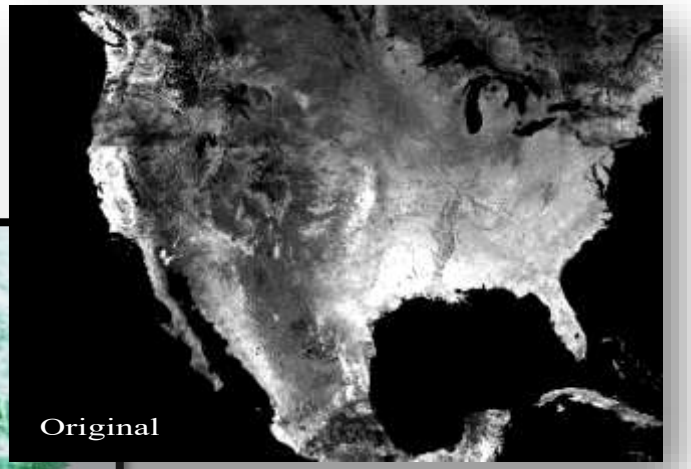
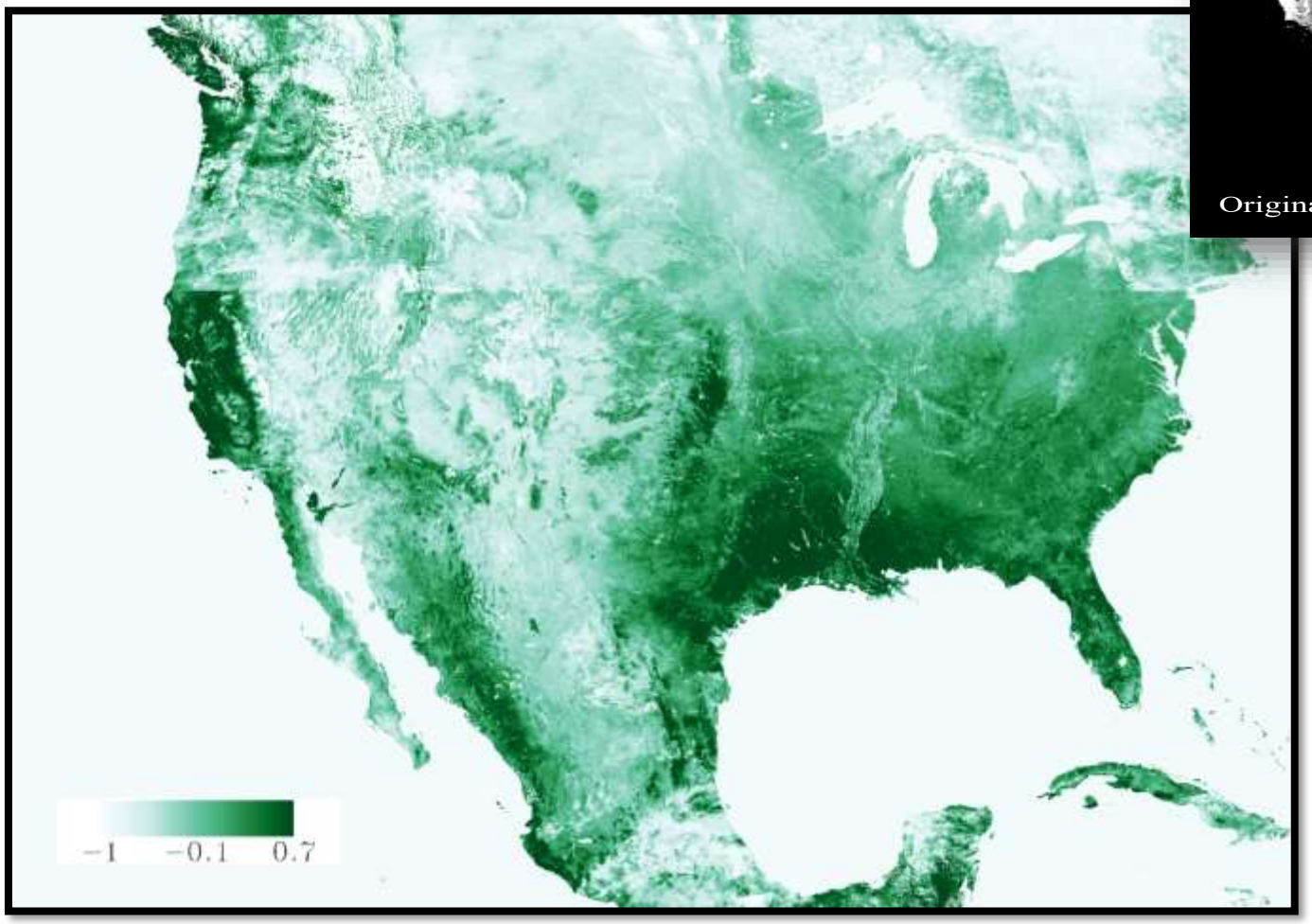
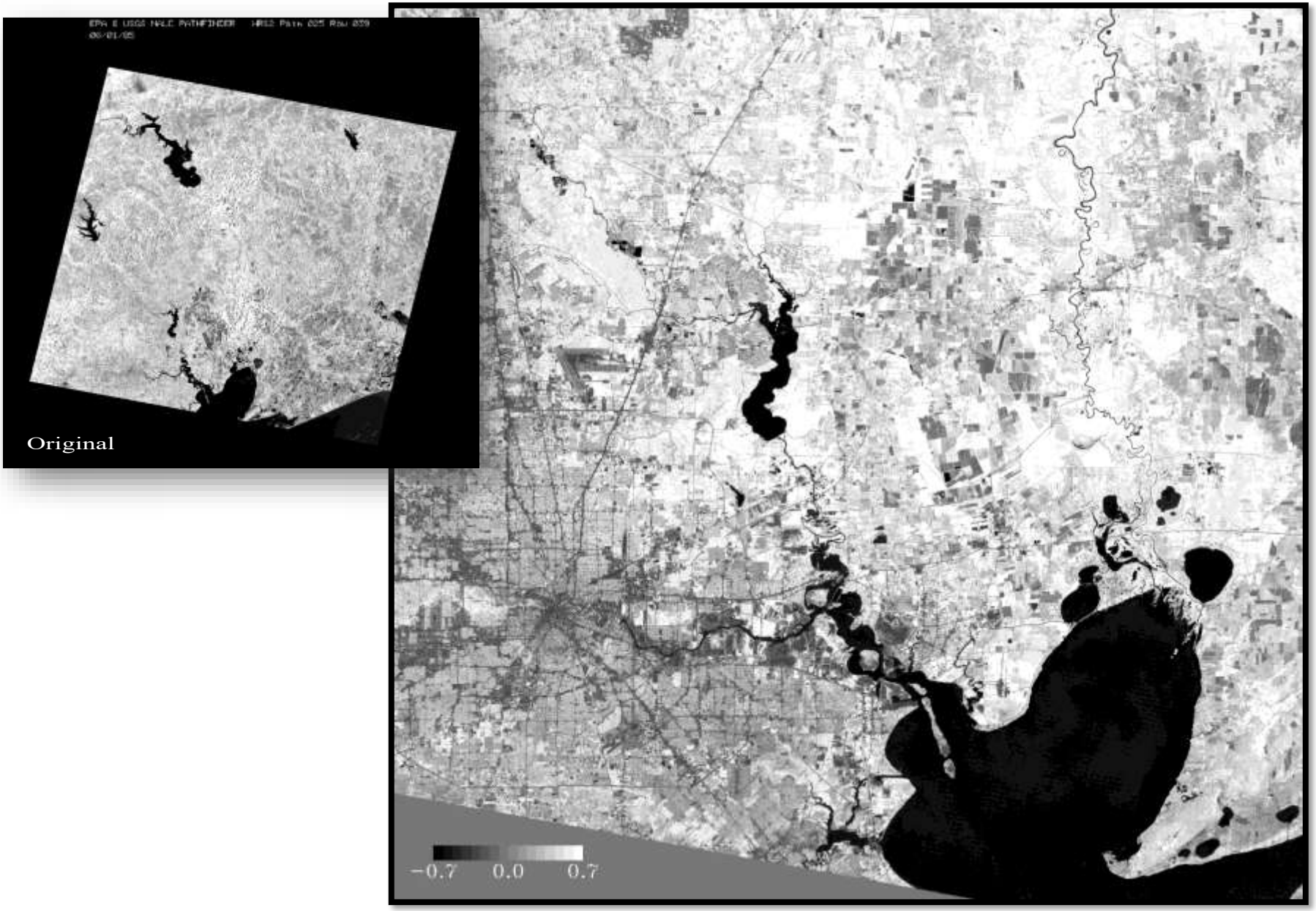
TASK 1: NORMALIZED DIFFERENCE VEGETATION






Original
−0.7
0.0
0.7

$$NDVI = \frac{NIR - RED}{NIR + RED}$$

1. Which bands in the AVHRR imagery are used to construct NDVI?

For the AVHRR image, band [redacted] was mapped to red and band [redacted] was mapped to near infrared.

The dark green areas have the highest NDVI value, meaning they are dense areas of photosynthesizing vegetation like [redacted] forests. The lighter green areas have lower NDVI values, meaning less vegetation (or potentially less healthy, less photosynthesizing vegetation); meadows are an example. The lightest/whitest areas have the least amount of vegetation and correspond to things like exposed soil, rock, or urban development.

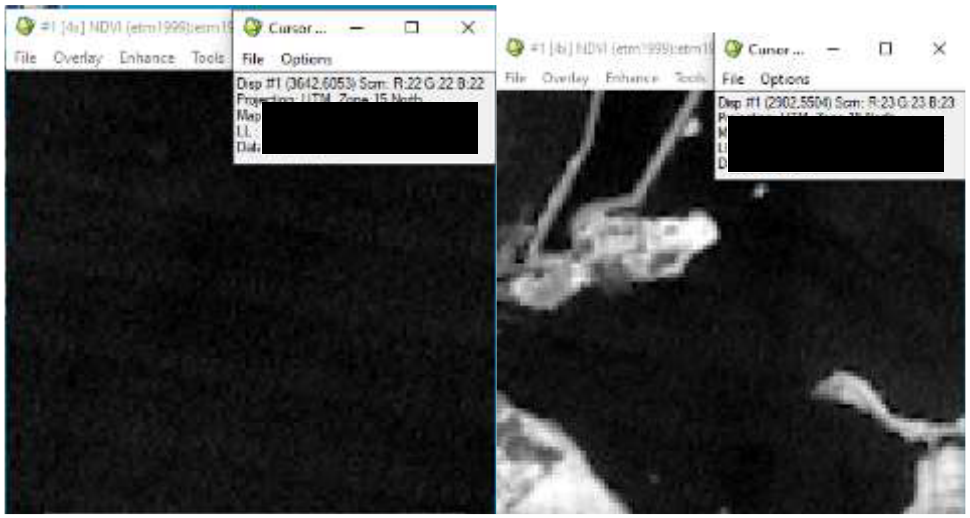
From the AVHRR imagery, we can see that in April, the [redacted] region had the least vegetation which increased towards the central plains. The densest areas of vegetation in the U.S. were in the South around the Mississippi basin, and along the West coast.

The Northeast also had relatively high NDVI values, but slightly lower than the areas in the South. This could be because of differences in plant species composition. The two main division of plant species are angiosperm ("contained" seed, i.e. fruits) and gymnosperm ("naked" seed, i.e. cones). Angiosperms are [redacted] resulting in a higher NDVI score, but they don't survive well in the cold or at high altitudes. Gymnosperms, like pines and conifers, on the other hand, can survive these extreme conditions but aren't quite as [redacted]

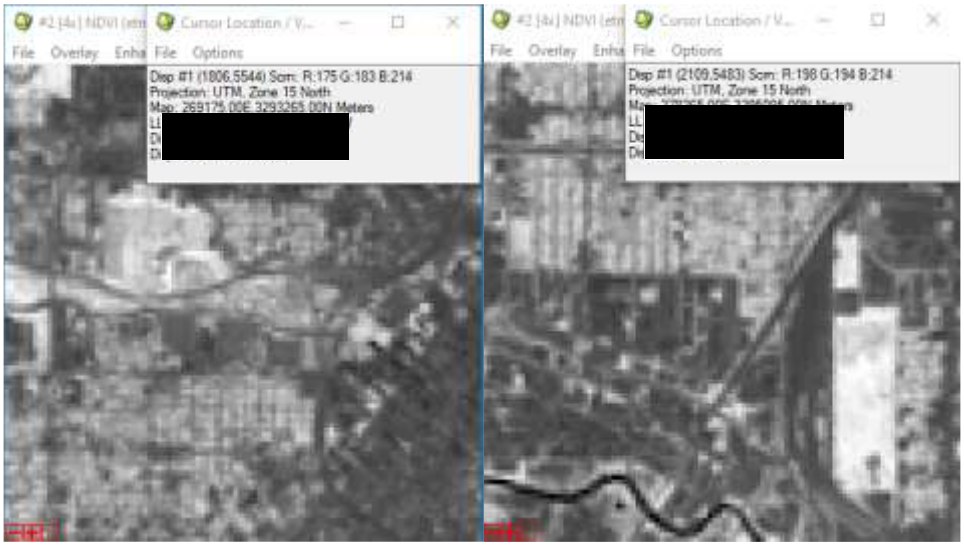
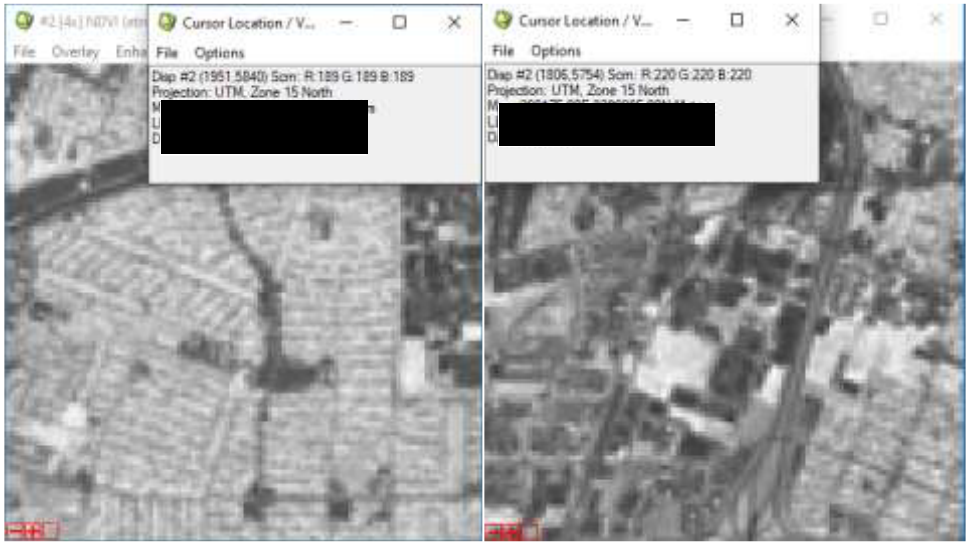
2. Which bands in the Landsat EMT+ imagery are used to construct NDVI? Does the ETM+ NDVI image offer an improved vegetation discrimination capability and/or more spatial details over that of the AVHRR?

For the Landsat EMT+ image, band [redacted] was mapped to red and band [redacted] was mapped to near infrared.

The narrower ranges of wavelengths for each band compared to the AVHRR bands ([redacted]) allows for greater detail in vegetation/biomass discrimination. [redacted] It would probably be possible to distinguish different crops or plant families within a region. Comparatively, the AVHRR could only broadly distinguish between the major plant groups.

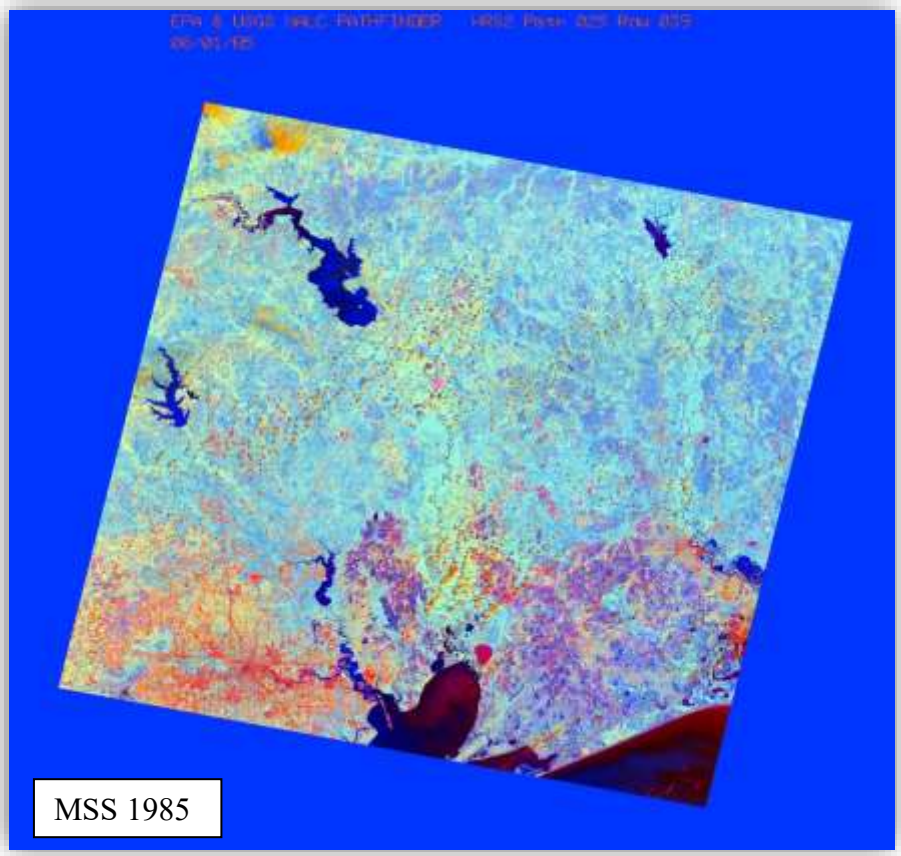
Type	NDVI Values	Image
Water	[redacted]	
Grass	[redacted]	
Forest	[redacted]	

[redacted]

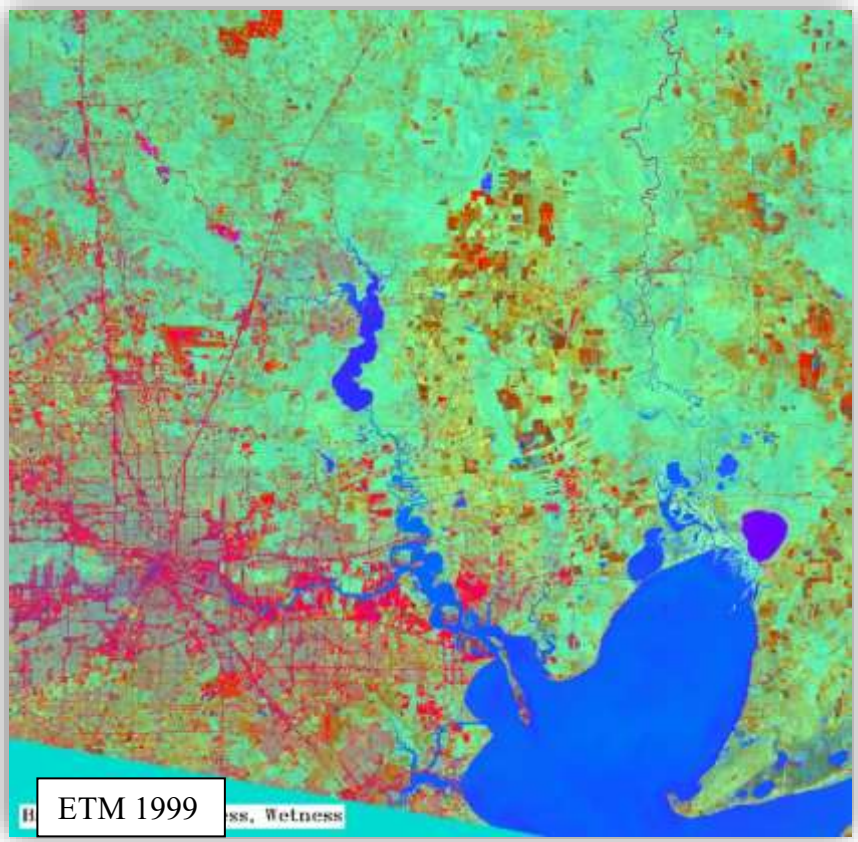
Urban Road	[redacted]	
Urban Building	[redacted]	

[redacted]

TASK 2: TASSELED CAP TRANSFORMATION



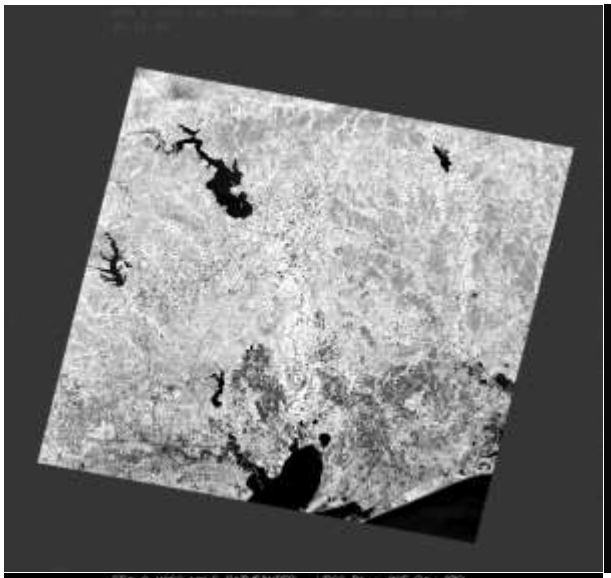
MSS 1985

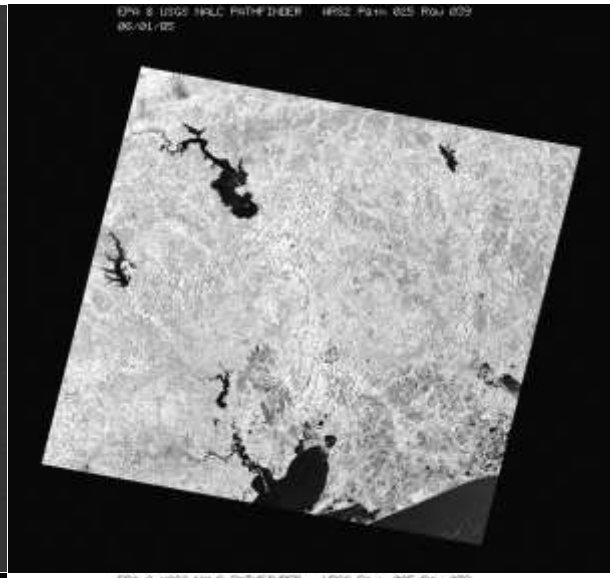


ETM 1999

MSS 1985

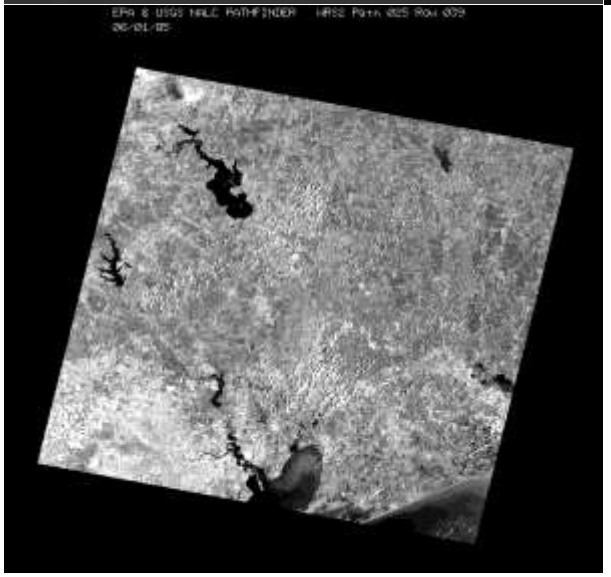
GREEN VEG INDEX





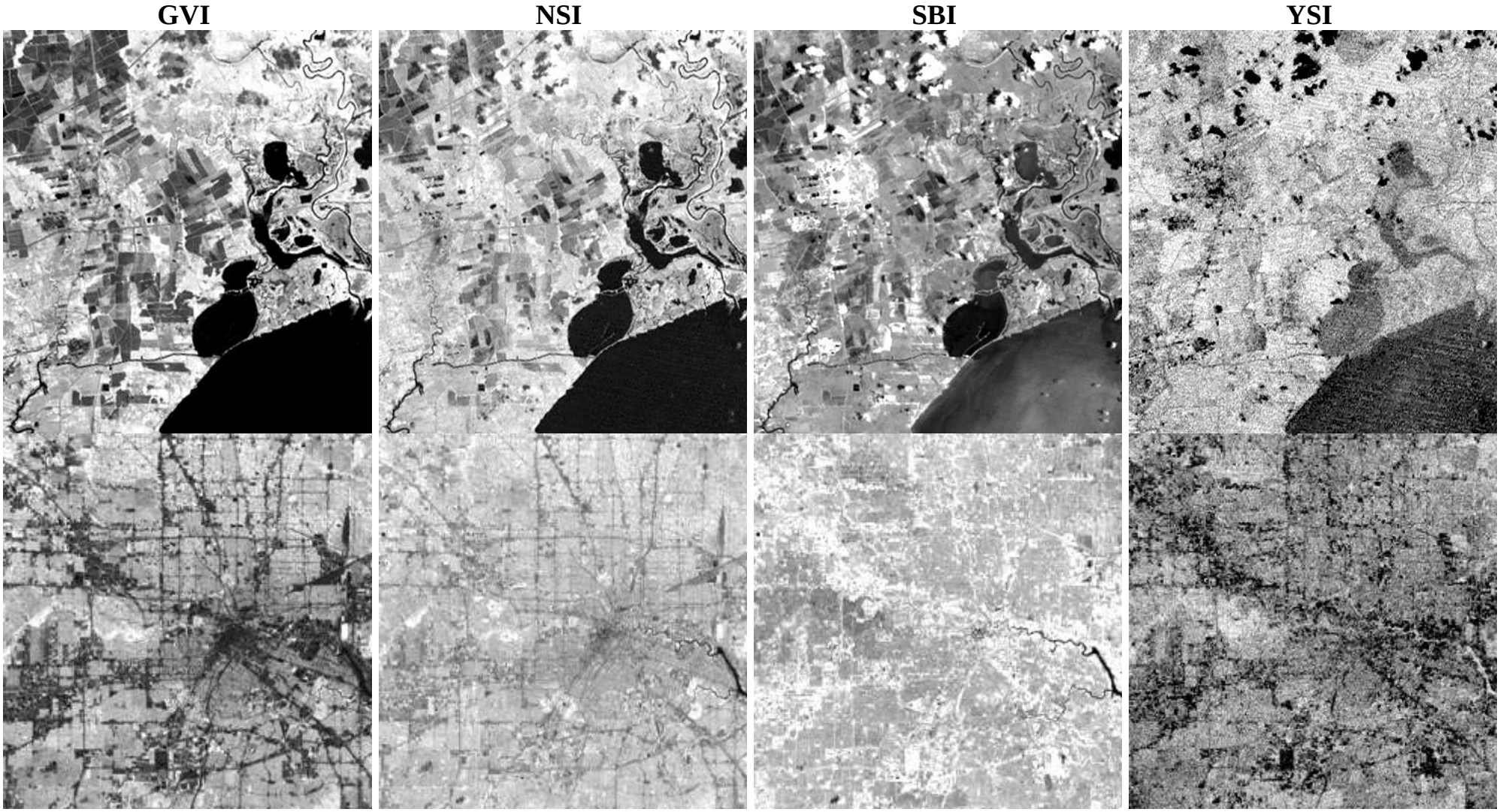
NO SUCH INDEX

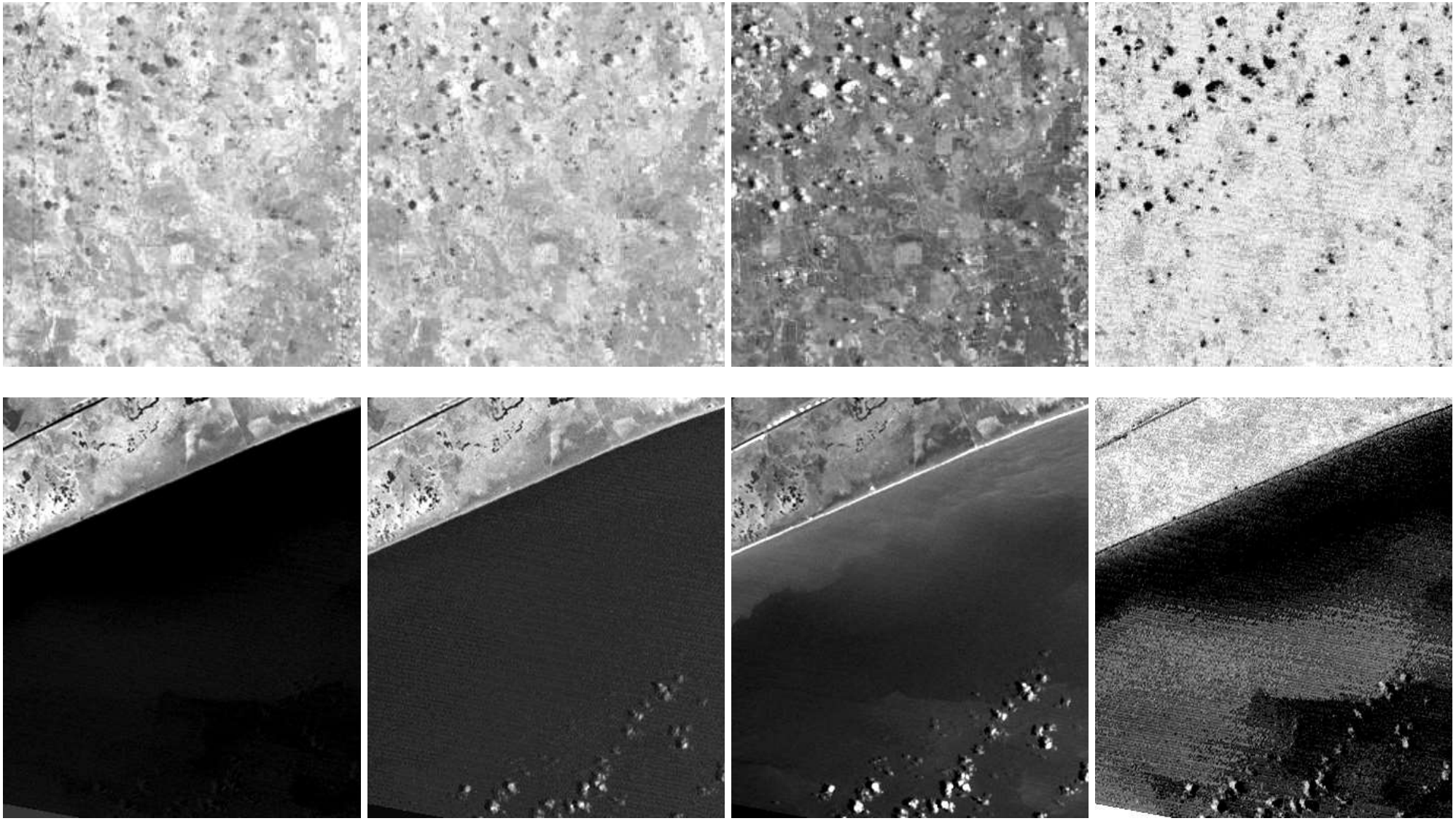
SOIL BRIGHTNESS INDEX



YELLOW STUFF INDEX

[redacted]


GVI
NSI
SBI
YSI



[redacted]

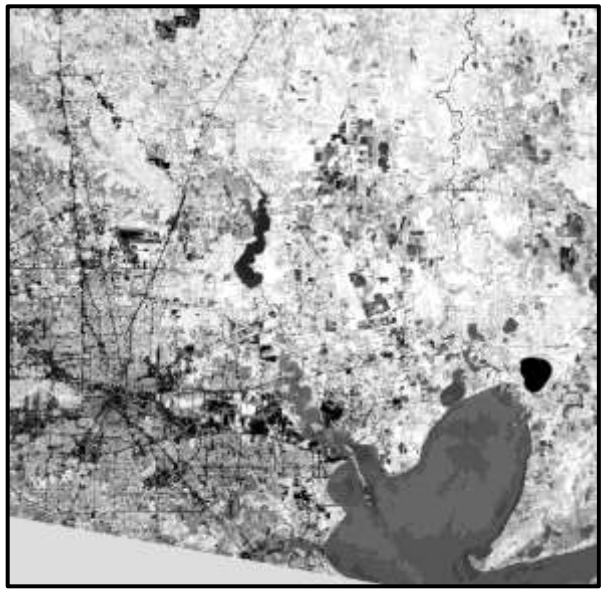
3. Visually interpret the soil brightness index (SBI), the green vegetation index (GVI), the yellow stuff index (YVI), and a non-such index (NSI) images. What does each image of the Tasseled Cap components (SBI, GVI, and YVI) highlight?

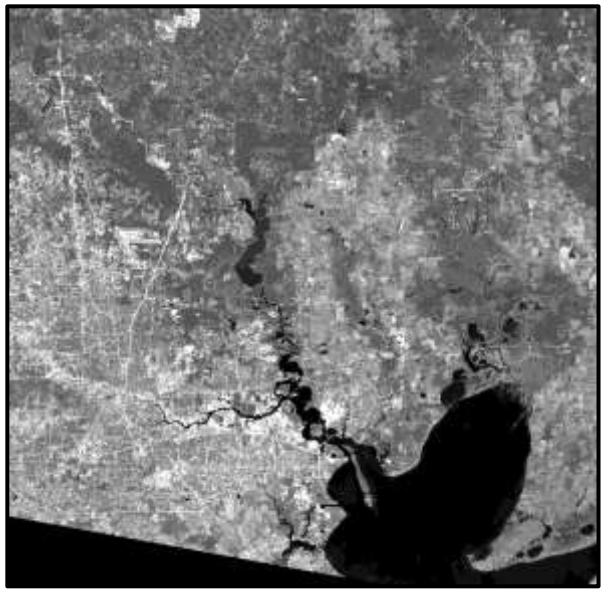
NSI deals with atmospheric effects like clouds and snow. GVI highlights green vegetation, similar to the NDVI in task one. SBI is good for soil analysis. It can detect things like erosion and changes to [redacted] compositions. The YVI detects moisture and works well in combination with [redacted] for both vegetation and soil analysis.

In the above images, you can visible see how the rivers and ocean have the [redacted] values in the SBI and YVI indexes compared to the GVI. Meanwhile, the GVI has a sharp contrast between urban environments and water [redacted] and natural landscapes [redacted].

ETM 1999

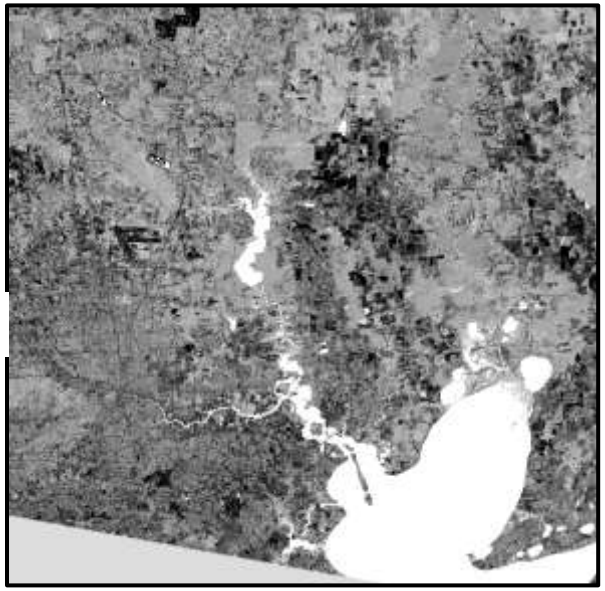
GREEN VEG INDEX

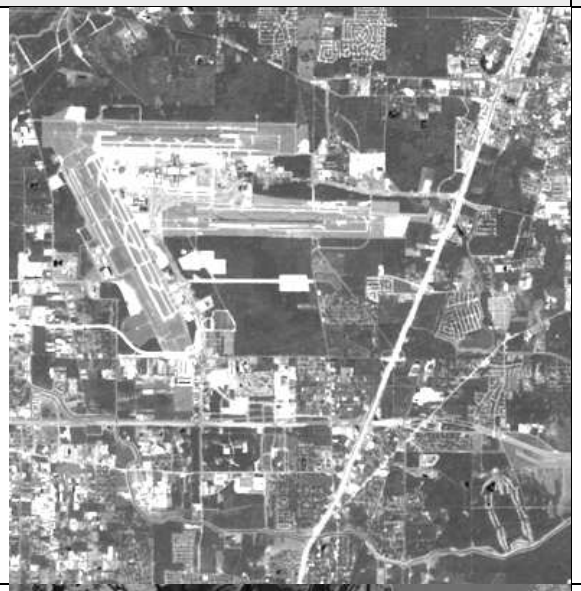
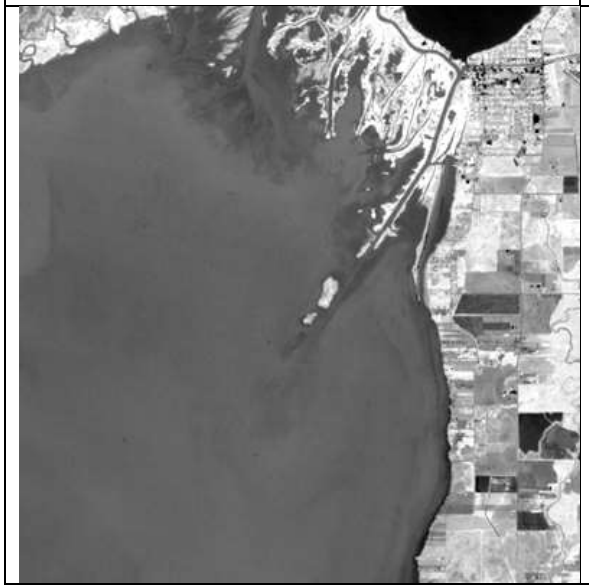


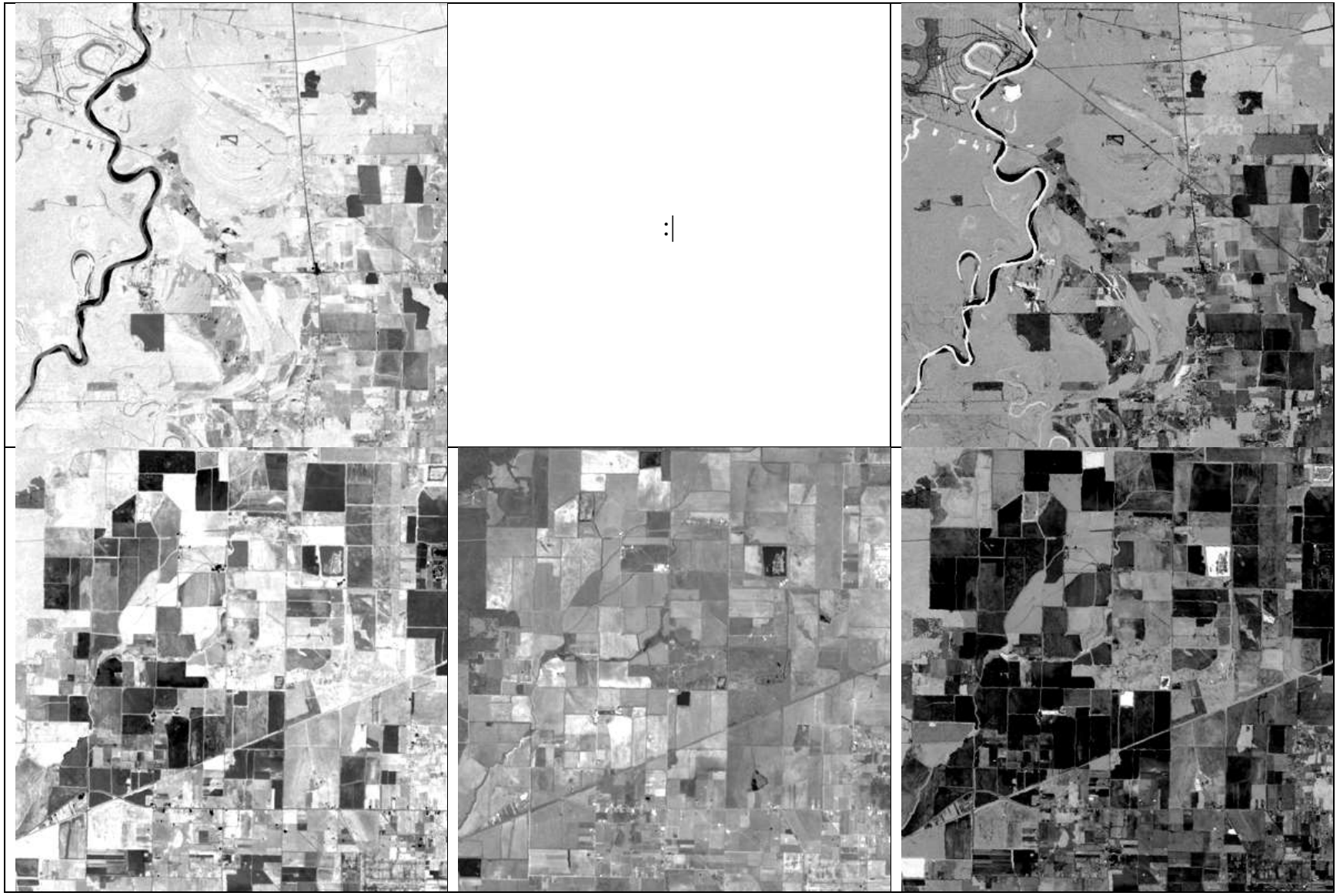


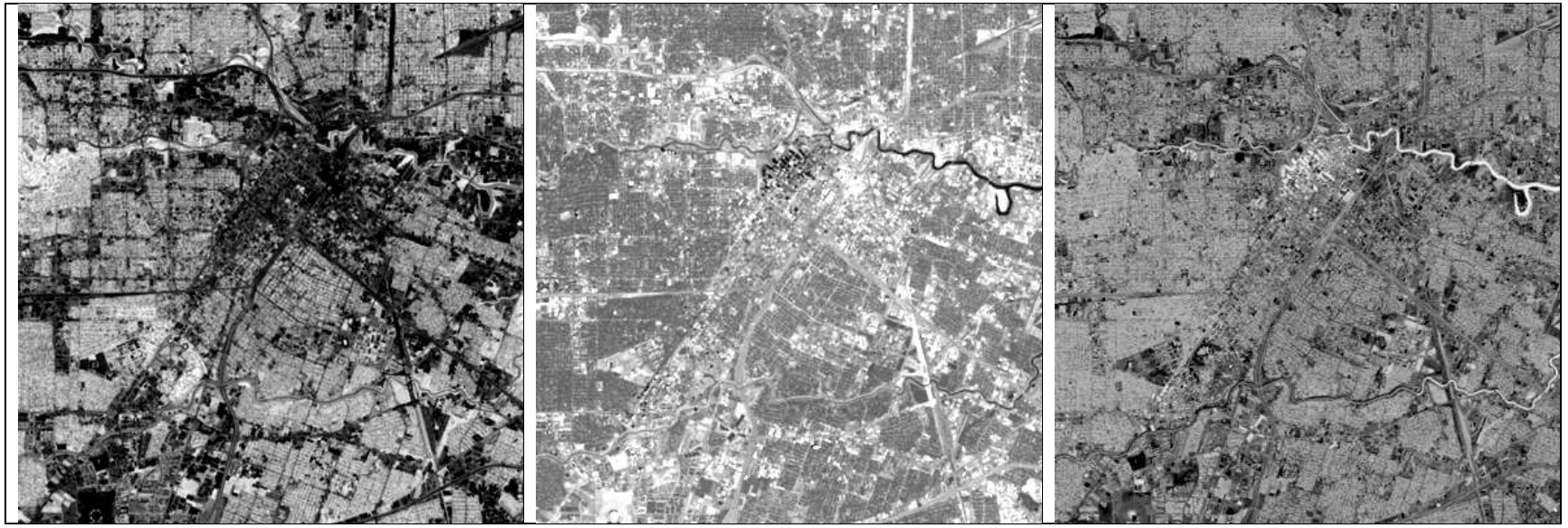
BRIGHTNESS INDEX

WETNESS INDEX



GREEN	BRIGHT	WET
:		
		



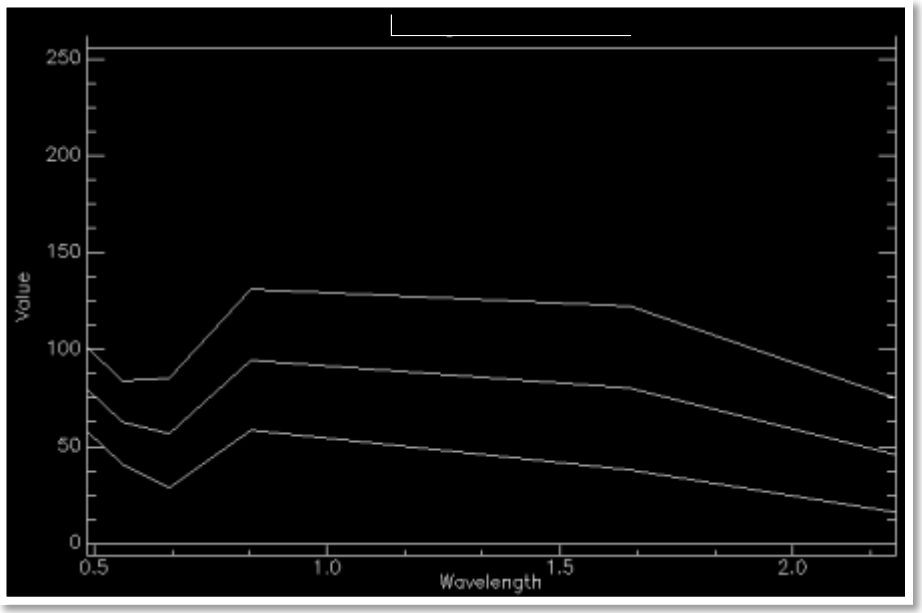


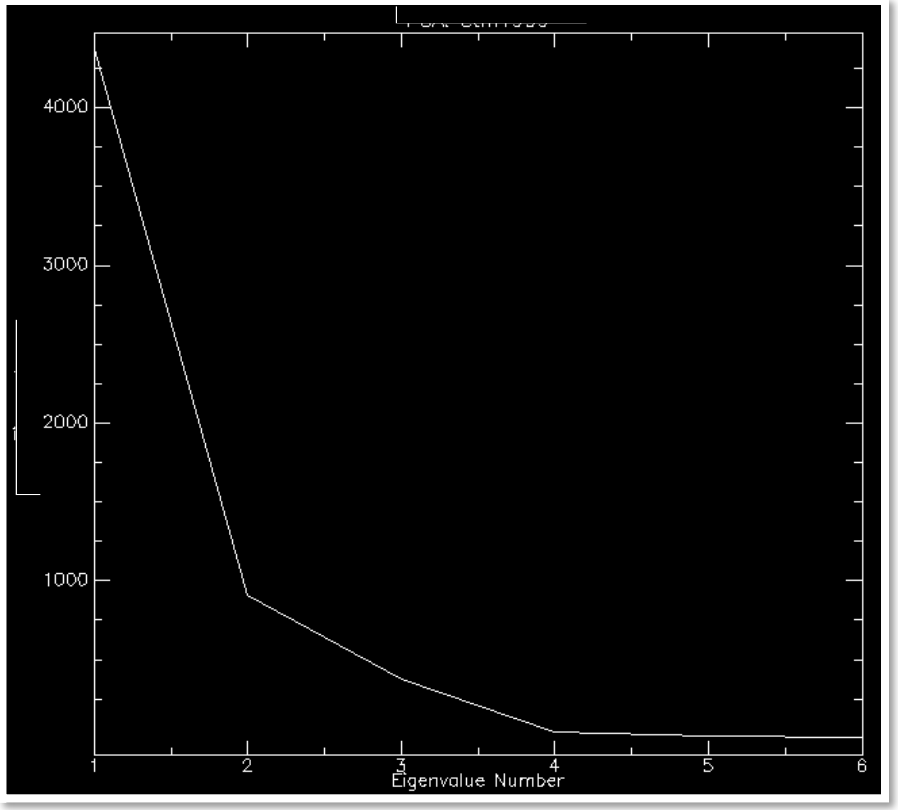
4. What is the relationship of scene brightness with the original six non-thermal bands of the ETM+ data? What is the relationship of the vegetation greenness with the red and NIR bands? What does each of the Tasseled Cap components highlight?

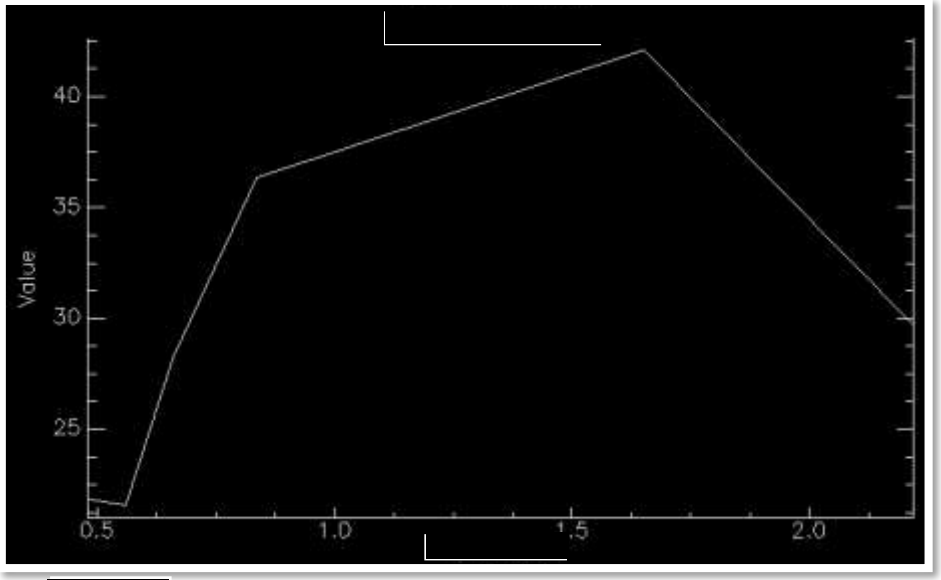
The Greenness index for the ETM tasseled cap is derived from a [redacted] of gr[redacted], r[redacted], n[redacted], and m[redacted] bands. Similarly, the Brightness index is derived from a combination of [redacted] original bands.

The Brightness and Greenness indices are similar to the MSS tasseled cap [redacted] indices. Brightness measures soil r[redacted]. The wetness band combines [redacted] bands moisture in a range of contexts such as soil, vegetation, ice, and turbid water.

TASK 3: PRINCIPAL COMPONENT ANALYSIS







Dims: Full Scene (9,050,260 points)

Basic Stats	Min	Max	Mean	Stdev	Num	Eigenvalue
Band 1	0	255	79.394738	21.854359	1	4368.[redacted]
Band 2	0	255	62.572129	21.554298	2	911.[redacted]
Band 3	0	255	56.612445	28.272074	3	377.[redacted]
Band 4	0	255	94.774721	36.327227	4	38.[redacted]
Band 5	0	255	80.104578	42.102909	5	17.[redacted]
Band 6	0	255	45.741516	29.708323	6	2.[redacted]

Total: [redacted]

[redacted]

	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6
Band 1	477.613021	457.823954	551.265197	337.199575	540.179963	445.473977
Band 2	457.823954	464.587758	586.856036	328.374112	584.889312	488.496273
Band 3	551.265197	586.856036	799.310192	404.017655	857.950142	718.410305
Band 4	337.199575	328.374112	404.017655	1319.667422	1153.972635	613.755023
Band 5	540.179963	584.889312	857.950142	1153.972635	1772.654977	1175.345181
Band 6	445.473977	488.496273	718.410305	613.755023	1175.345181	882.584432

[redacted]

	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6
Band 1	1.000000	0.971911	0.892205	0.424734	0.587068	0.686130
Band 2	0.971911	1.000000	0.963030	0.419375	0.644507	0.762868
Band 3	0.892205	0.963030	1.000000	0.393378	0.720763	0.855336
Band 4	0.424734	0.419375	0.393378	1.000000	0.754486	0.568702
Band 5	0.587068	0.644507	0.720763	0.754486	1.000000	0.939670
Band 6	0.686130	0.762868	0.855336	0.568702	0.939670	1.000000

[redacted]

	Band 1	Band 2	Band 3	Band 4	Band 5	Band 6
Eig. 1	-0.252913	-0.264740	-0.363198	-0.422065	-0.612502	-0.425132
Eig. 2	-0.339266	-0.356729	-0.468909	0.690003	0.199493	-0.147870
Eig. 3	0.448930	0.327282	0.124088	0.527995	-0.484543	-0.402976
Eig. 4	-0.641883	-0.031769	0.609931	0.225855	-0.363019	0.179356
Eig. 5	0.209868	-0.099591	-0.336102	0.124291	-0.467276	0.774130
Eig. 6	0.404150	-0.827415	0.384491	0.022774	-0.011510	-0.059683

[redacted]

5. If you want to reduce the dimensionality of the data set while keeping at least [redacted] of the information, how many and which principal components are needed to replace original six bands?

	Band #					
	1	**2**	**3**	**4**	**5**	**6**
Variance	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]	[redacted]
Cumulative	[redacted]	92.[redacted]	98.[redacted]	99.[redacted]	99[redacted]	100%

To keep at least [redacted] of the original information, you would only need to keep [redacted] principal components: [redacted]. Together, they retain [redacted] of the original information.

[See next page for visual demonstration.]

6. Produce a color composite using PC1, PC2 and PC3.

Red: PC 1 | Green: PC 2 | Blue: PC 3