000	✔	✔	✔	✔	
14		Water/River		0.000	0.000	1.000	16	16	23	1.000	✔	✔	✔	✔	
15		Water/River 1		0.000	0.000	1.000	17	17	34	1.000	✔	✔	✔	✔	
16		Water/River 2		0.000	0.000	1.000	18	18	100	1.000	✔	✔	✔	✔	
17		Water/River 3		0.000	0.000	1.000	19	19	22	1.000	✔	✔	✔	✔	
18		Water/River 4		0.000	0.000	1.000	20	20	21	1.000	✔	✔	✔	✔	
19		Road		0.753	0.753	0.753	21	21	26	1.000	✔	✔	✔	✔	
20		Road 1		0.753	0.753	0.753	23	23	41	1.000	✔	✔	✔	✔	
21		Road 2		0.753	0.753	0.753	22	24	100	1.000	✔	✔	✔	✔	
22		Road 3		0.753	0.753	0.753	24	25	36	1.000	✔	✔	✔	✔	
23		Cutdown		0.627	0.322	0.176	25	26	100	1.000	✔	✔	✔	✔	
24		Cutdown 1		0.627	0.322	0.176	26	27	63	1.000	✔	✔	✔	✔	
25		Cutdown 2		0.627	0.322	0.176	27	28	100	1.000	✔	✔	✔	✔	
26		Cutdown 3		0.627	0.322	0.176	28	29	26	1.000	✔	✔	✔	✔	
27		Cutdown 4		0.627	0.322	0.176	29	30	100	1.000	✔	✔	✔	✔	
28		Forest		0.000	0.392	0.000	30	31	100	1.000	✔	✔	✔	✔	
29		Forest 1		0.000	0.392	0.000	31	32	100	1.000	✔	✔	✔	✔	
30		Forest 3		0.000	0.392	0.000	32	33	100	1.000	✔	✔	✔	✔	
31		Forest 4		0.000	0.392	0.000	33	34	100	1.000	✔	✔	✔	✔	
32	▶	Forest 5		0.000	0.392	0.000	34	35	100	1.000	✔	✔	✔	✔	



<u>Separability</u>

The tables below show how separate our training sites are, or in other words how different the pixels from our training sets are, which affects how well-made and accurate our classes will be. The only discrepancies we notice are the occasional values going below 1600 (which are usually 2000). Some values go as low as 560, but that is fine as it just means those training sites should be a single class, which they ended up being.

1. **2013**

Signature Name		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27
Urban1	1	0	1299.75	1339.49	1368.56	1463.56	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban2	2	1299.75	0	1947.98	1344.97	1356.35	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban3	3	1339.49	1947.98	0	1753.35	1940.31	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban4	4	1368.56	1344.97	1753.35	0	1015.57	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban5	5	1463.56	1356.35	1940.31	1015.57	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud1	6	2000	2000	2000	2000	2000	0	2000	1999.99	1986.14	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud2	7	2000	2000	2000	2000	2000	2000	0	1972.92	1970.82	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud3	8	2000	2000	2000	2000	2000	1999.99	1972.92	0	1494.26	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud4	9	2000	2000	2000	2000	2000	1986.14	1970.82	1494.26	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud Shadow1	10	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1846.38	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud Shadow2	11	2000	2000	2000	2000	2000	2000	2000	2000	2000	1846.38	0	2000	1999.99	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud Shadow3	12	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	2000	2000	2000	2000	2000	2000	1999.99	2000	2000	2000	2000	2000	2000	2000	2000
Water1	13	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	2000	0	1392.93	1996.59	1695.36	2000	2000	2000	2000	2000	1999.99	2000	2000	2000	2000	2000
Water2	14	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1392.93	0	1980.45	1758.22	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water3	15	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1996.59	1980.45	0	1685.04	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water4	16	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1695.36	1758.22	1685.04	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Forest1	17	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1621.07	1453.63	1599.6	1601.04	2000	2000	2000	1999.97	2000	2000
Forest2	18	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1621.07	0	1977.12	1937.51	1983.29	2000	2000	2000	2000	2000	2000
Forest3	19	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	2000	2000	2000	2000	1453.63	1977.12	0	1762.61	595.933	2000	2000	2000	1985.44	2000	1998.83
Forest4	20	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1599.6	1937.51	1762.61	0	1841.55	2000	2000	2000	1999.99	2000	2000
Forest5	21	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1601.04	1983.29	595.933	1841.55	0	2000	2000	2000	1994.22	2000	1999.29
Road1	22	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	2000	2000	2000	2000	2000	2000	2000	2000	0	1820.63	2000	2000	2000	2000
Road2	23	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1820.63	0	2000	2000	2000	2000
Cutdown1	24	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	2000	1876.39	2000
Cutdown2	25	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.97	2000	1985.44	1999.99	1994.22	2000	2000	2000	0	2000	1999.84
Cutdown3	26	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1876.39	2000	0	2000
Cutdown4	27	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1998.83	2000	1999.29	2000	2000	2000	1999.84	2000	0

2. **2017**

Signature Name		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
CloudShadow1	1	0	2000	1934.42	1992.98	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CloudShadow2	2	2000	0	2000	1999.95	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud Shadow 3	3	1934.42	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CloudShadow4	4	1992.98	1999.95	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud4	5	2000	2000	2000	2000	0	1973.96	1999.98	1948.36	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud3	6	2000	2000	2000	2000	1973.96	0	1670.38	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud2	7	2000	2000	2000	2000	1999.98	1670.38	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cloud1	8	2000	2000	2000	2000	1948.36	2000	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cutdown1	9	2000	2000	2000	2000	2000	2000	2000	2000	0	1908.34	1976.06	1951.16	1999.99	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cutodwn2	10	2000	2000	2000	2000	2000	2000	2000	2000	1908.34	0	1965.39	1942.95	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cutodwn3	11	2000	2000	2000	2000	2000	2000	2000	2000	1976.06	1965.39	0	1929.77	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cutdown4	12	2000	2000	2000	2000	2000	2000	2000	2000	1951.16	1942.95	1929.77	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Forest1	13	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	2000	2000	2000	0	1998.94	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Forest2	14	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1998.94	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban1	15	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1285.05	571.946	2000	2000	2000	1978.85	1999.9	2000	2000	2000	2000
Urabn2	16	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1285.05	0	1084.78	2000	2000	1999.17	1993.17	1999.42	2000	2000	2000	2000
Urban3	17	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	571.946	1084.78	0	2000	2000	2000	1970.36	2000	2000	2000	2000	2000
Urban4	18	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1729.79	2000	1943.3	1995.98	2000	2000	2000	2000
road1	19	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1729.79	0	1995.95	1640.57	1985.36	2000	2000	2000	2000
road2	20	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.17	2000	2000	1995.95	0	1999.98	1986.71	2000	2000	2000	2000
road3	21	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1978.85	1993.17	1970.36	1943.3	1640.57	1999.98	0	1998.75	2000	2000	2000	2000
road4	22	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.9	1999.42	2000	1995.98	1985.36	1986.71	1998.75	0	2000	2000	2000	2000
Water1	23	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1953.27	1916.69	1647.29
Water2	24	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1953.27	0	1988.87	1886.4
Water3	25	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1916.69	1988.87	0	1873.22
Water4	26	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1647.29	1886.4	1873.22	0

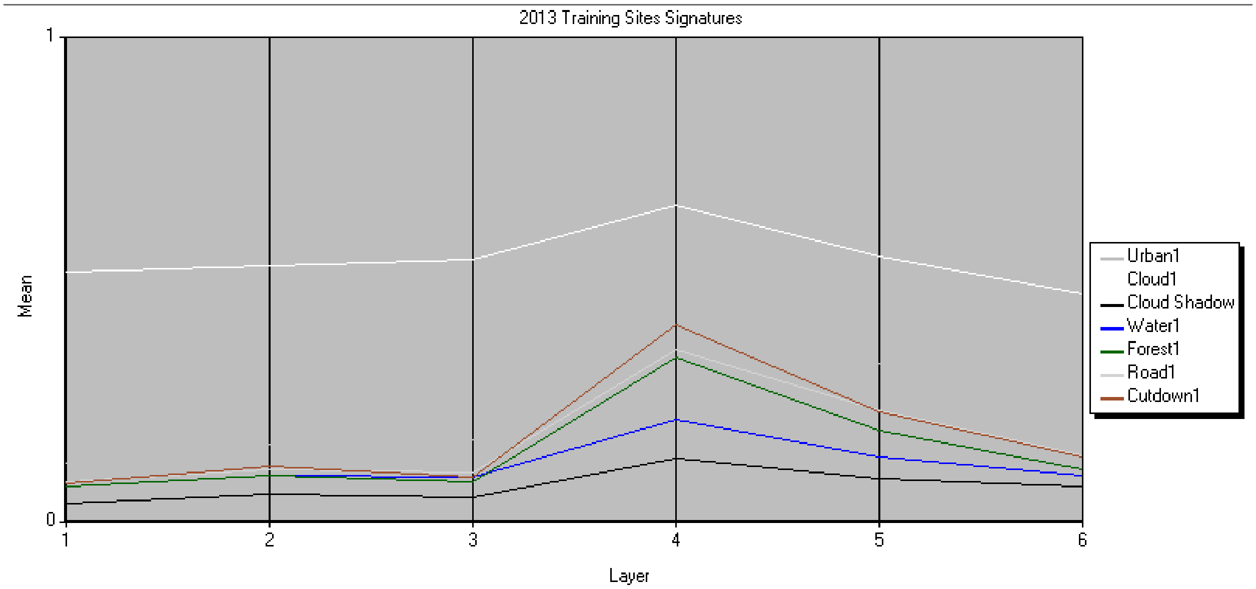
3. **2022**

Signature Name		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Urban Area	1	0	1005.3	1290.64	1233.19	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	1999.5	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban 1	2	1005.3	0	507.235	1007.5	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1994.3	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban 2	3	1290.64	507.235	0	1296.12	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.47	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Urban 3	4	1233.19	1007.5	1296.12	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.26	1997.5	2000	1999.98	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CS1	5	2000	2000	2000	2000	0	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CS2	6	2000	2000	2000	2000	0	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CS3	7	2000	2000	2000	2000	2000	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
CS4	8	2000	2000	2000	2000	2000	2000	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Clouds	9	2000	2000	2000	2000	2000	2000	2000	2000	0	1869.51	2000	1983.86	1481.21	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
C1	10	2000	2000	2000	2000	2000	2000	2000	2000	1869.51	0	1987.29	1999.92	1597.58	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
C2	11	2000	2000	2000	2000	2000	2000	2000	2000	2000	1987.29	0	2000	1997.78	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
C3	12	2000	2000	2000	2000	2000	2000	2000	2000	1983.86	1999.92	2000	0	1973.94	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
C4	13	2000	2000	2000	2000	2000	2000	2000	2000	1481.21	1597.58	1997.78	1973.94	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water/River	14	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1546.67	1696.64	1856.77	1761.67	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water/River 1	15	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1546.67	0	1115.44	1661.07	1997.16	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water/River 2	16	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1696.64	1115.44	0	1680.03	1999.58	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water/River 3	17	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1856.77	1661.07	1680.03	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Water/River 4	18	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1761.67	1997.16	1999.58	2000	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Road	19	1999.99	2000	2000	1999.26	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1999.14	1982	1965.12	2000	2000	1999.99	2000	2000	2000	2000	2000	2000	2000
Road 1	20	1999.5	1994.3	1999.47	1997.5	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.14	0	1998.82	2000	1999.83	2000	1999.98	2000	1997.5	2000	2000	2000	2000	2000
Road 2	21	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1982	1998.82	0	1988.32	2000	2000	1993.65	2000	1998.1	2000	2000	2000	2000	2000
Road 3	22	2000	2000	2000	1999.98	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1965.12	2000	1988.32	0	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000
Cutdown	23	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.83	2000	2000	0	1999.76	1994.09	1897.45	1835.62	2000	2000	2000	2000	2000
Cutdown 1	24	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.76	0	1998.17	2000	1984.36	2000	2000	2000	2000	2000
Cutdown 2	25	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1999.99	1999.98	1993.65	2000	1994.09	1998.17	0	2000	1081.66	2000	2000	2000	2000	2000
Cutdown 3	26	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1897.45	2000	2000	0	1997.66	2000	2000	2000	2000	2000
Cutdown 4	27	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1997.5	1998.1	2000	1835.62	1984.36	1081.66	1997.66	0	2000	2000	2000	2000	2000
Forest	28	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	0	1146.72	1874.99	1025.35	1072.36
Forest 1	29	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1146.72	0	1980.26	1708.54	1516.68
Forest 3	30	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1874.99	1980.26	0	1814	1539.28
Forest 4	31	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1025.35	1708.54	1814	0	766.382
Forest 5	32	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	2000	1072.36	1516.68	1539.28	766.382	0

<u>Signature Mean Statistics</u>

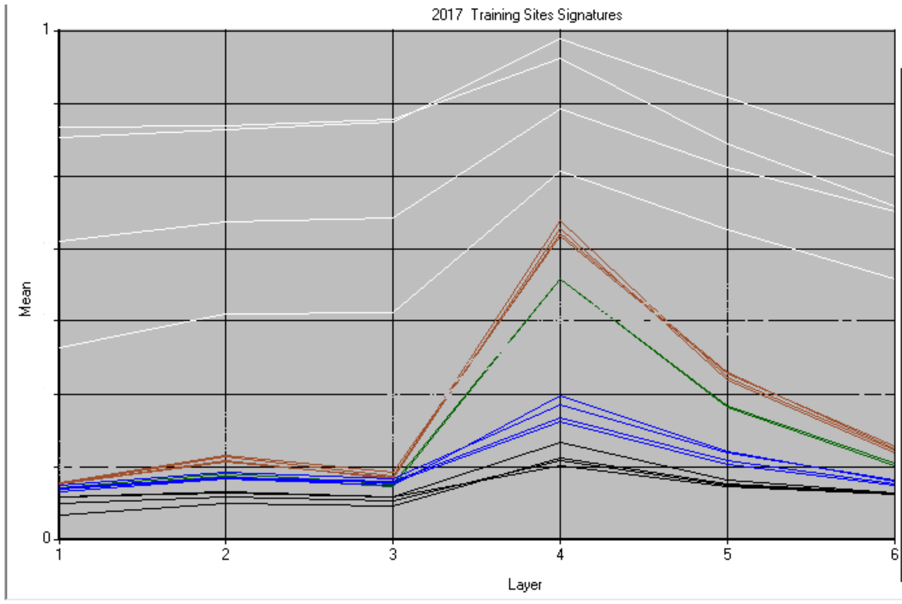
These are the signatures for our training sites. They are graphs showing the relationship between the bands(layers) and the average reflectance values of the layer (mean).

1. **2013**

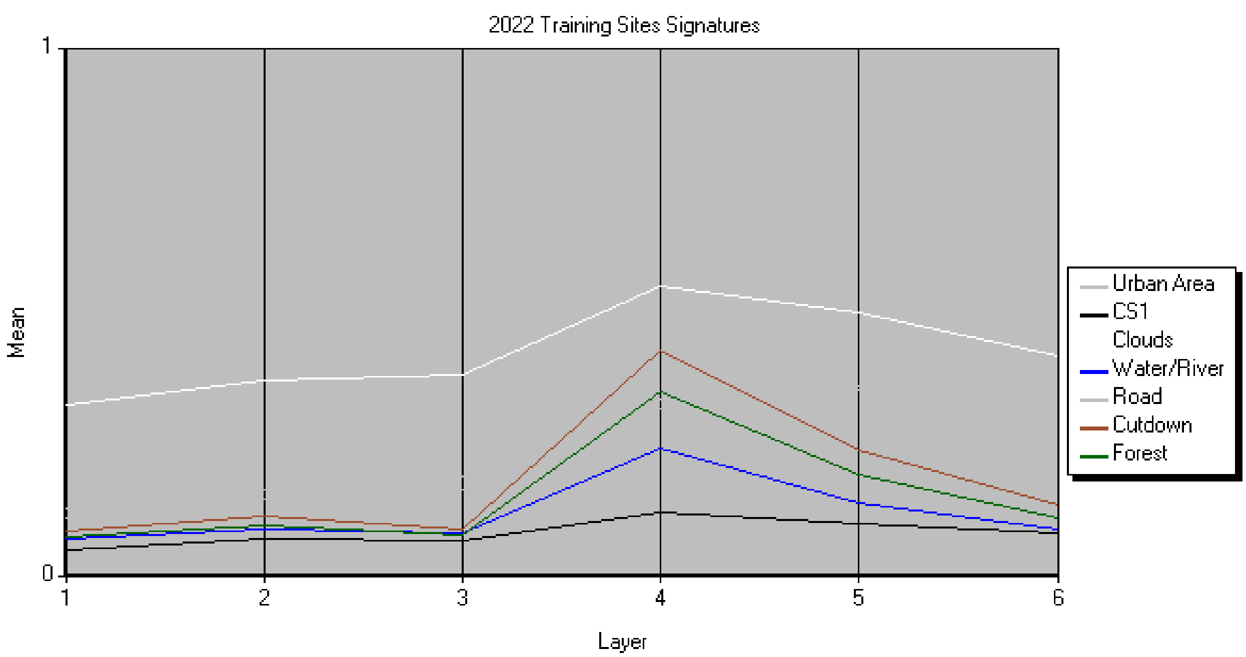


2013 Training Sites Signatures
1
0
Mean
1
2
3
4
5
6
Layer
Urban1
Cloud1
Cloud Shadow
Water1
Forest1
Road1
Cutdown1

2. 2017

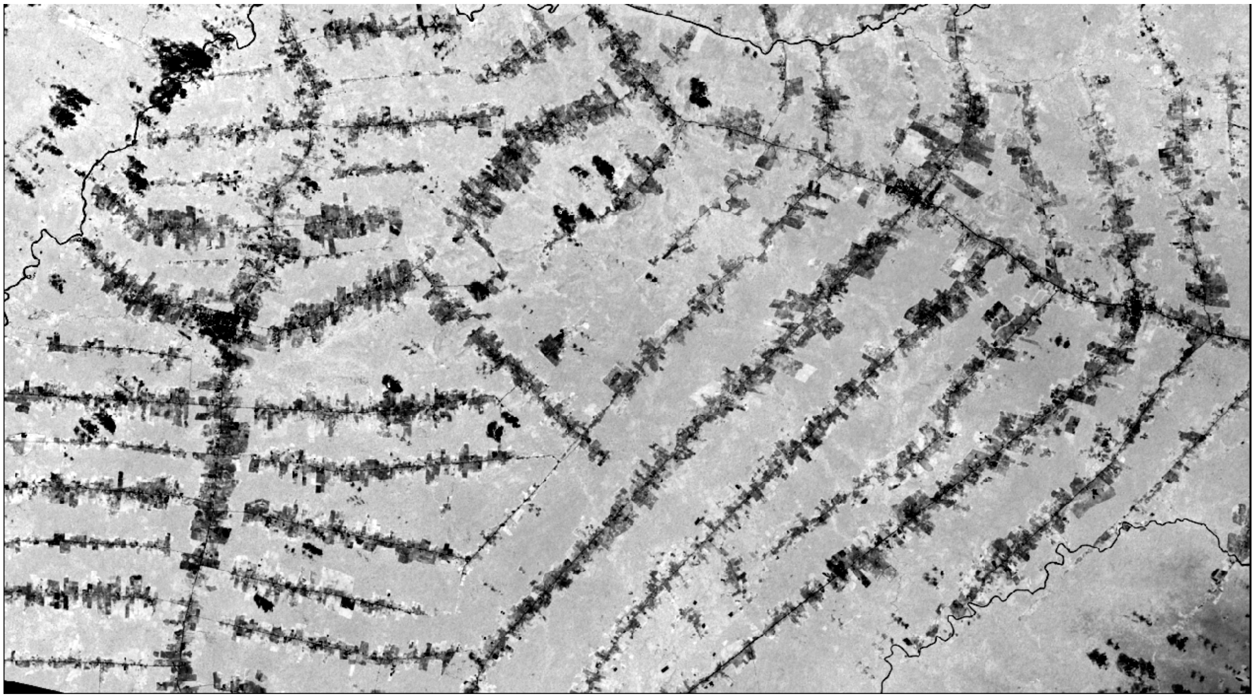

2017 Training Sites Signatures
1
0
Mean
1
2
3
4
5
6
Layer

3. 2022

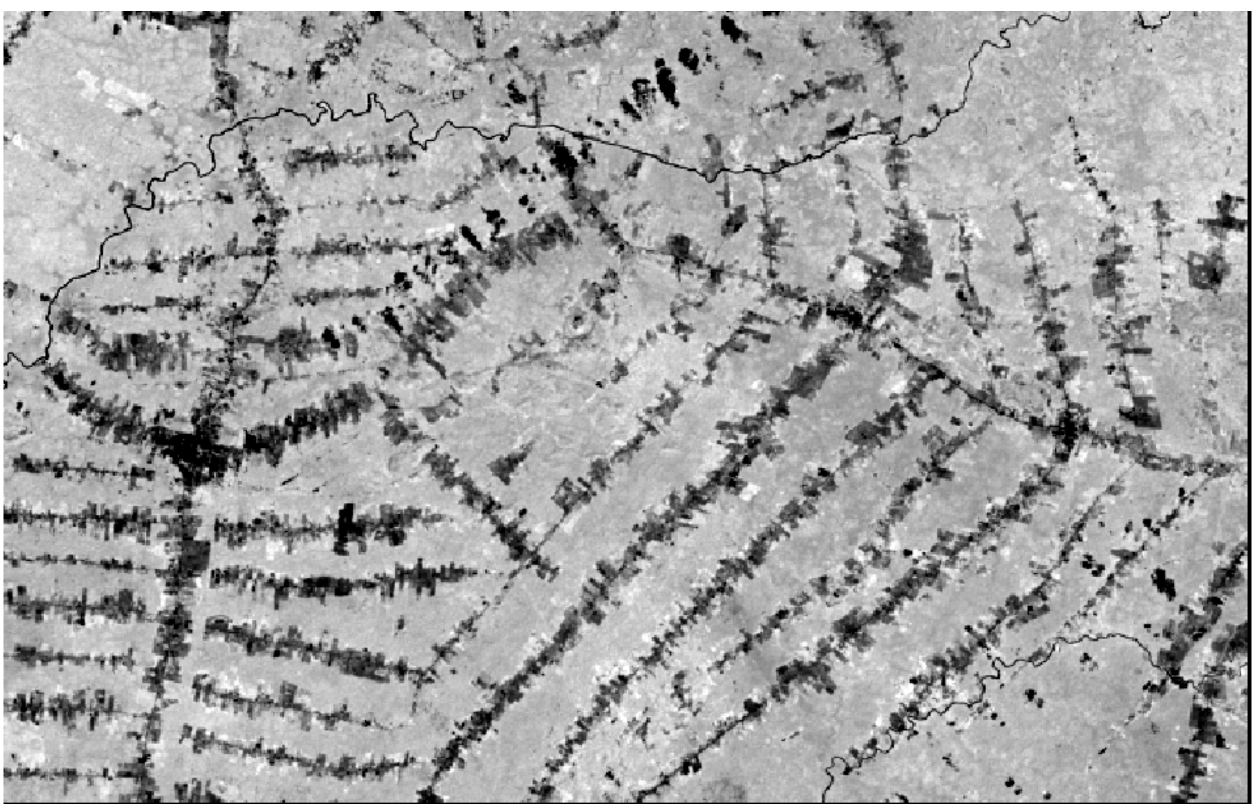

2022 Training Sites Signatures
1
0
Mean
1
2
3
4
5
6
Layer
Urban Area
CS1
Clouds
Water/River
Road
Cutdown
Forest

NDVI Analysis

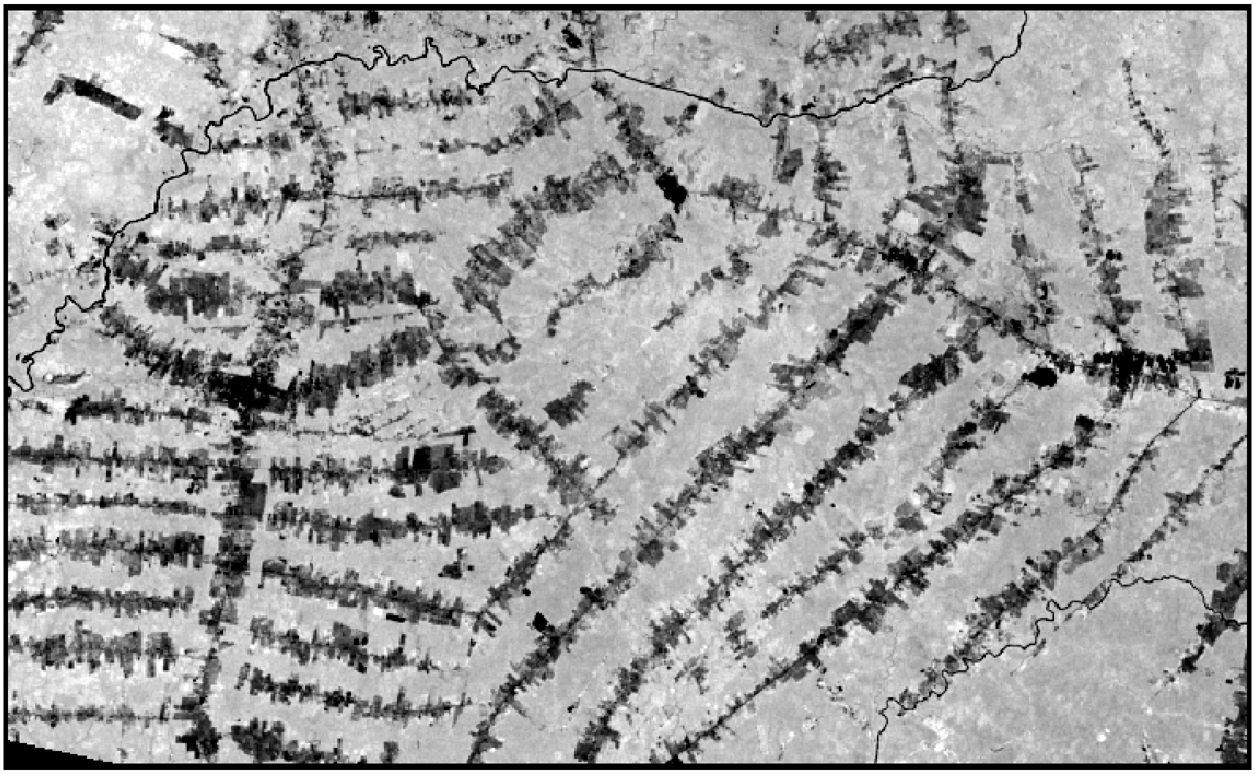
2013



2017

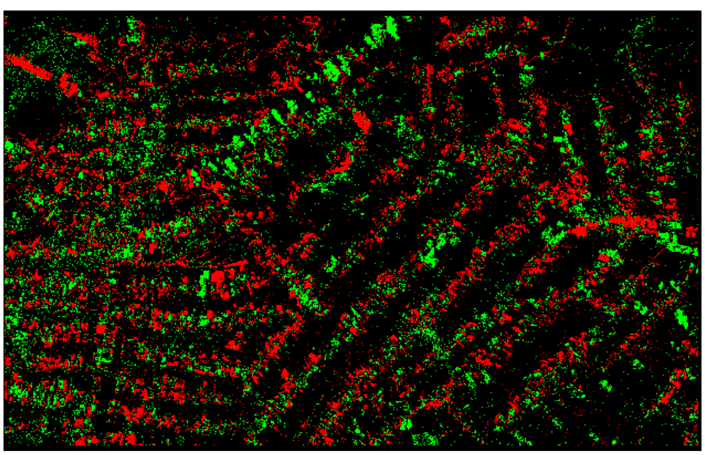


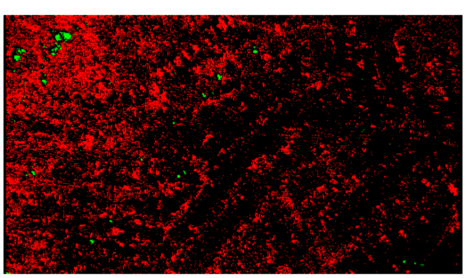
2022



<u>**Ndvi Change Analysis**</u>

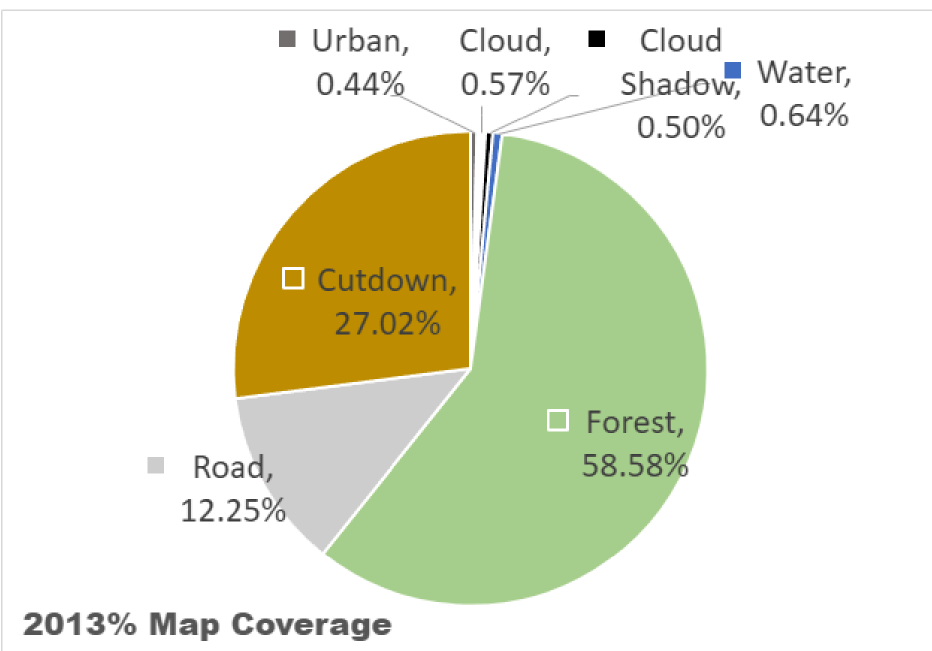
2017-2022

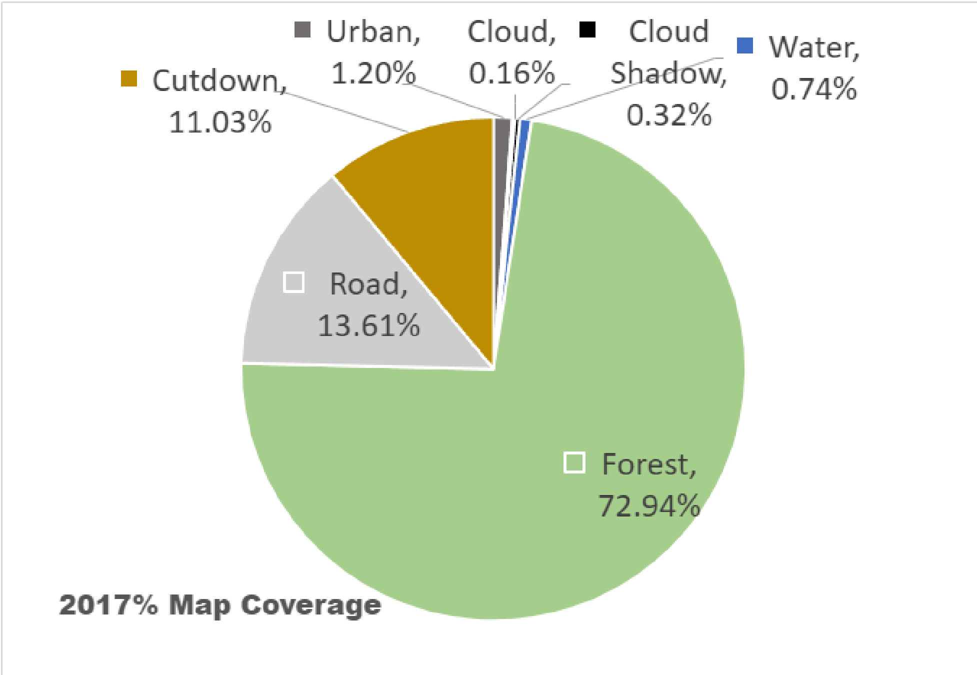


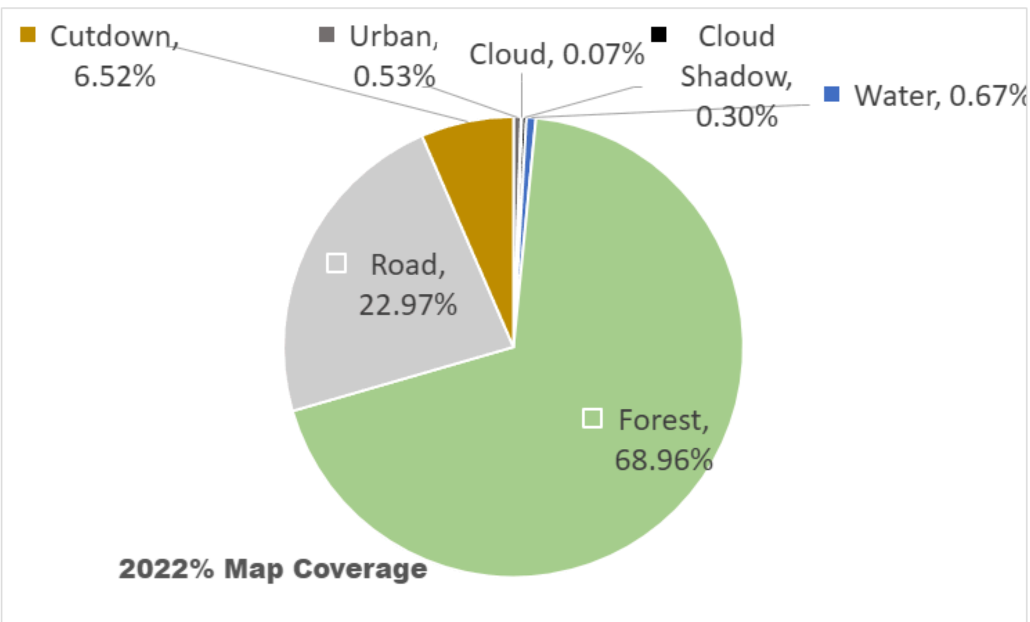
2013-2017 

Accuracy Assessment

Land Change Analysis (Pi Charts)







Conclusion

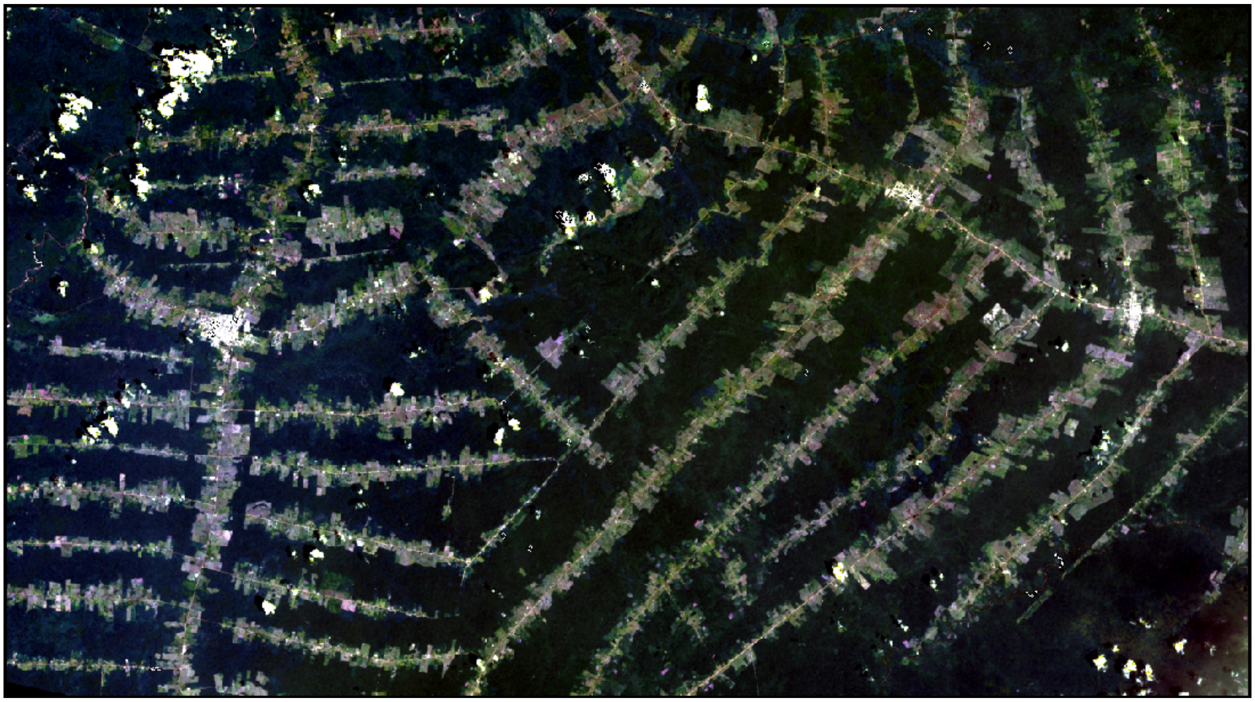
For our project, our area of study was the Brazilian Amazon and our goal was to find areas of deforestation over a 15 year duration. Through the process of remote sensing we were able to find exactly where this deforestation occurred, how much deforestation occurred, and how the land changed over time. First, we had to enhance our images so that we were able to clearly identify the different aspects of the landscape such as

vegetation and agricultural land, Once classifying the different landscapes, we completed a supervised classification on all three images in order to be able to separate all the landscapes and get detailed information as to how much of the area was covered y different types of crops, and other aspects such as clouds their shadows. After comparing the areas of vegetation we saw a decline in forest and an increase in soil and crops showing how deforestation occurred in our specific area of the Amazon. There were a few components that were being misclassified such as shadows, clouds, and urban areas. (MENTION WHAT ISSUES WE FACED). Creating the training sites and performing the supervised classification was the most challenging part of the project since we had to create numerous training sets and make sure that the final image came out properly and showed all parts of the landscape. In the end we found why the deforestation occurred and we believed it was due to more people coming into the Amazon resulting in the need for more agriculture. This conclusion came form the change analysis because it proved that over the span of 15 years, vegetation and forests declined whereas agriculture, and urban areas increased in a fishbone pattern.

New Conclusion

In our project, we delved into the Brazilian Amazon, aiming to track deforestation over a 15-year period from 2013 to 2022. Utilizing remote sensing techniques, we pinpointed deforested areas, tracked changes in the landscape, and assessed the extent of vegetation loss. Initially, we enhanced image clarity to discern landscape features such as vegetation and agricultural land. Subsequently, employing supervised classification across three images, we differentiated various landscapes and gathered detailed data on crop coverage and other features like clouds and shadows. Despite facing challenges such as misclassification of shadows, clouds, and urban areas, we persisted. Establishing training sites and executing supervised classification proved to be the most demanding tasks, ensuring the accurate portrayal of the landscape. Our analysis revealed a decline in forest cover and a rise in agricultural land, indicating deforestation in our study area of the Amazon. We attributed this trend to increased human activity, particularly agriculture. This inference was supported by change analysis, which demonstrated a gradual shift over the 15-year period from vegetation to agriculture and urbanization, resembling a fishbone pattern.

True color
2013



2022

Urban Area
Cloud Shadow
Clouds
Water/River
Road
Cutdown
Forest