Landsat 8: Coastal Aerosol Band

Purpose

The coastal aerosol band (Band 1: 0.4333 – 0.4530 µm) has two objectives. One is to estimate the concentration of aerosols in the atmosphere, which may be used to refine the atmospheric correction procedures such as dark object subtraction. Another objective is to provide a closer inspection of the coastal and inland waters. Relative to the MODIS and the SeaWiFS sensor, the Landsat 8 sensor allows for better imaging of these shallow waters due to its superior spatial and radiometric resolutions. With this band, scientists hope to make clearer observations of sediments, particles, organic matter, coral reefs, and suspended chlorophyll-rich phytoplankton in these bodies of water.[1]

Table 1: Coastal Aerosol Band Statistics

	Minimum	Maximum	Mean	StDev
Alaska	0.140536	1.500768	0.696539	0.232801
Dominica	0.096634	1.190295	0.181911	0.079683
Florida	0.087660	1.292374	0.189447	0.106132
Mississippi	0.108868	0.956560	0.143460	0.038287
Nova Scotia	0.098743	1.189423	0.134308	0.049732
Los Angeles	0.104013	1.031497	0.173848	0.068252

Table 2: Aerosol Index (B1-B2)/(B1+B2) Statistics

	Minimum	Maximum	Mean	StDev
Alaska	-0.159277	0.244017	0.005952	0.024097
Dominica	-0.103756	0.224566	0.075644	0.026319
Florida	-0.160424	0.243168	0.065773	0.033022
Mississippi	-0.238334	0.453076	0.081025	0.024173
Nova Scotia	-0.273329	0.272969	0.095160	0.020822
Los Angeles	-0.202950	0.203088	0.033973	0.033632

Table 3: Aerosol Index over Forests

	Min	Max	Mean	StDev
Nova Scotia	0.069677	0.132026	0.116303	0.007045
Florida	0.062880	0.127559	0.103233	0.007369
Mississippi	0.060710	0.123825	0.113224	0.003460
Los Angeles	-0.003951	0.103934	0.085527	0.008280

Table 4: Aerosol Index over Water

	Min	Max	Mean	StDev
Nova Scotia	0.067265	0.142604	0.107593	0.009838
Florida	0.003255	0.090609	0.065411	0.005647
Mississippi	0.023771	0.061259	0.039220	0.008154
Los Angeles	0.060694	0.114329	0.097448	0.003147

[1] http://earthobservatory.nasa.gov/IOTD/view.php?id=81238

Table 5: Mississippi Transect over Land (MississippiTrans1)

	Average Difference across Wildfire Smoke Plume (NoSmoke – Smoke)	Minimum	Maximum
Aerosol Index	0.100	-0.005	0.133
NDVI	0.350	-0.239	0.716
Albedo	-0.150	0.048	0.304
Temperature (Degrees)	8.0	290	306

Calibration Error

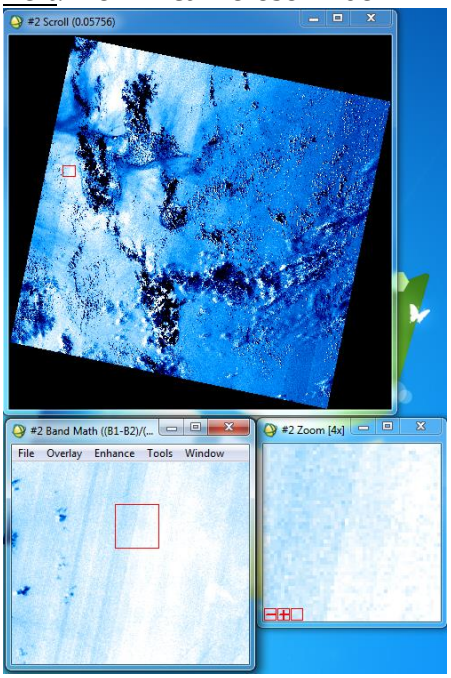
Surprisingly, the images of the aerosol index show calibration error that is reminiscent of that in the cirrus band: broad in area but small in value. This calibration error is not evident in either Band 1 or Band 2 images alone but shows up clearly in the aerosol index images. The difference in the aerosol index value across the boundary is about 0.01. This difference due to calibration error is consistent in all scenes.

The color mapping that I will be using for the rest of the report is Blue/White:

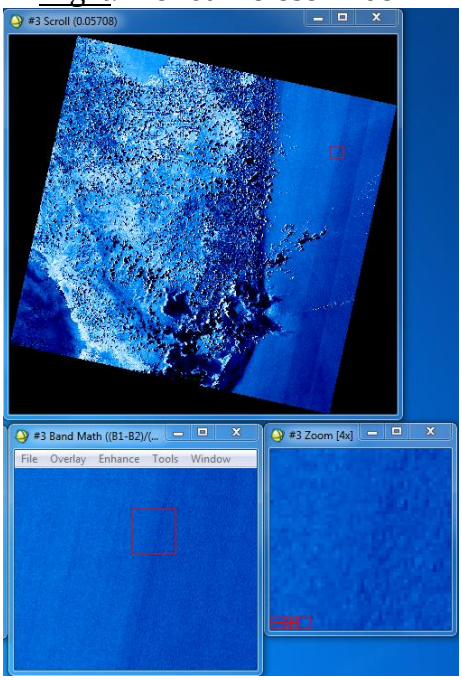
B1<B2 (Low Index Value) B1>B2 (High Index Value)

The lower the Aerosol Index value, the darker blue it is. The higher the Aerosol Index value, the lighter it is.

Left: Dominica Aerosol Index



Right: Florida Aerosol Index



Part I

Summary

Objects with the highest aerosol index value are shallow waters, shadowed surface, and dense/some type of vegetation.[2] On the other hand, ice, sandy shoreline, and clouds (both cumulous and cirrus) are objects with the lowest aerosol index values.

The aerosol index image closely mirrors the blue band image, except the brightness scale is the opposite. Bright objects in the aerosol index image appear dark in the blue band image, vice versa.

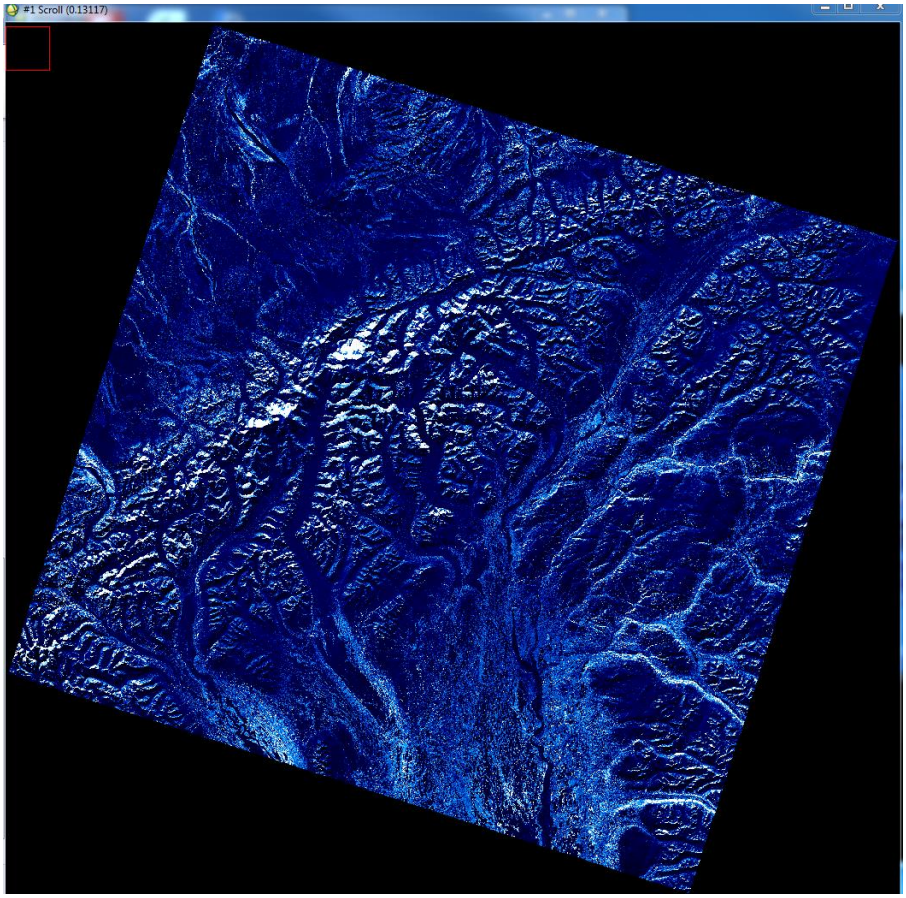
The biggest obstacle was to distinguish between aerosols and shallow waters. Perhaps, the more urgent question is how valid the Albedo Index is in visualizing information regarding aerosol and coastal waters.

Note: Nova Scotia image is not discussed until the second part of the analysis since it was added only later as a case study of high latitude region not covered in snow. The same goes for the Los Angeles scene.

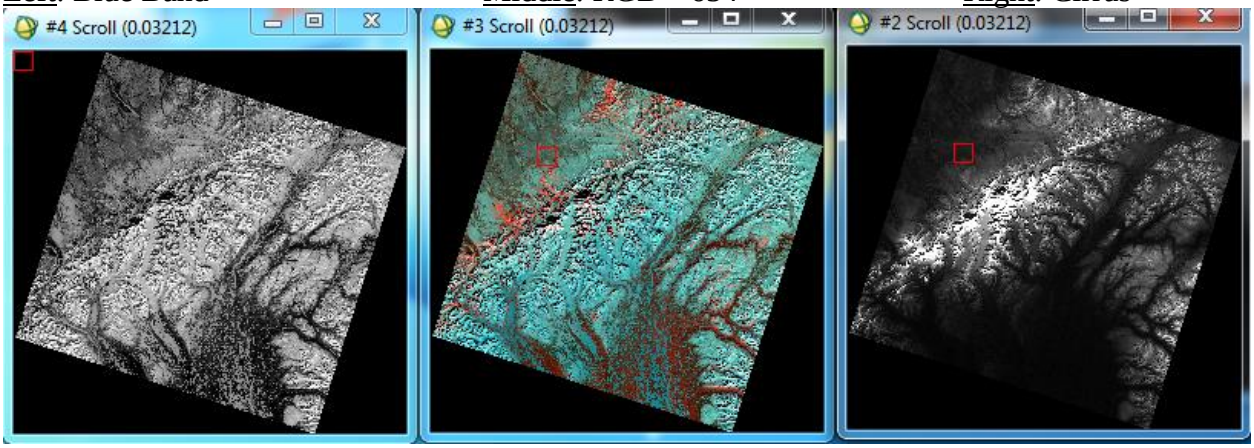
[2] Most plants product surface wax, which reflects harmful ultraviolet rays away.
http://en.wikipedia.org/wiki/Epicuticular_wax

❖ Alaska: 2013April22_AerosolIndex

	Minimum	Maximum	Mean	StDev
Alaska	-0.159277	2.44017	0.005952	0.024097

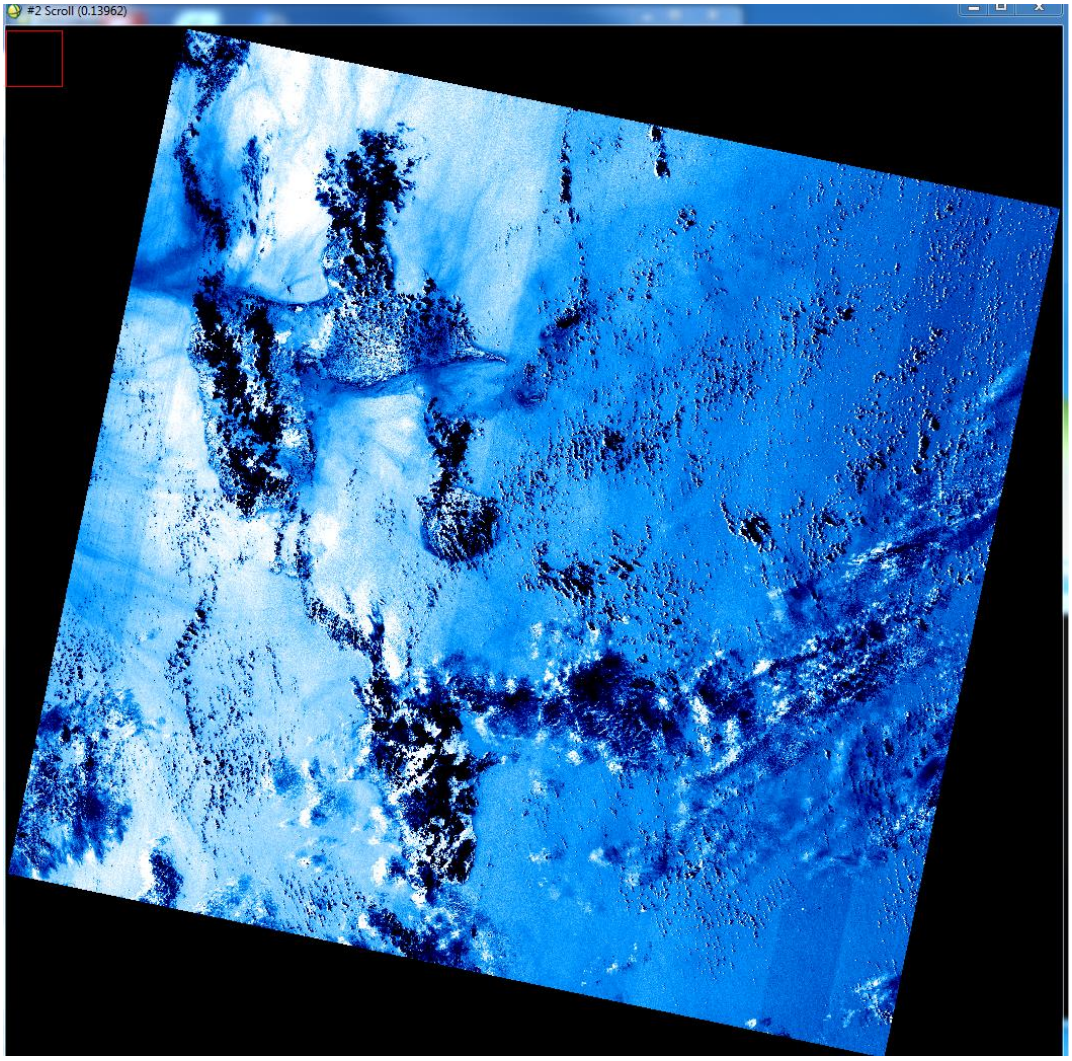


Left: Blue Band Middle: RGB – 654 Right: Cirrus

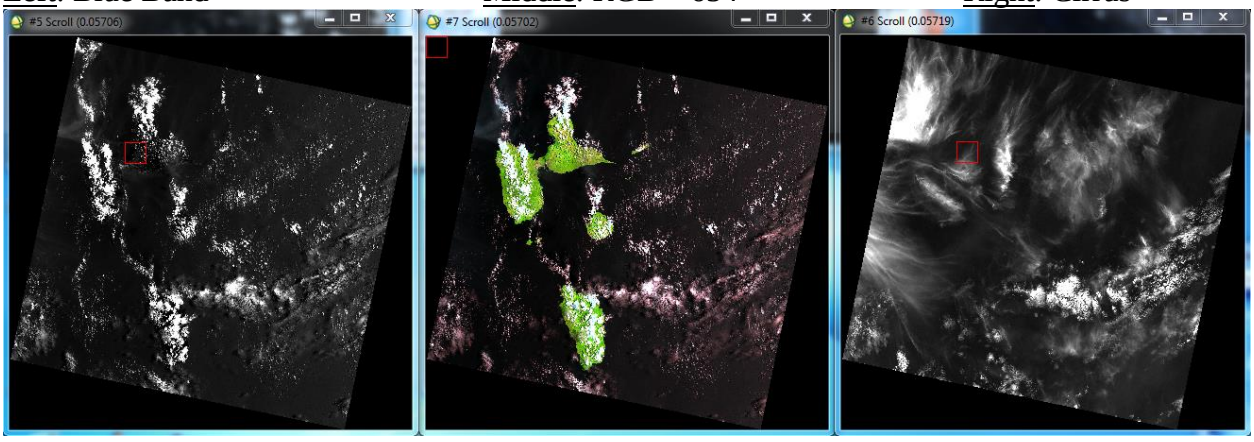


❖ Dominica: 2013May05_AerosolIndex

	Minimum	Maximum	Mean	StDev
Dominica	-0.103756	0.224566	0.075644	0.026319

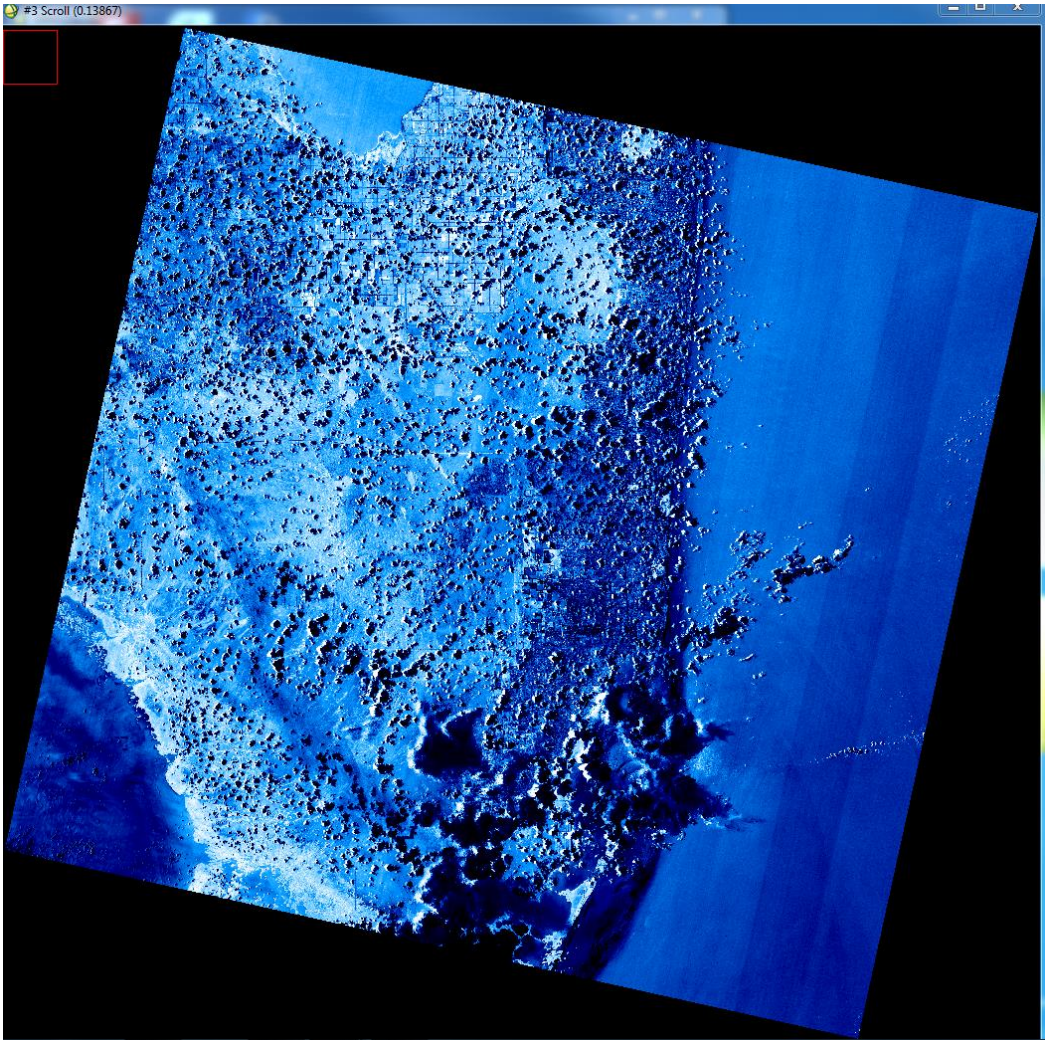


Left: Blue Band Middle: RGB – 654 Right: Cirrus

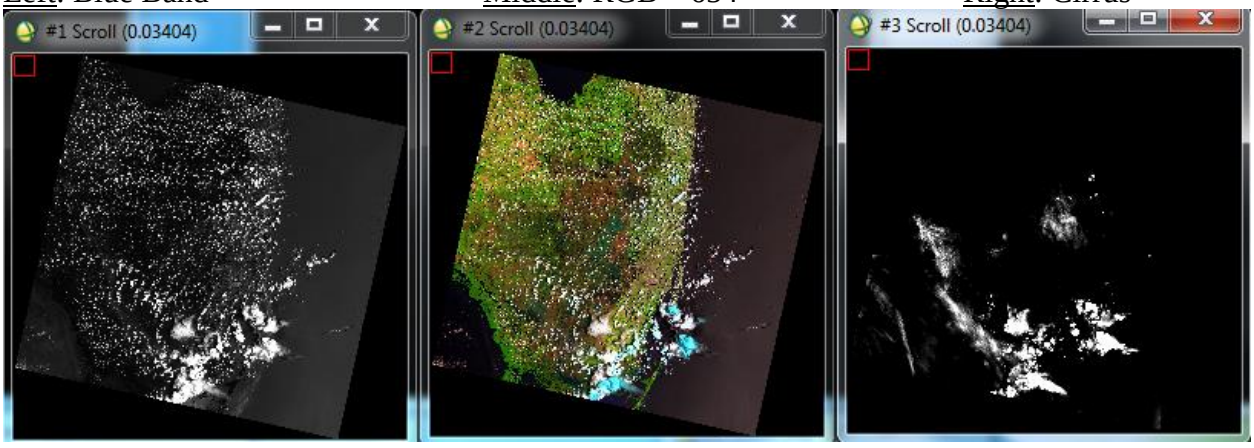


❖ Florida: 2013May23_AerosolIndex

	Minimum	Maximum	Mean	StDev
Florida	-0.160424	0.243168	0.065773	0.033022

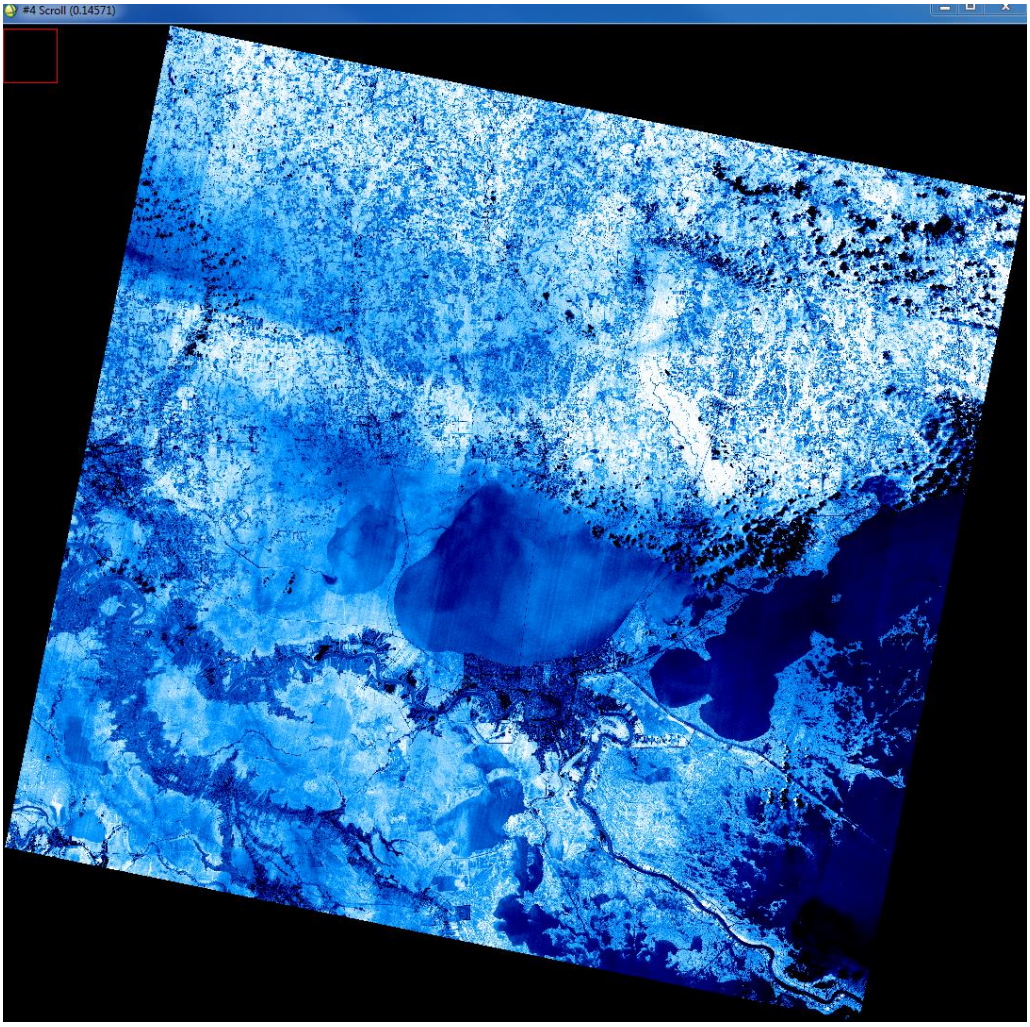


Left: Blue Band Middle: RGB – 654 Right: Cirrus

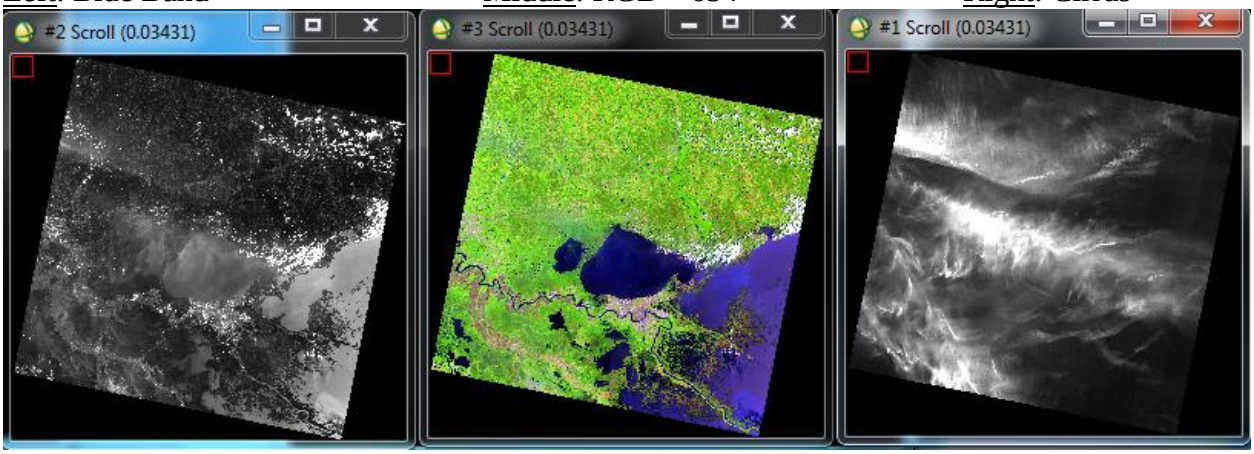


❖ Mississippi: 2013May23_AerosolIndex

	Minimum	Maximum	Mean	StDev
Mississippi	-0.238334	0.453076	0.081025	0.024173



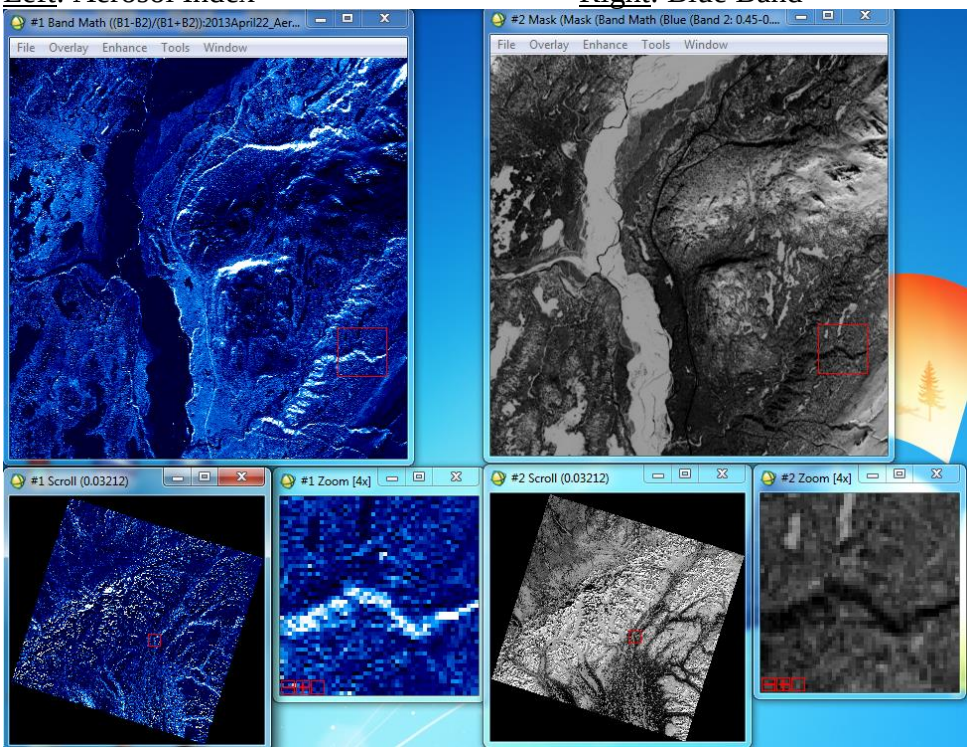
Left: Blue Band Middle: RGB – 654 Right: Cirrus



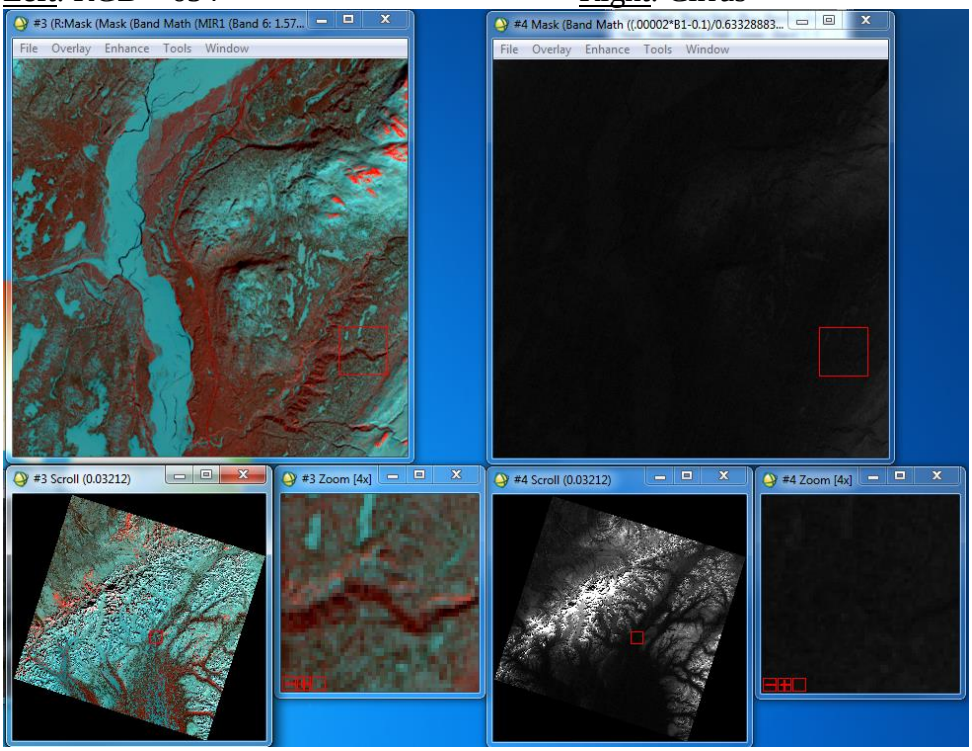
Examples

- Alaska: Icy River

Left: Aerosol Index Right: Blue Band

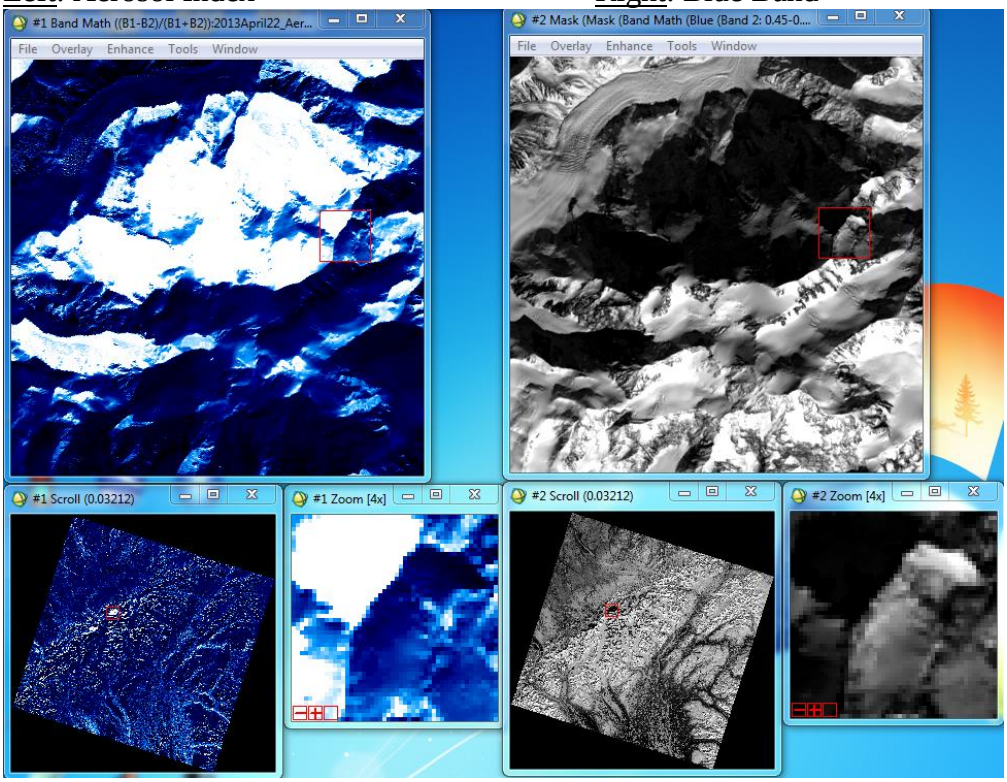


Left: RGB – 654 Right: Cirrus

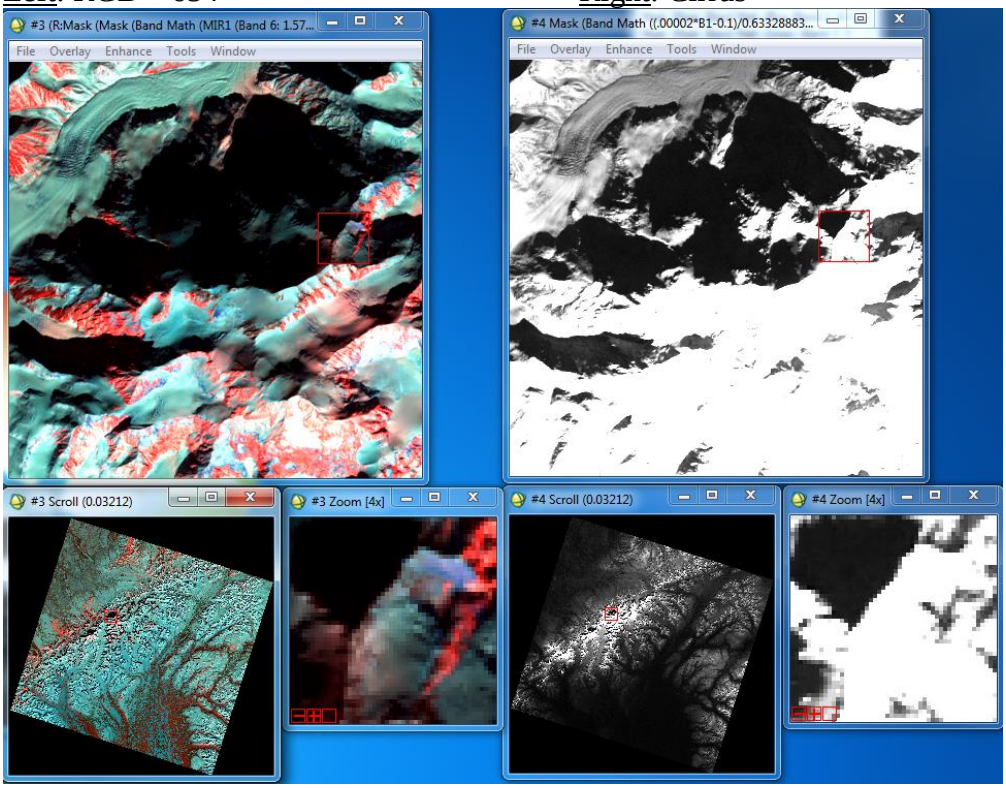


- Alaska: (Shadowed) Snow Caps

Left: Aerosol Index Right: Blue Band

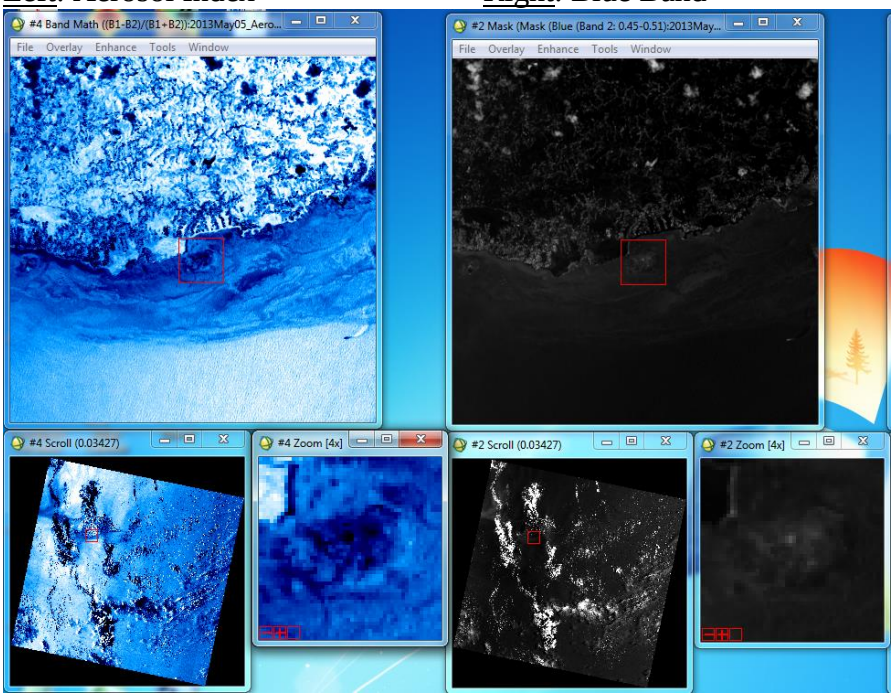


Left: RGB – 654 Right: Cirrus

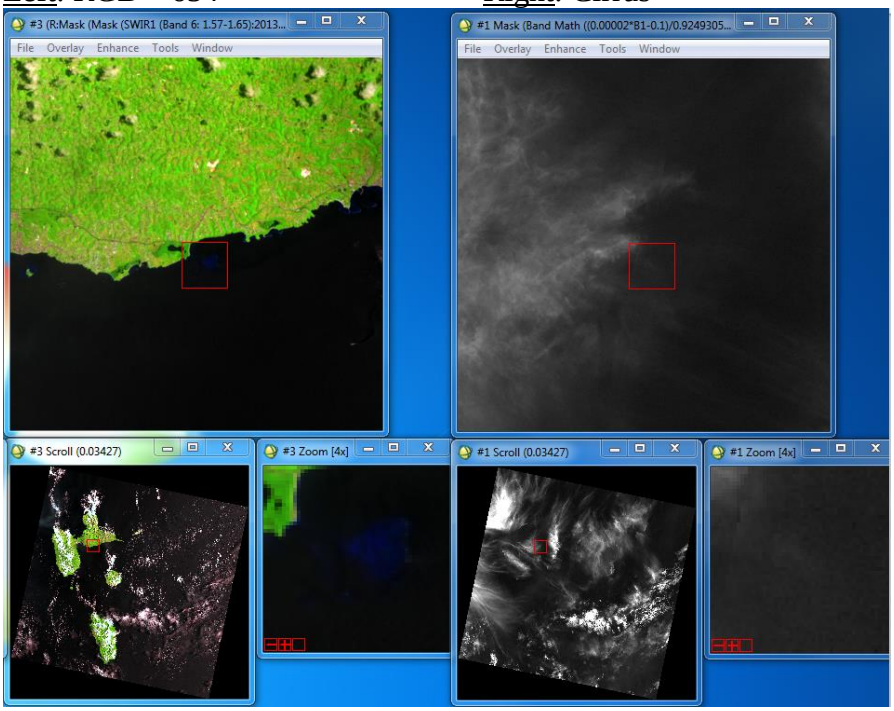


- Dominica: Coral Reef

Left: Aerosol Index Right: Blue Band



Left: RGB – 654 Right: Cirrus

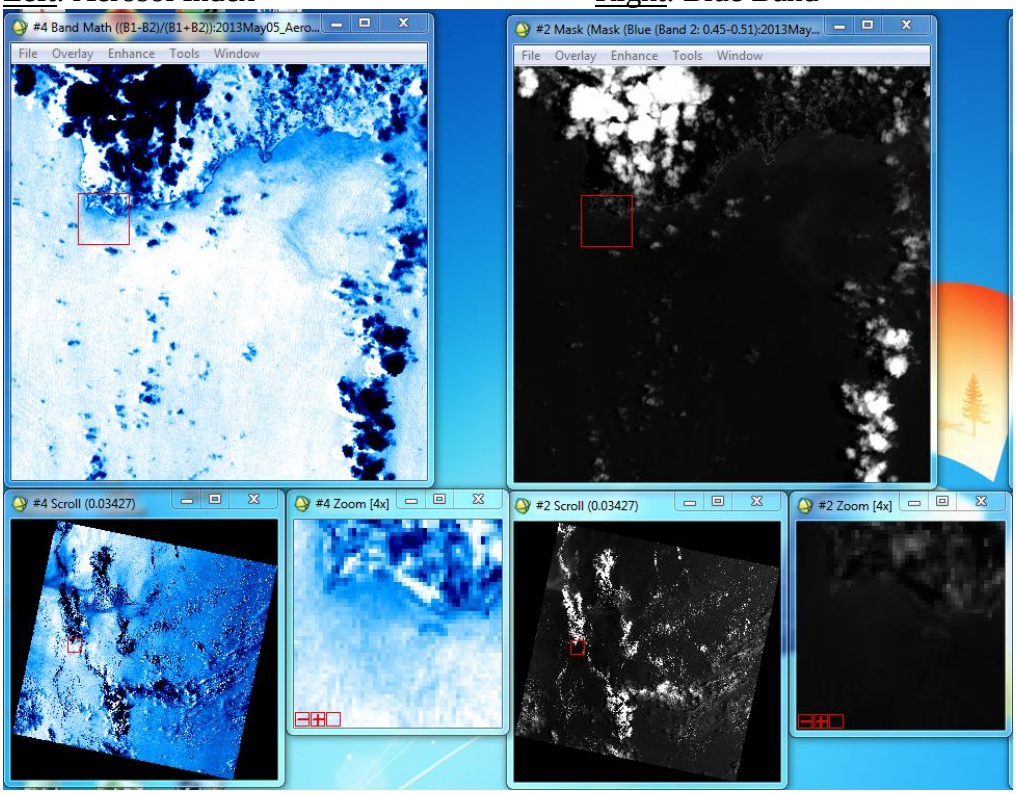


Note: In the RGB's Zoom window, you can see a dark blue patch that corresponds to the distinct shape in the Aerosol Index and Blue Band windows. I suspect these are coral reefs.[3]

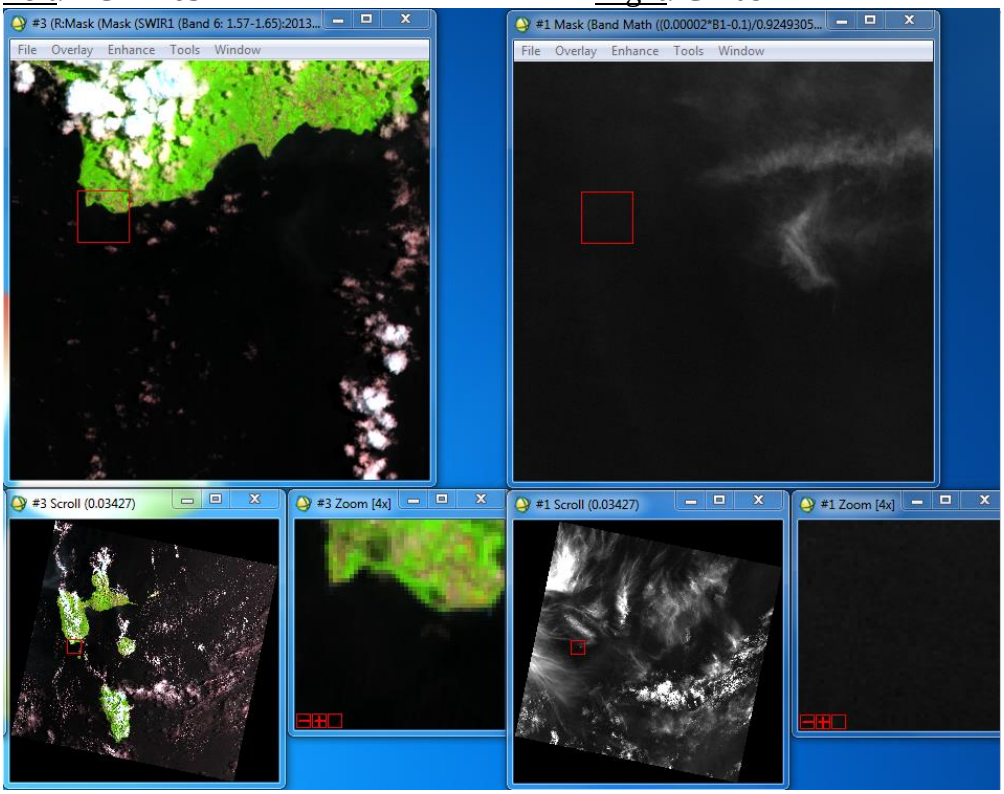
[3] http://www.coral.noaa.gov/images/reef_maps/volume1/guadeloupe.jpg

- Dominica: Coastal Waters

Left: Aerosol Index Right: Blue Band

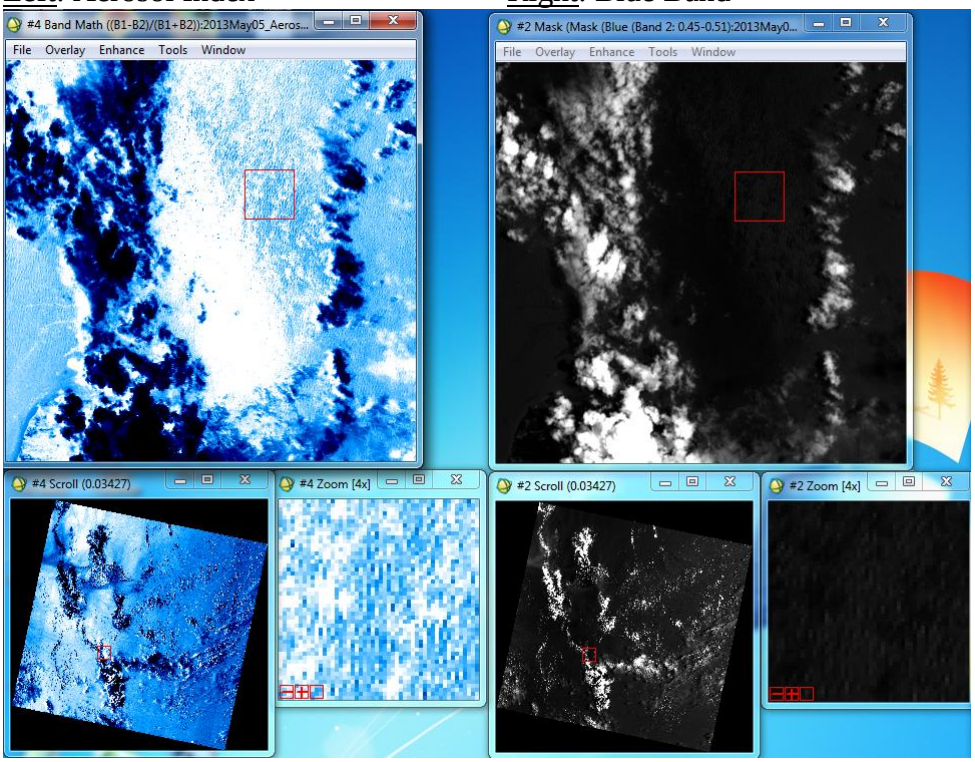


Left: RGB – 654 Right: Cirrus

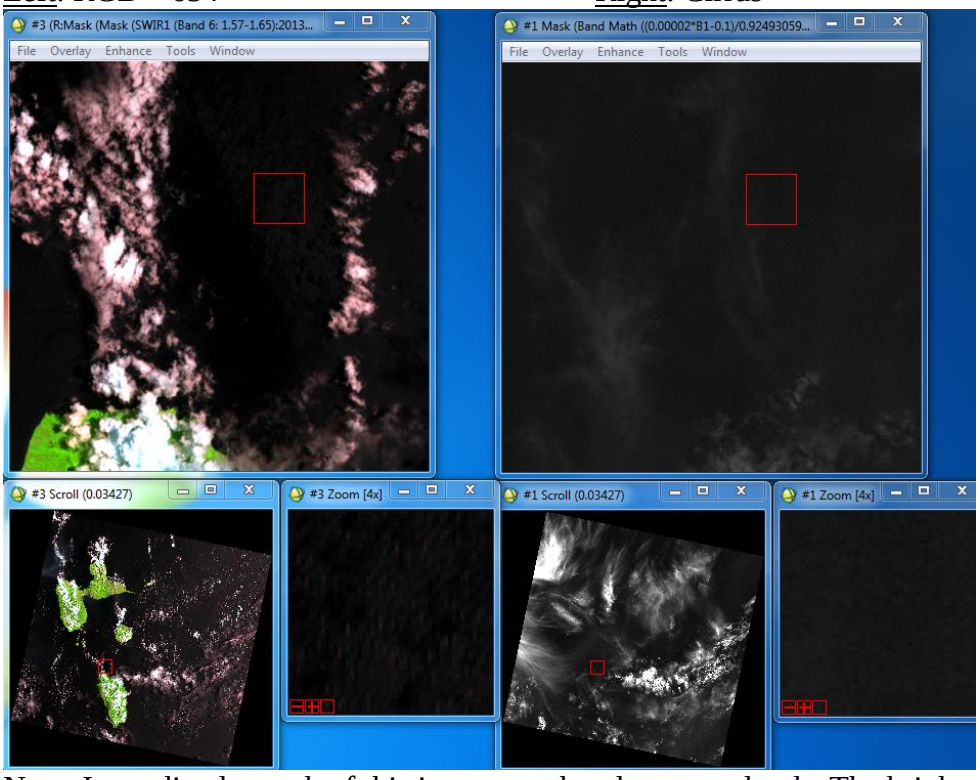


- Dominica: Wind from Thunderstorm Cloud?

Left: Aerosol Index Right: Blue Band



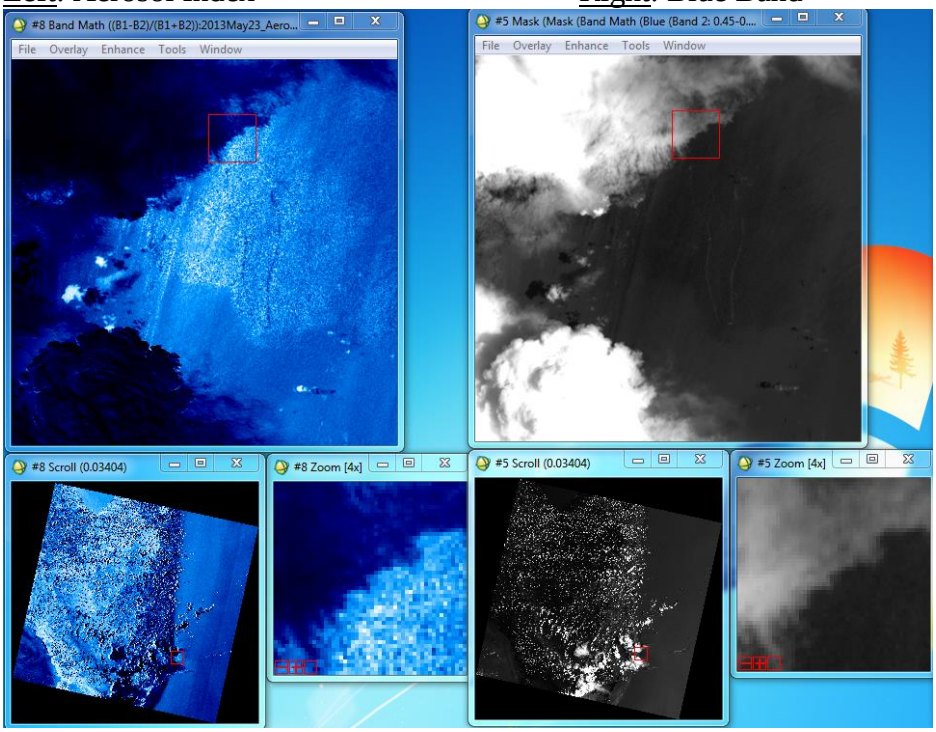
Left: RGB – 654 Right: Cirrus



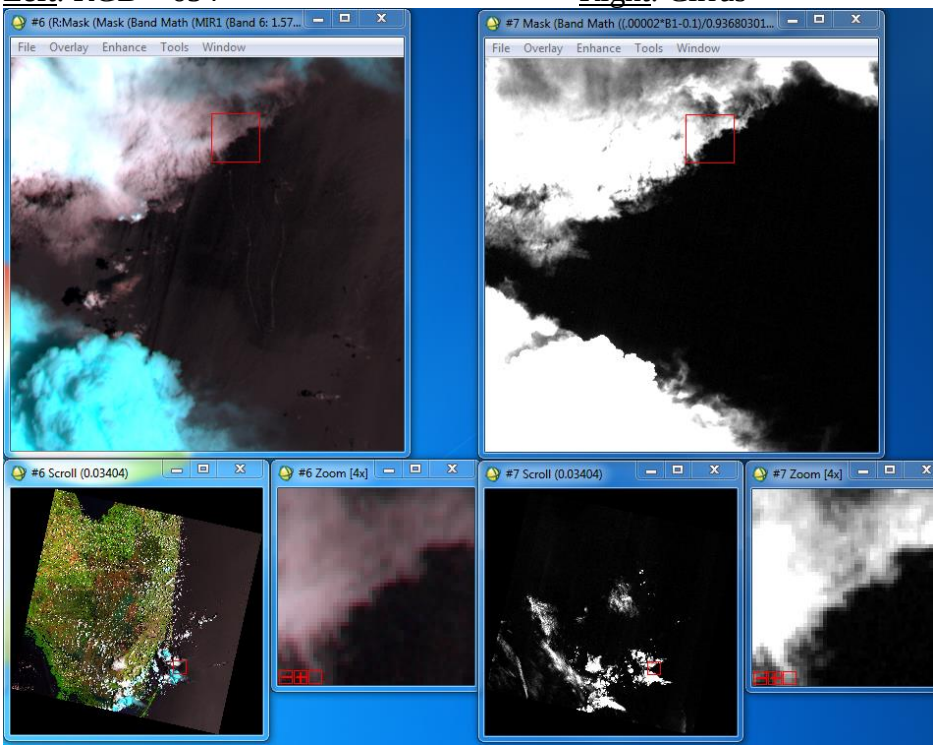
Note: Immediately south of this image are thunderstorm clouds. The bright scattered mass could be from spectral reflectance due to the wind stirring up the liquid droplets in the atmosphere.

- Florida: Wind from Thunderstorm Cloud?

Left: Aerosol Index Right: Blue Band



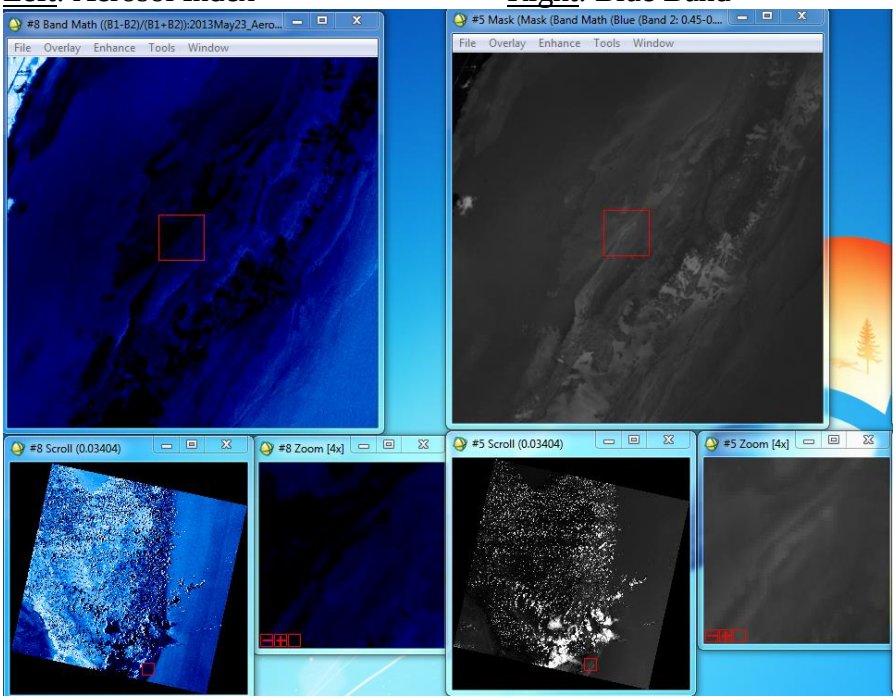
Left: RGB – 654 Right: Cirrus



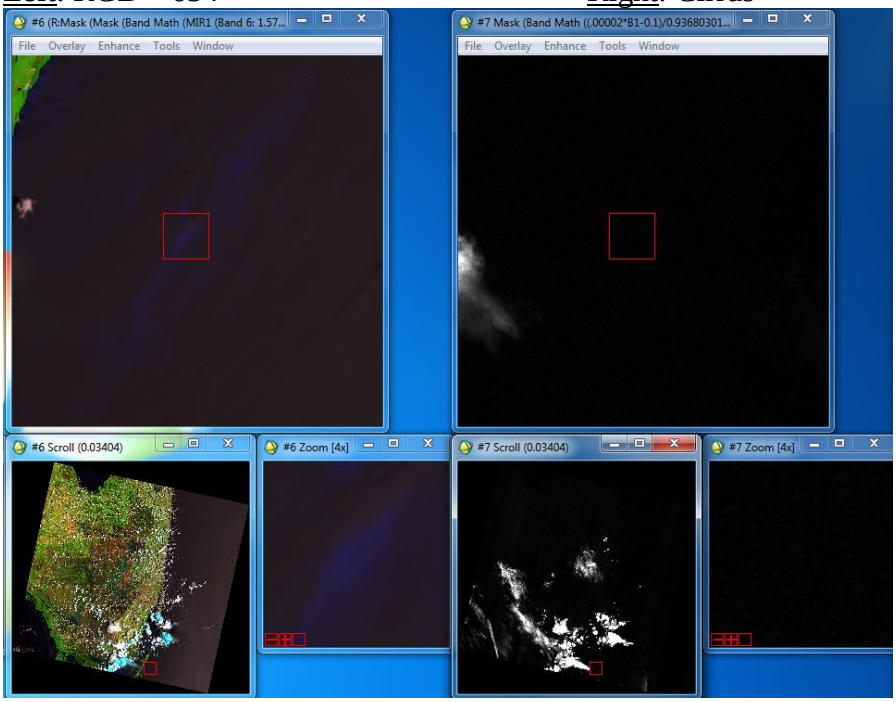
Note: Immediately west and south of this image are thunderstorm clouds. Again, could be from spectral reflectance from the wind.

- Florida: Coral Reef

Left: Aerosol Index Right: Blue Band



Left: RGB – 654 Right: Cirrus

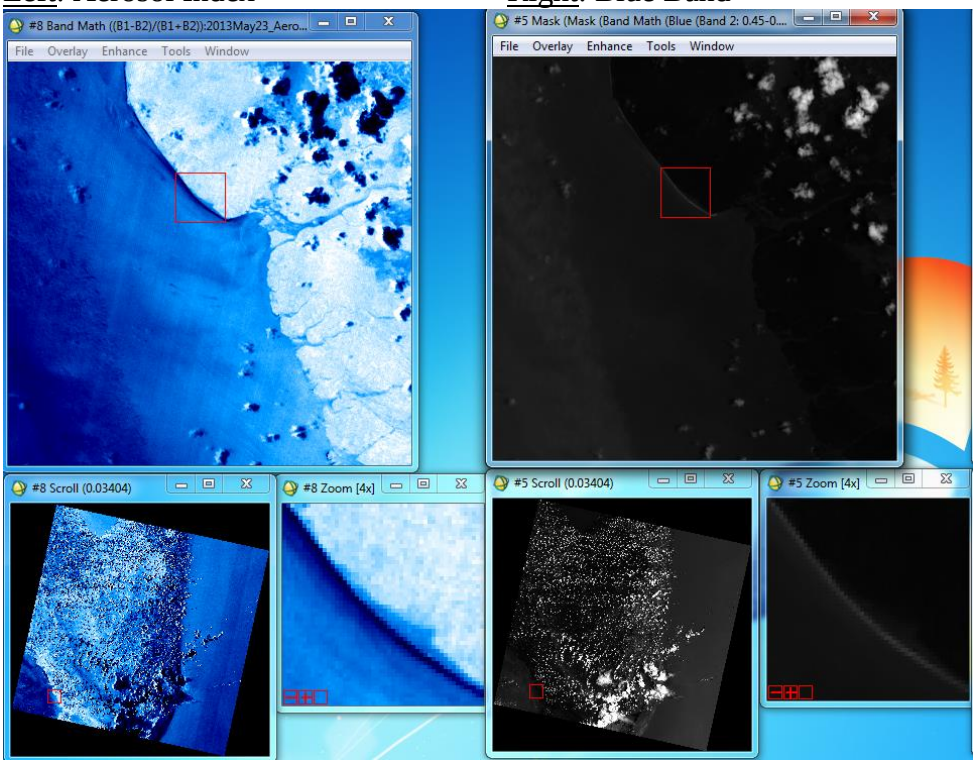


Note: The dark blue shapes in the Aerosol Index and Blue Band windows probably are coral reefs. In the RGB – 654 window, a part shows up as a dark blue patch.[4]

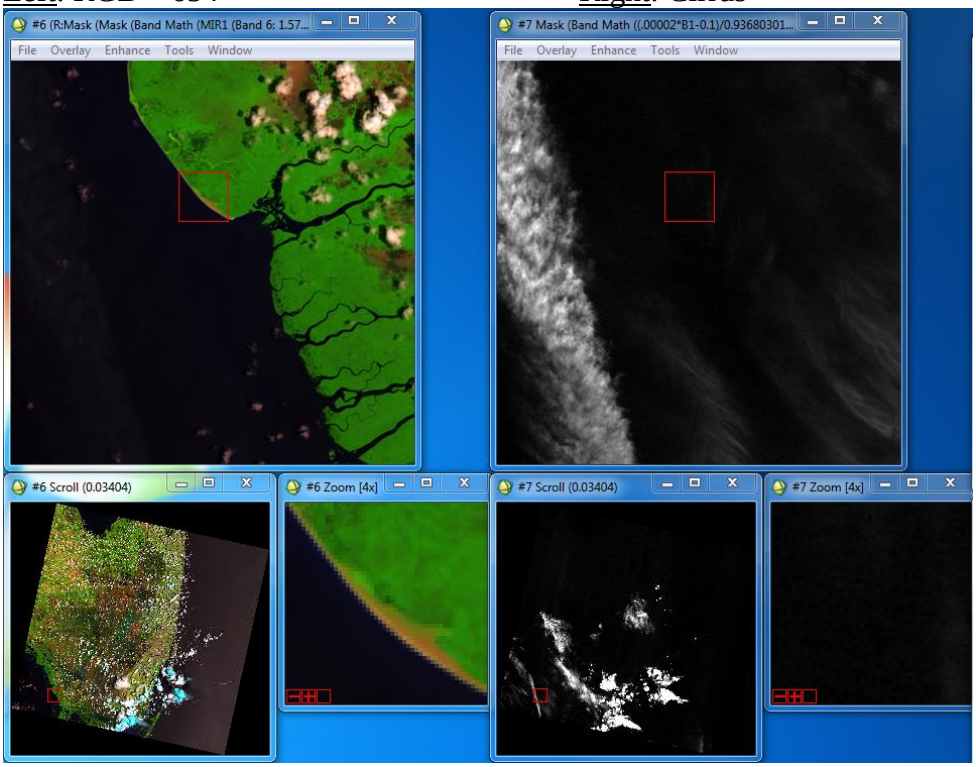
[4] http://www.coral.noaa.gov/images/reef_maps/volume1/usa_large.jpg

- Florida: Cirrus Cloud/Sand

Left: Aerosol Index Right: Blue Band



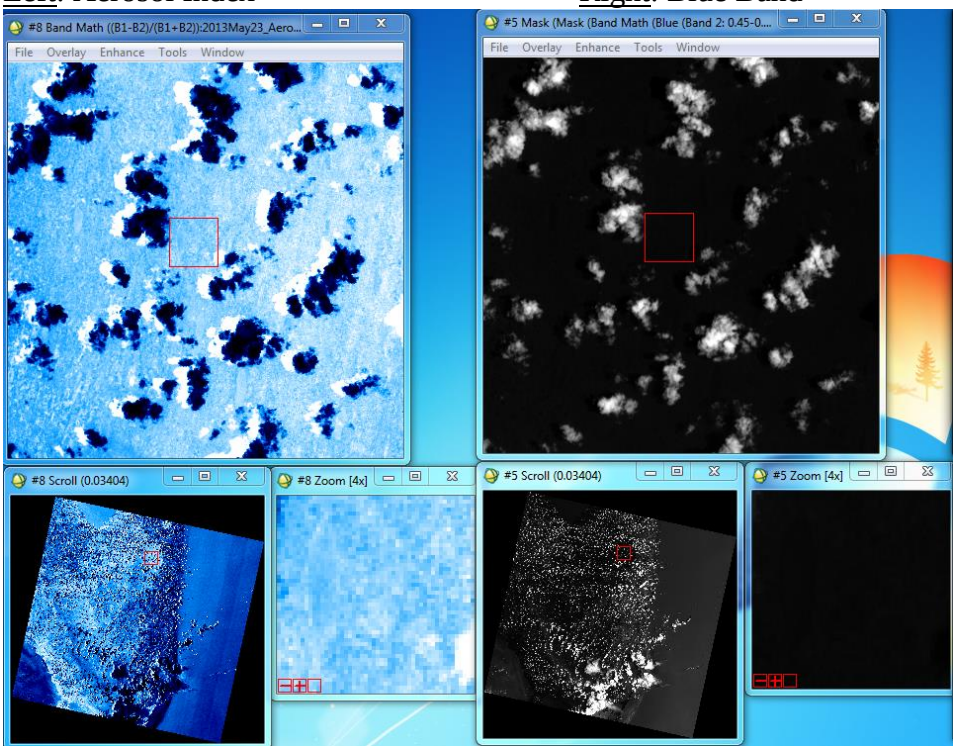
Left: RGB – 654 Right: Cirrus



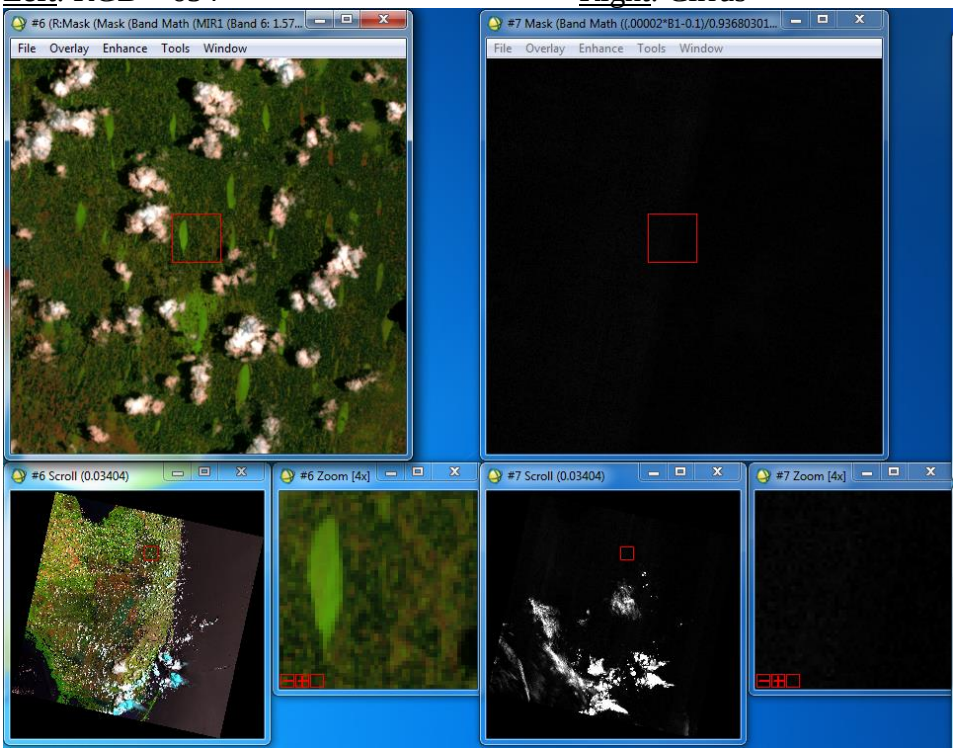
Note: The cirrus cloud lowers the Aerosol Index value. So, does the presence of sandy coastline.

- Florida: Vegetation

Left: Aerosol Index Right: Blue Band



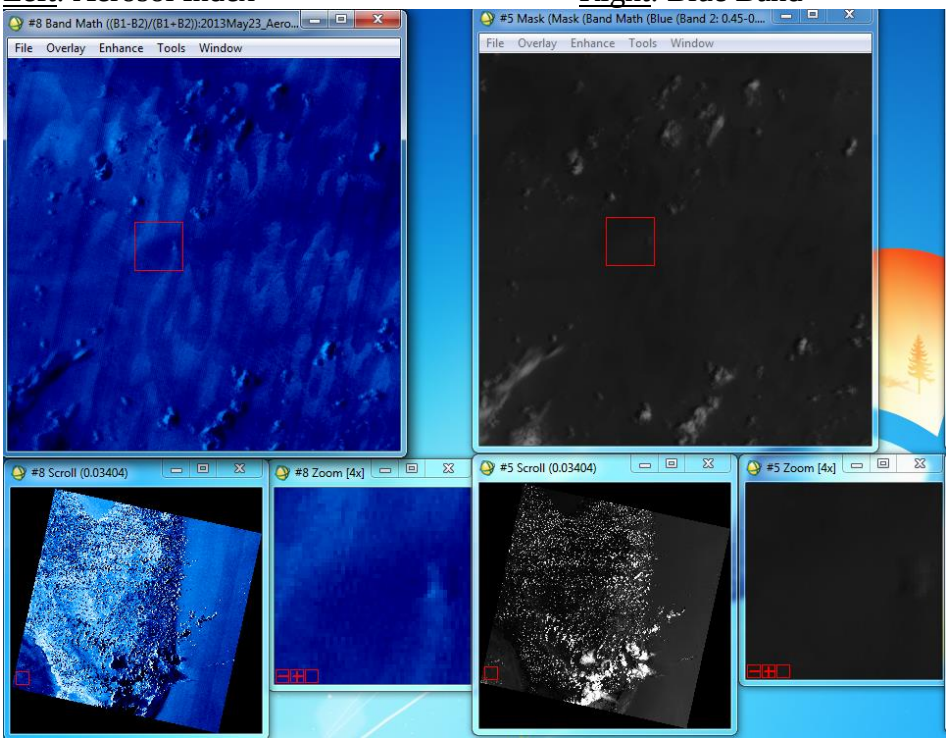
Left: RGB – 654 Right: Cirrus



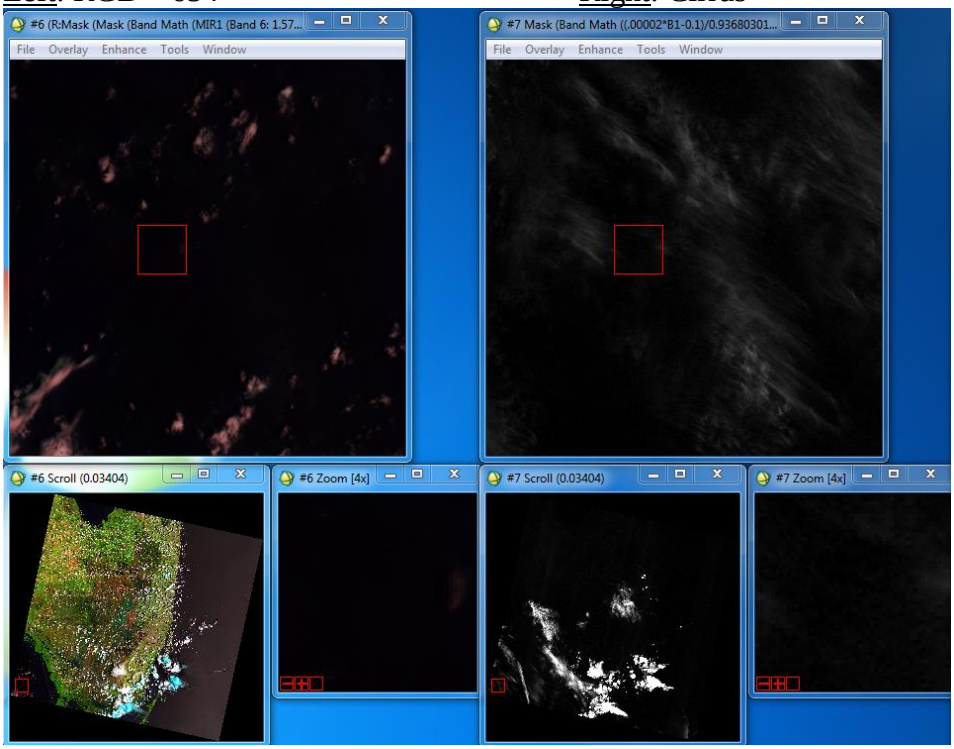
Note: The spatial subset is one of the brightest areas in the Aerosol Index image. The darker green it appears in RGB-654, the higher the aerosol index value.

- Florida: ???

Left: Aerosol Index Right: Blue Band



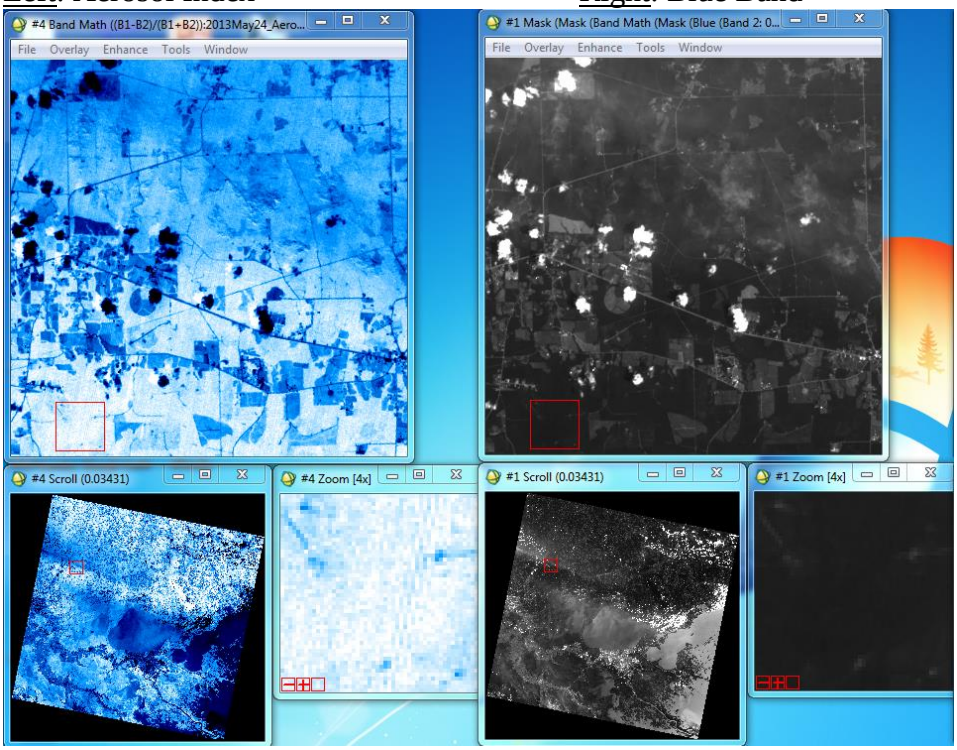
Left: RGB – 654 Right: Cirrus



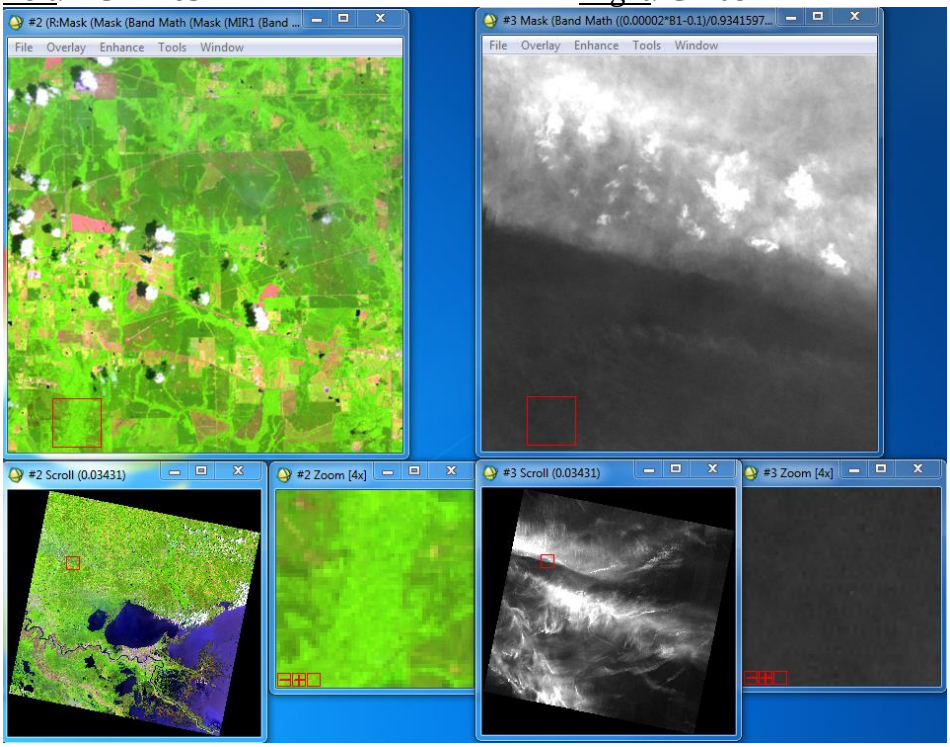
Note: I am not sure what the white shapes in the Aerosol Index image are. They do not show up in any other windows.

- Mississippi: Cirrus/Vegetation

Left: Aerosol Index Right: Blue Band



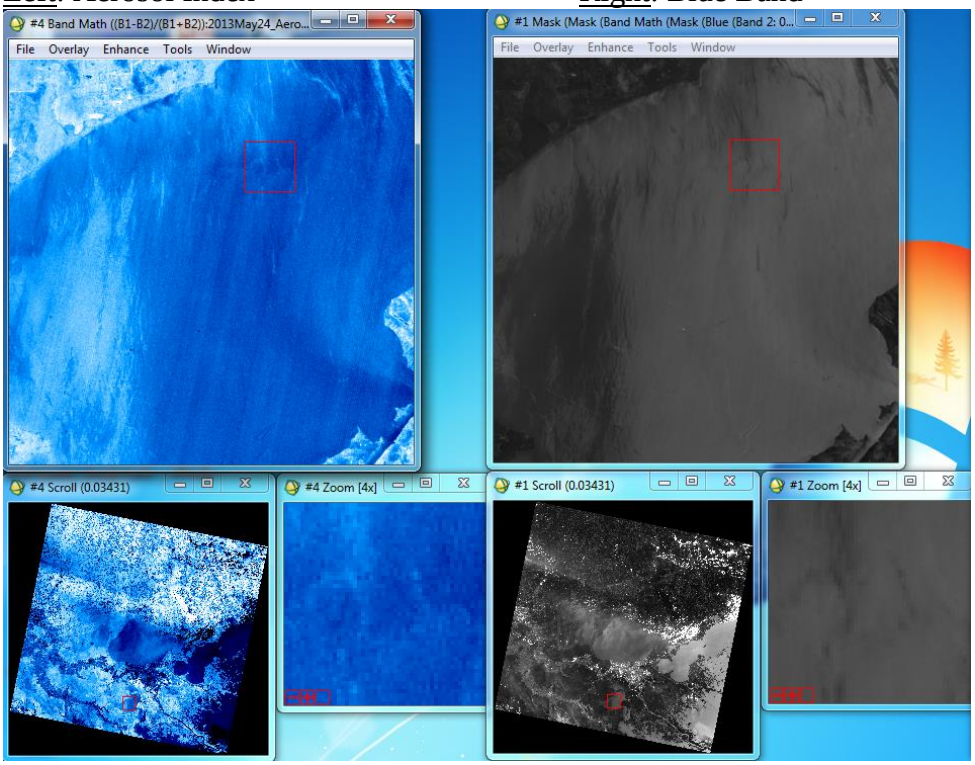
Left: RGB – 654 Right: Cirrus



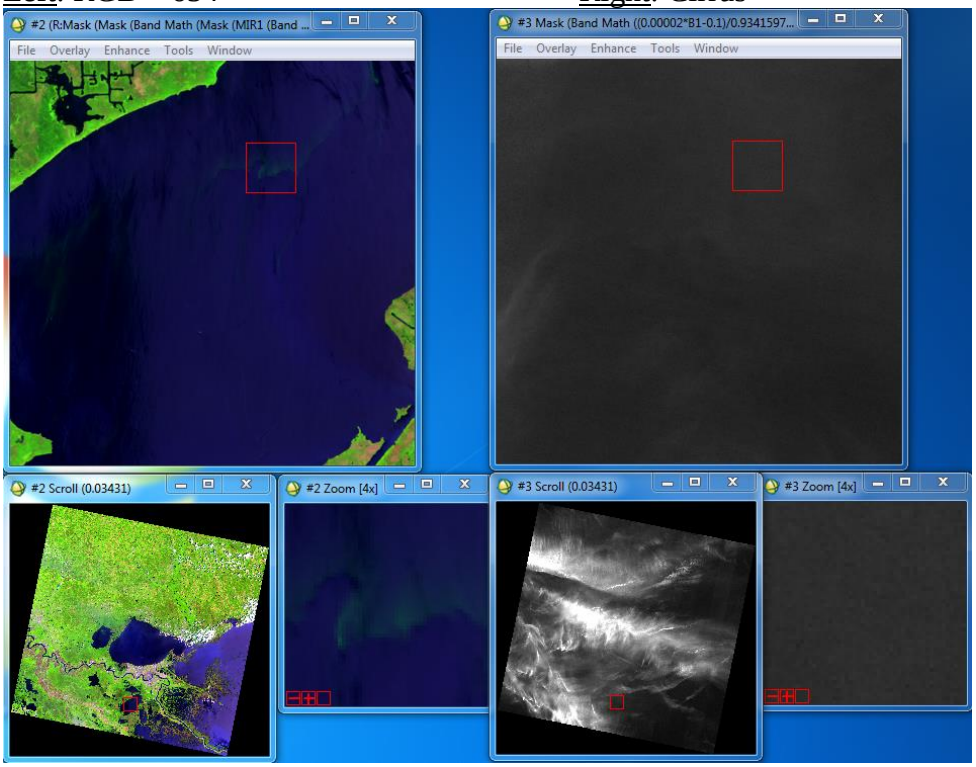
Note: The effect of cirrus cloud is best observed in the Image window while the effect of vegetation is best observed in the Zoom window.

- Mississippi: Inland Lake

Left: Aerosol Index Right: Blue Band



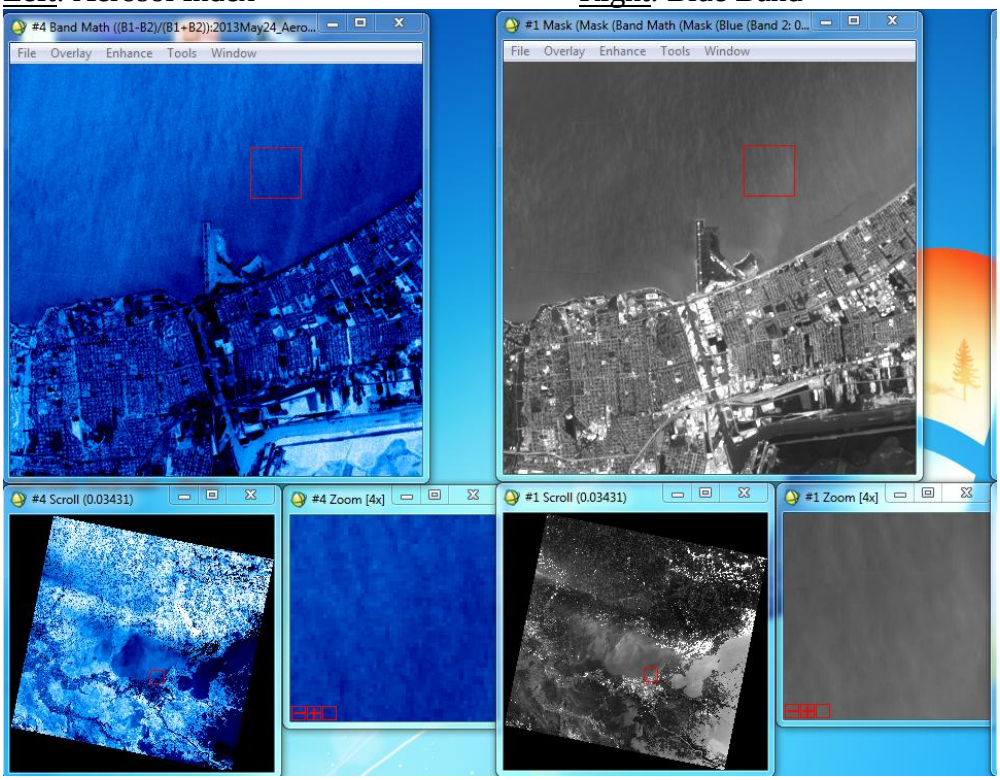
Left: RGB – 654 Right: Cirrus



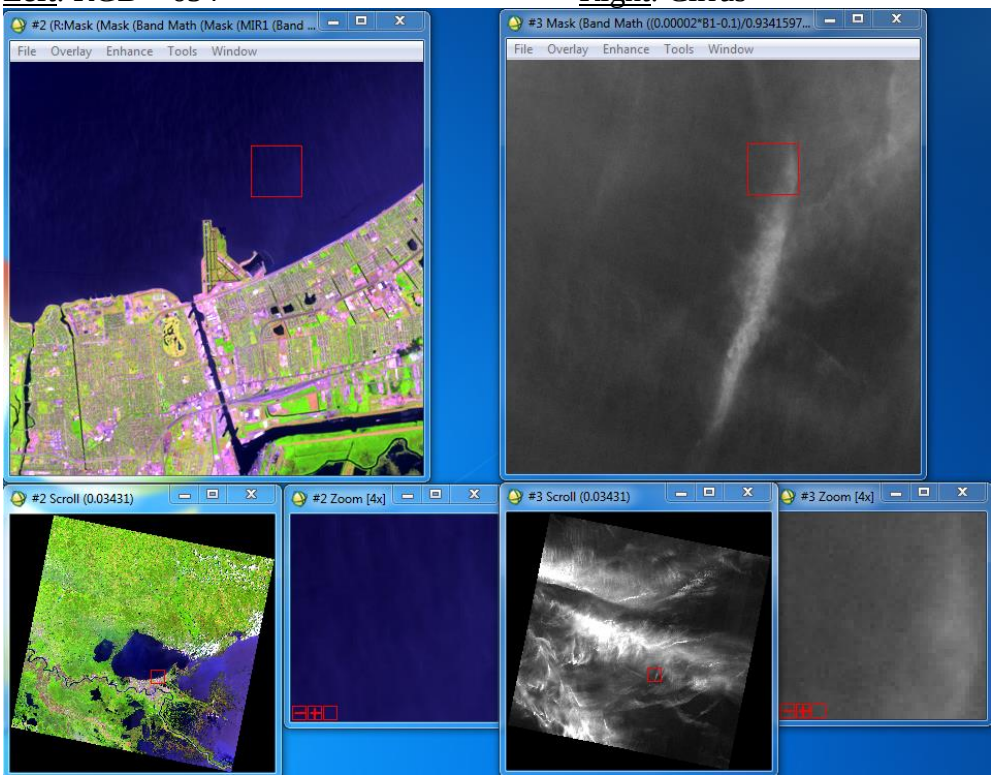
Note: Algae bloom can be detected in the Zoom window, notably the RGB – 654.

- Mississippi: Lake Ponchartrain

Left: Aerosol Index Right: Blue Band

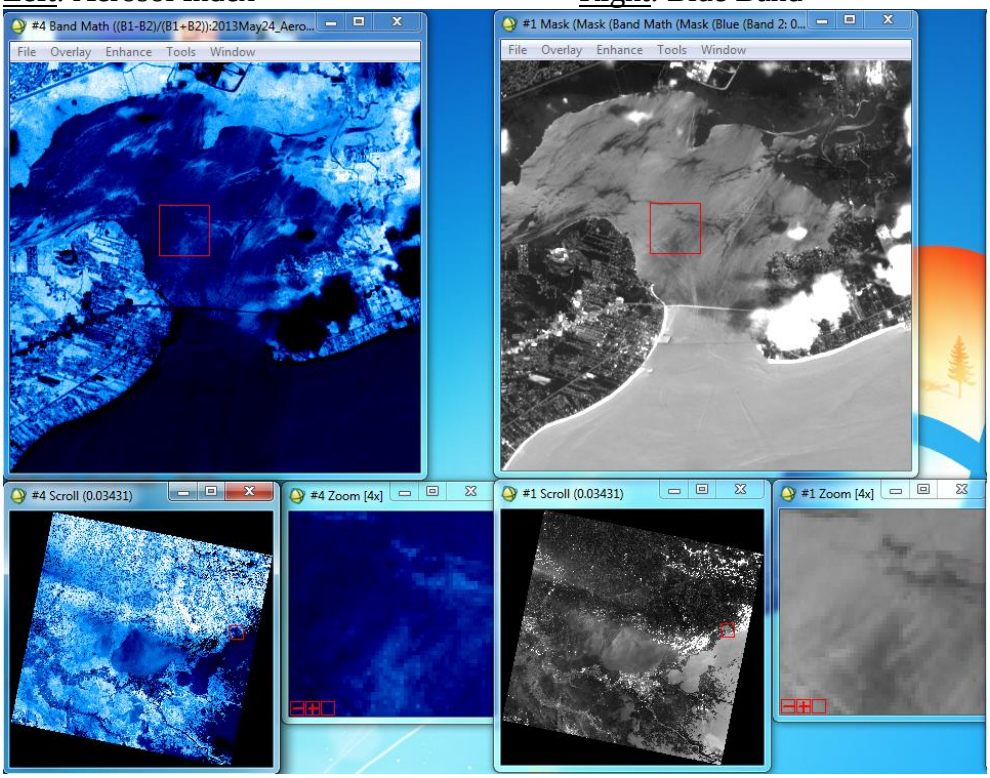


Left: RGB – 654 Right: Cirrus

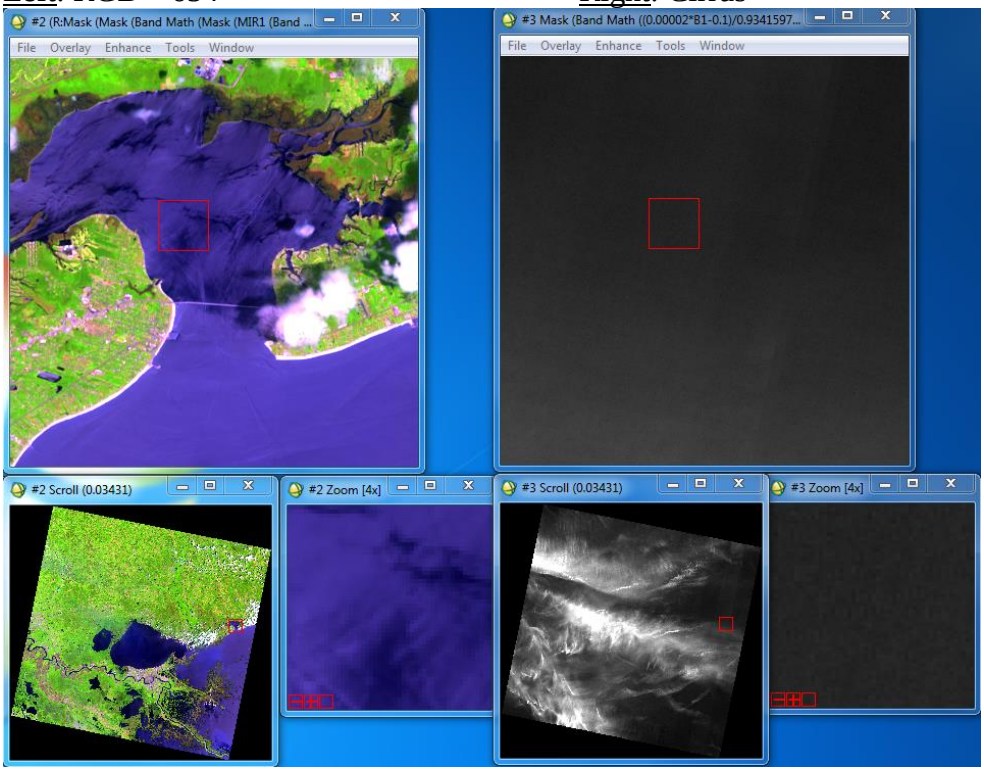


- Mississippi: River Discharge

Left: Aerosol Index Right: Blue Band

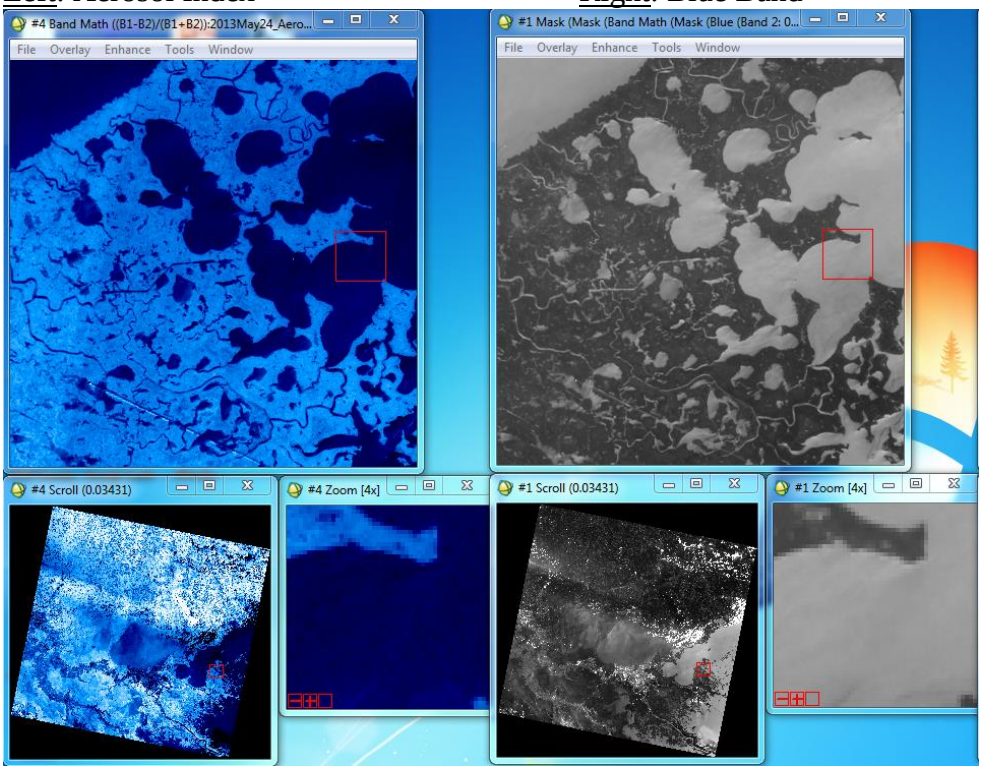


Left: RGB – 654 Right: Cirrus

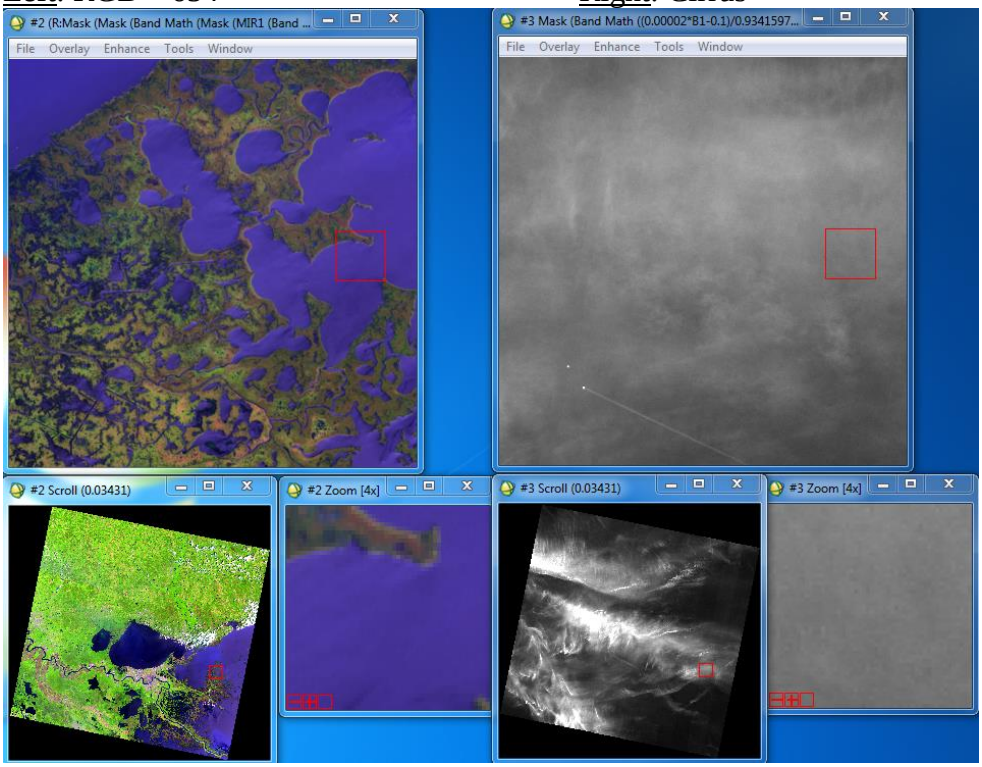


- Mississippi: Bay

Left: Aerosol Index Right: Blue Band



Left: RGB – 654 Right: Cirrus



PART II

Atmospheric Aerosols: A comparison study of Aerosol Index variations in water and forest substrates across different scenes.

Hypopthesis: Higher latitude scenes such as Nova Scotia has low relative humidity, and thus lower probability of aerosols present in the atmosphere. Lower latitude scenes such as Florida has high humidty and thus higher probability of aerosols present in the atmosphere.

In this study, I looked at the following scenes:
High Latitude: Nova Scotia (2013June16)
Low Latitude: Florida (2013May23) and Mississippi (2013May24)

In addition to these scenes, I also looked at Los Angeles (2013June30) too since the air quality was moderately poor on that day, and thus the scene promises aerosols in the atmosphere.

Note: The Dominica scene was left out due to heavy cirrus cloud contamination.

Results: The findings contradict the hypothesis. The lower latitude scenes display lower aerosol index values than the higher latitude scene did for BOTH substrates. This is curious since the PWAT value for Nova Scotia was significantly lower than those for Florida and Mississippi, indicating there are less moisture in the atmosphere in Nova Scotia. However, the balloon sounding data shows that there may be a shallow layer of fog, which may explain Nova Scotia's higher aerosol index.

It is important to also keep in mind that the sample size for this analysis is limited.

The aerosol index values over forest substrates were consistent across different scenes at the mean value of 0.11. For water subtrates, the aerosol index values were much less consistent.

Table 6: Aerosol Index over Forests

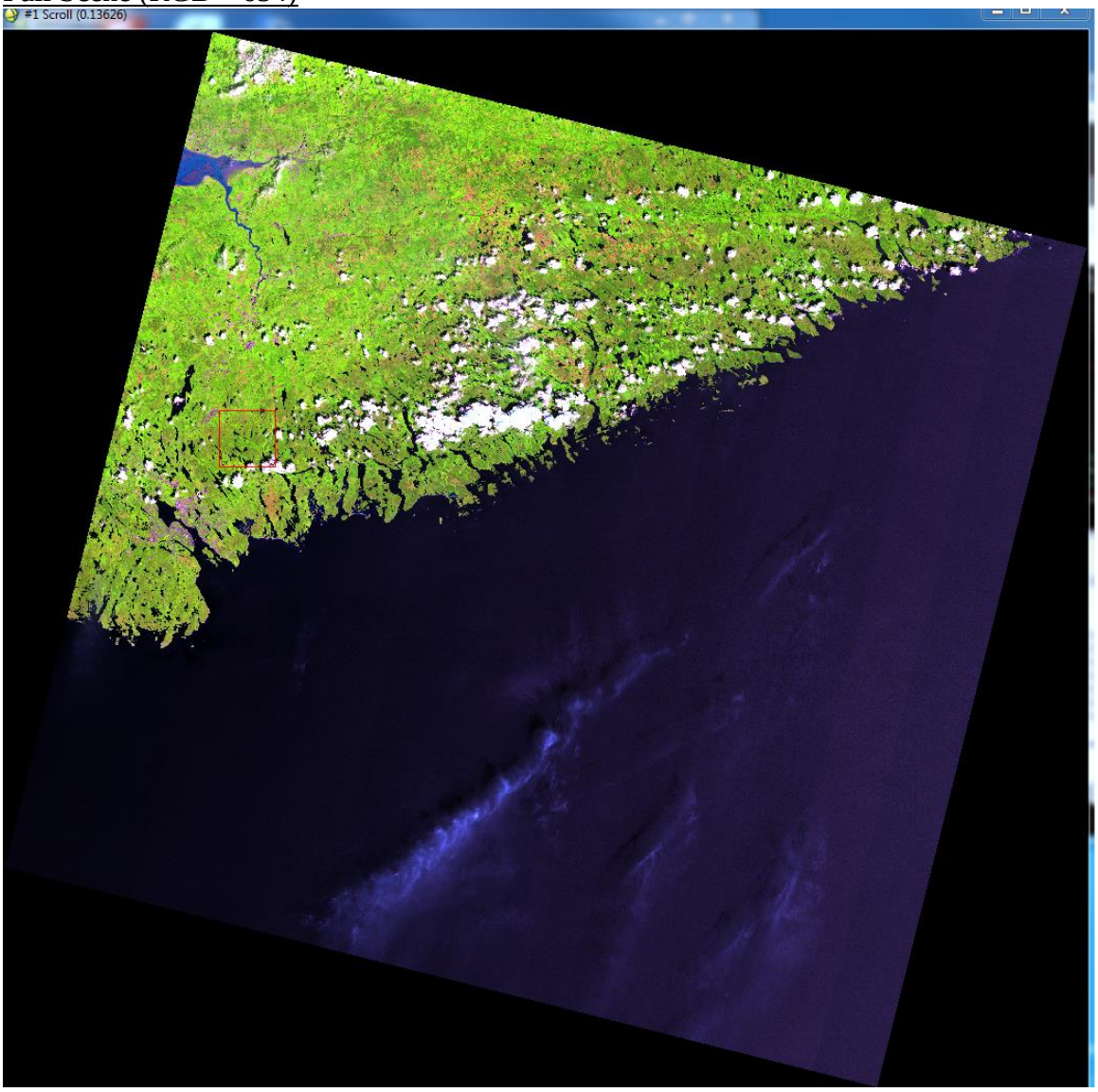
	Min	Max	Mean	StDev
Nova Scotia	0.069677	0.132026	0.116303	0.007045
Florida	0.062880	0.127559	0.103233	0.007369
Mississippi	0.060710	0.123825	0.113224	0.003460
Los Angeles	-0.003951	0.103934	0.085527	0.008280

Table 7: Aerosol Index over Water

	Min	Max	Mean	StDev
Nova Scotia	0.067265	0.142604	0.107593	0.009838
Florida	0.003255	0.090609	0.065411	0.005647
Mississippi	0.023771	0.061259	0.039220	0.008154
Los Angeles	0.060694	0.114329	0.097448	0.003147

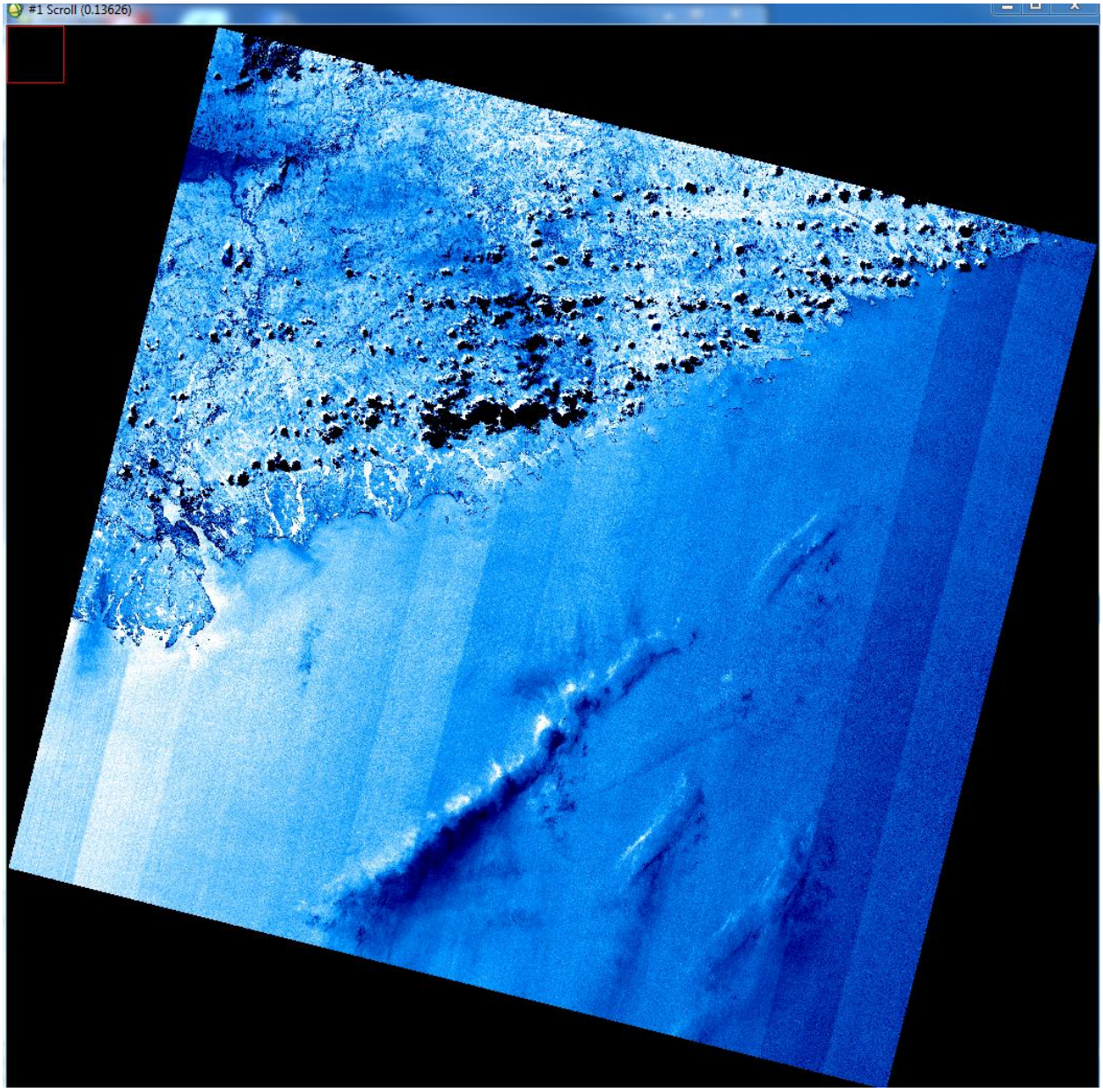
- Nova Scotia: 2013June16_AerosolIndex

Full Scene (RGB – 654)

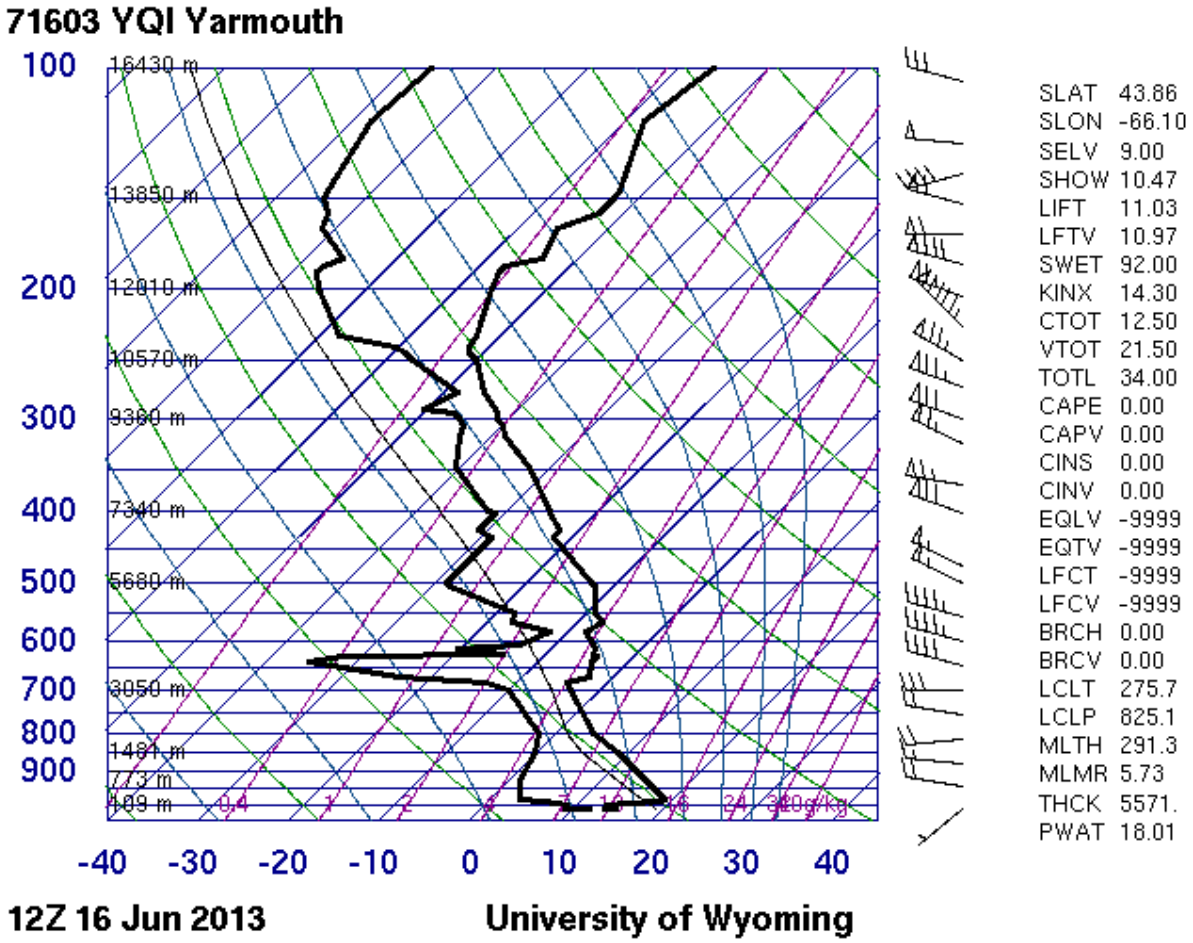


Full Scene: Aerosol Index (B1-B2/B1+B2)

	Minimum	Maximum	Mean	StDev
Nova Scotia	-0.273329	0.272969	0.095160	0.020822



Wyoming Sounding



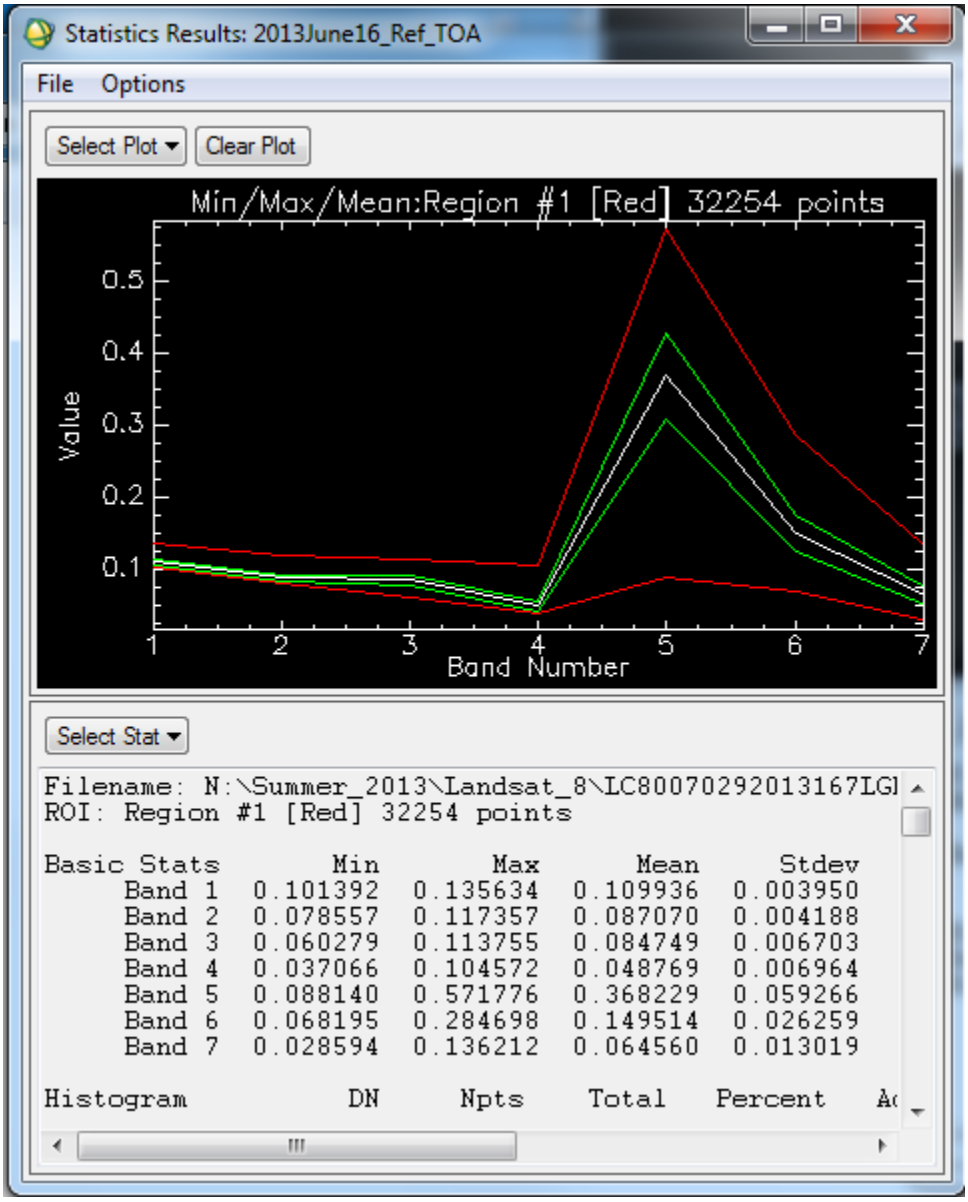
71603 YQI Yarmouth Observations at 12Z 16 Jun 2013

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1012.0	9	14.8	11.9	83	8.72	230	7	287.0	311.5	288.5
1011.0	17	13.6	9.1	74	7.22	232	8	285.9	306.2	287.1
1001.0	101	13.4	8.8	74	7.15	257	18	286.5	306.7	287.7
1000.0	109	13.4	8.9	74	7.20	260	19	286.6	306.9	287.8
992.0	177	15.6	7.6	59	6.64	262	21	289.4	308.5	290.6
990.0	194	19.0	6.0	43	5.96	262	21	293.0	310.4	294.0
983.0	255	19.2	3.2	35	4.92	264	23	293.8	308.4	294.7
977.2	305	18.8	3.0	35	4.88	265	24	293.9	308.4	294.7
942.9	610	16.3	1.7	37	4.61	280	20	294.4	308.1	295.2
925.0	773	15.0	1.0	39	4.47	265	25	294.6	308.0	295.4

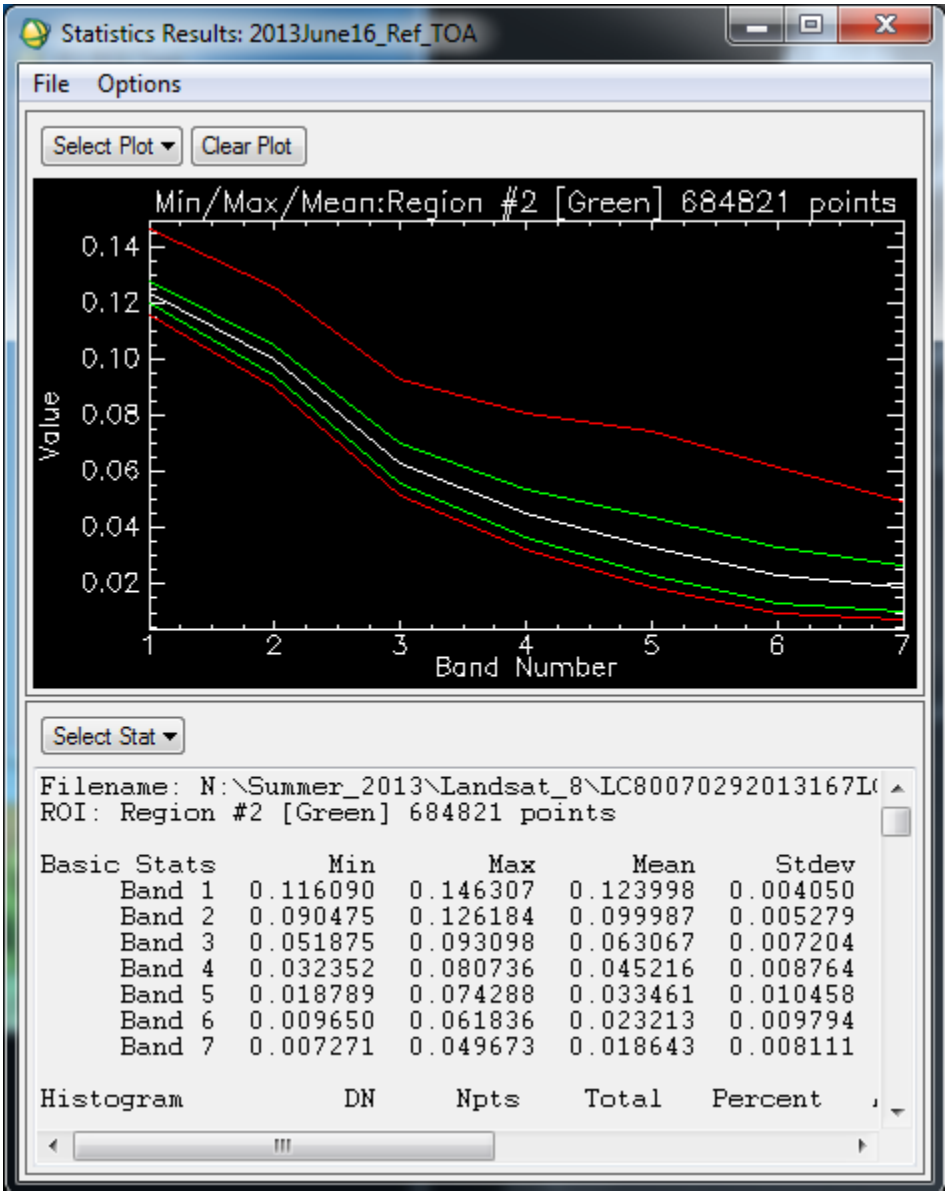
Table 8: Forest and Water Substrates Aerosol Index (B1-B2/B1+B2)

Substrate	Minimum	Maximum	Mean	StDev
Forest	0.069677	0.132026	0.116303	0.007045
Water	0.067265	0.142604	0.107593	0.009838

Nova Scotia FOREST Substrate Statistics

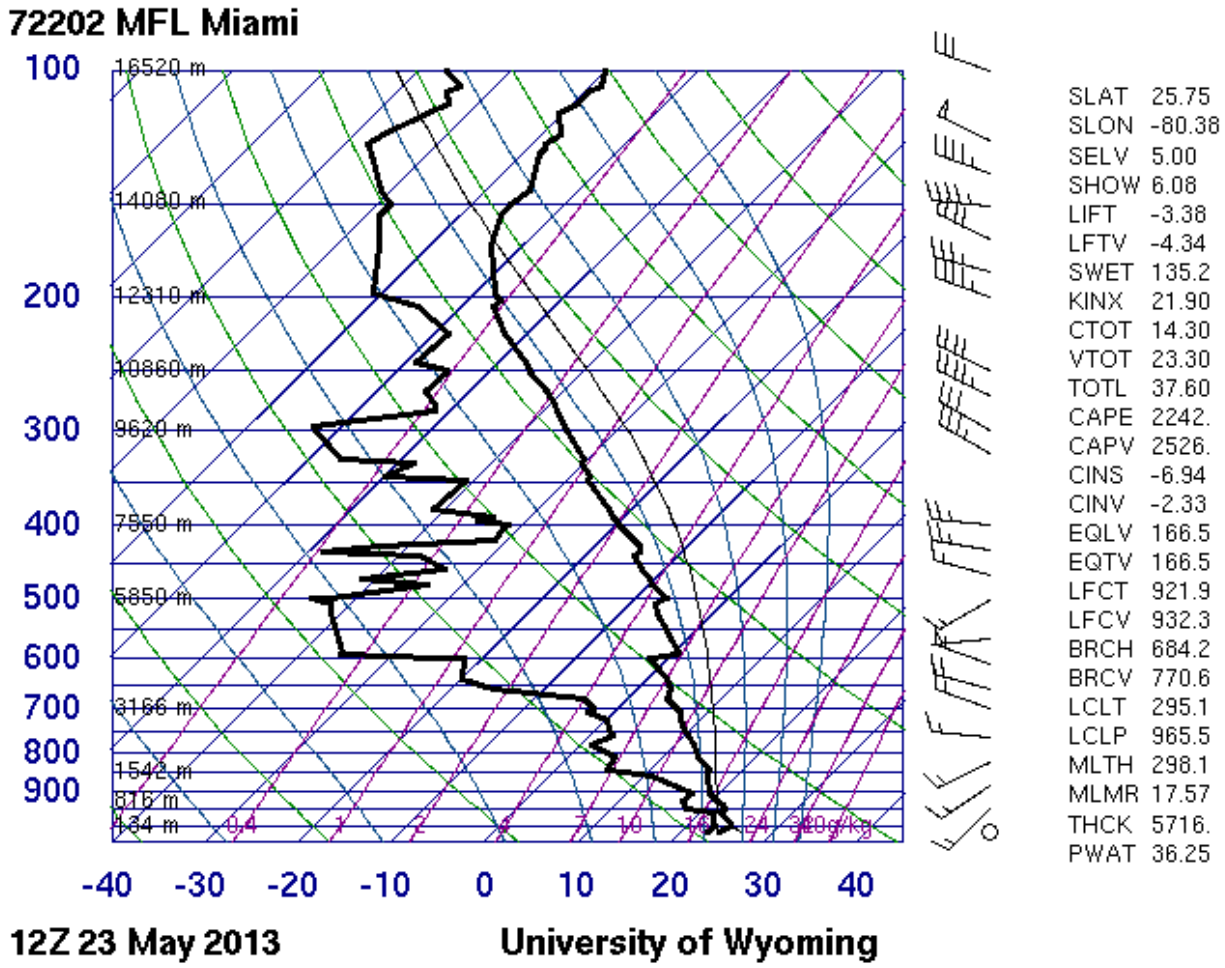


Nova Scotia WATER Substrate Statistics



- Florida: 2013May23_AerosolIndex

Wyoming Sounding



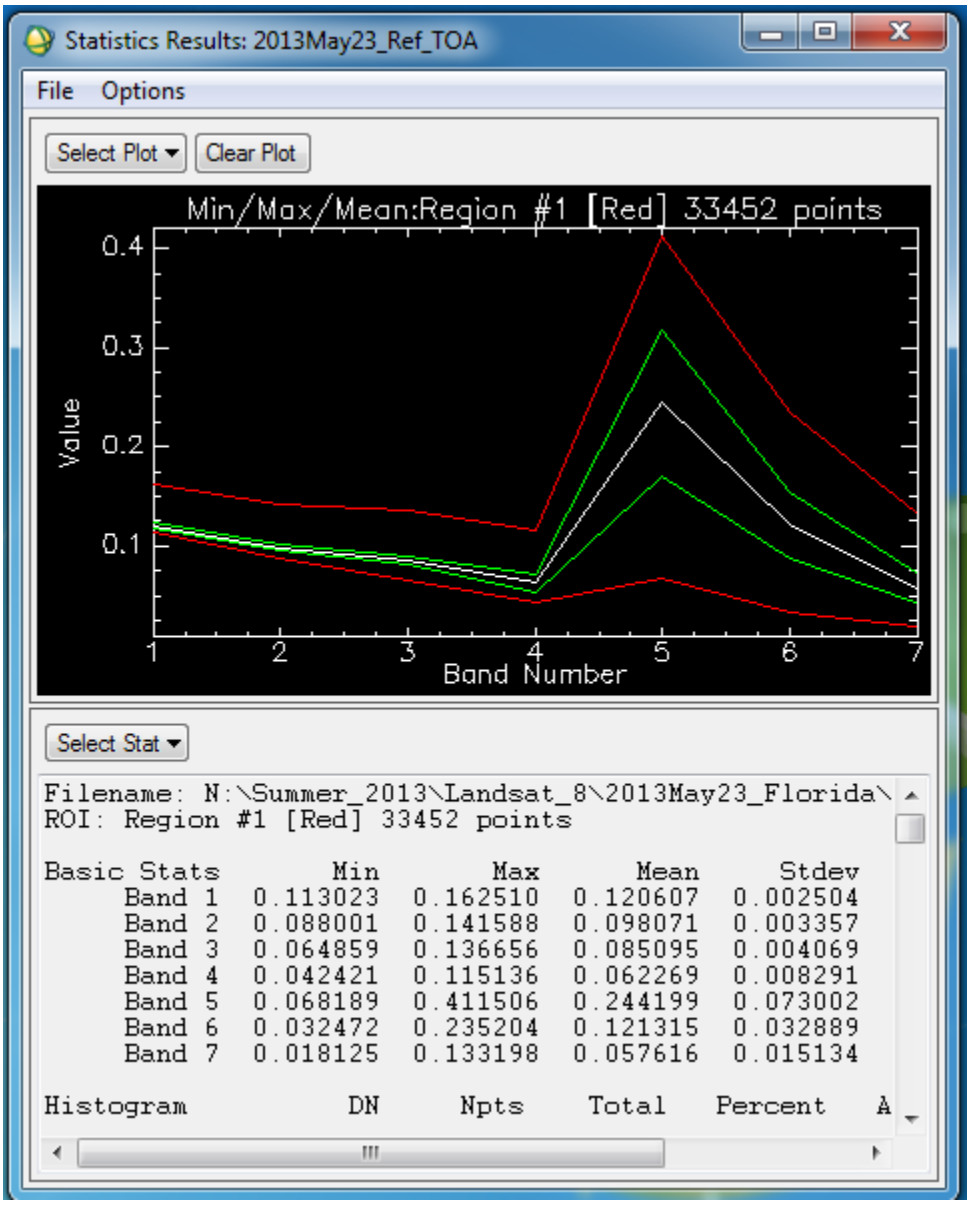
72202 MFL Miami Observations at 12Z 23 May 2013

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1015.0	5	24.0	22.8	93	17.56	0	0	295.9	346.6	299.0
1000.0	134	24.8	23.1	90	18.17	235	10	297.9	350.9	301.2
994.0	187	24.6	22.7	89	17.83	237	12	298.3	350.3	301.4
980.7	305	23.7	22.2	91	17.50	240	16	298.5	349.6	301.6
961.0	483	22.4	21.4	94	17.01	231	15	298.9	348.7	302.0
948.0	602	22.2	18.2	78	14.07	225	15	299.9	341.3	302.4
947.2	610	22.2	18.2	78	14.04	225	15	299.9	341.2	302.4
935.0	723	21.6	17.5	77	13.64	217	14	300.5	340.7	302.9
925.0	816	20.6	16.9	79	13.27	210	14	300.4	339.5	302.8
914.6	914	19.8	16.9	84	13.46	210	14	300.5	340.2	302.9

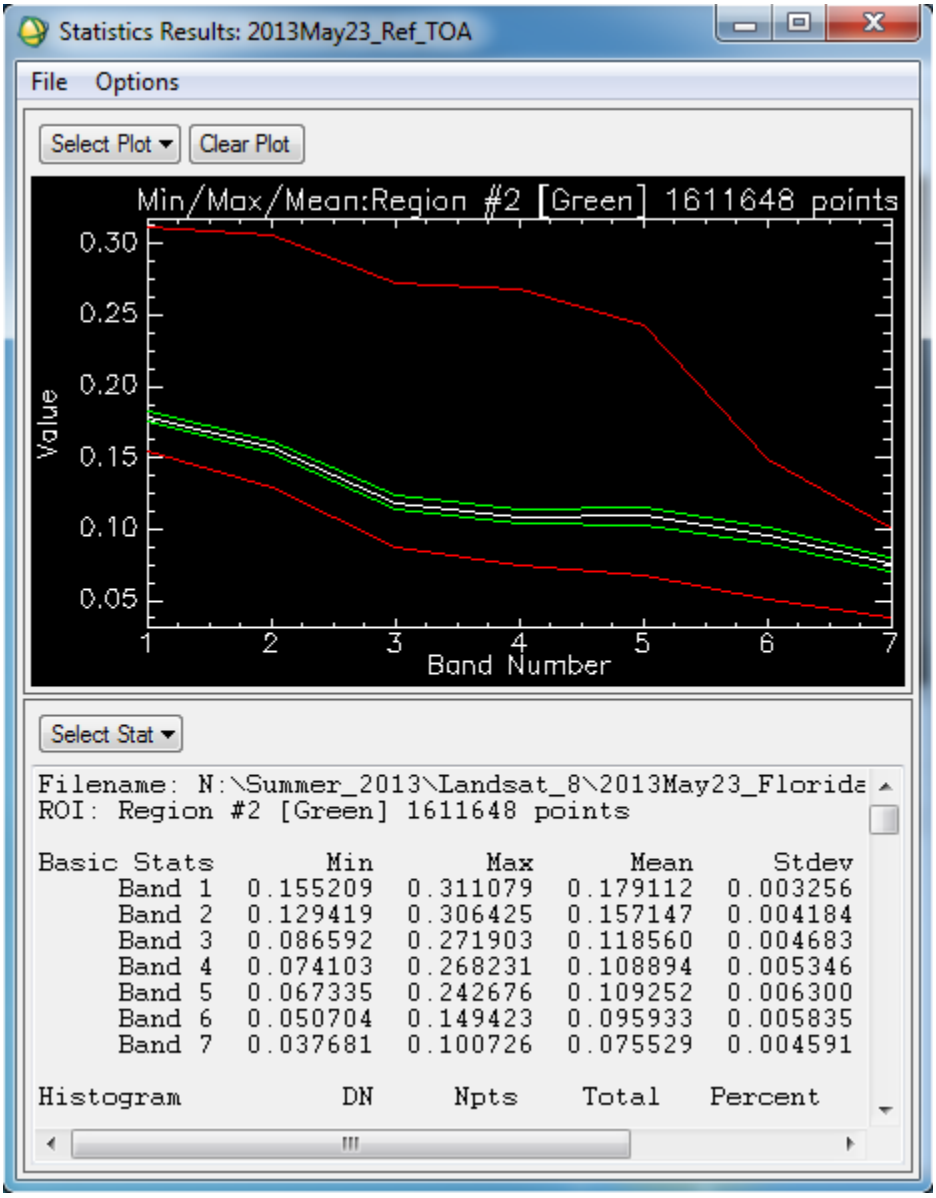
Table 9: Forest and Water Substrates Aerosol Index (B1-B2/B1+B2)

Substrate	Minimum	Maximum	Mean	StDev
Forest	0.062880	0.127559	0.103233	0.007369
Water	0.003255	0.090609	0.065411	0.005647

Florida FOREST Substrate Statistics

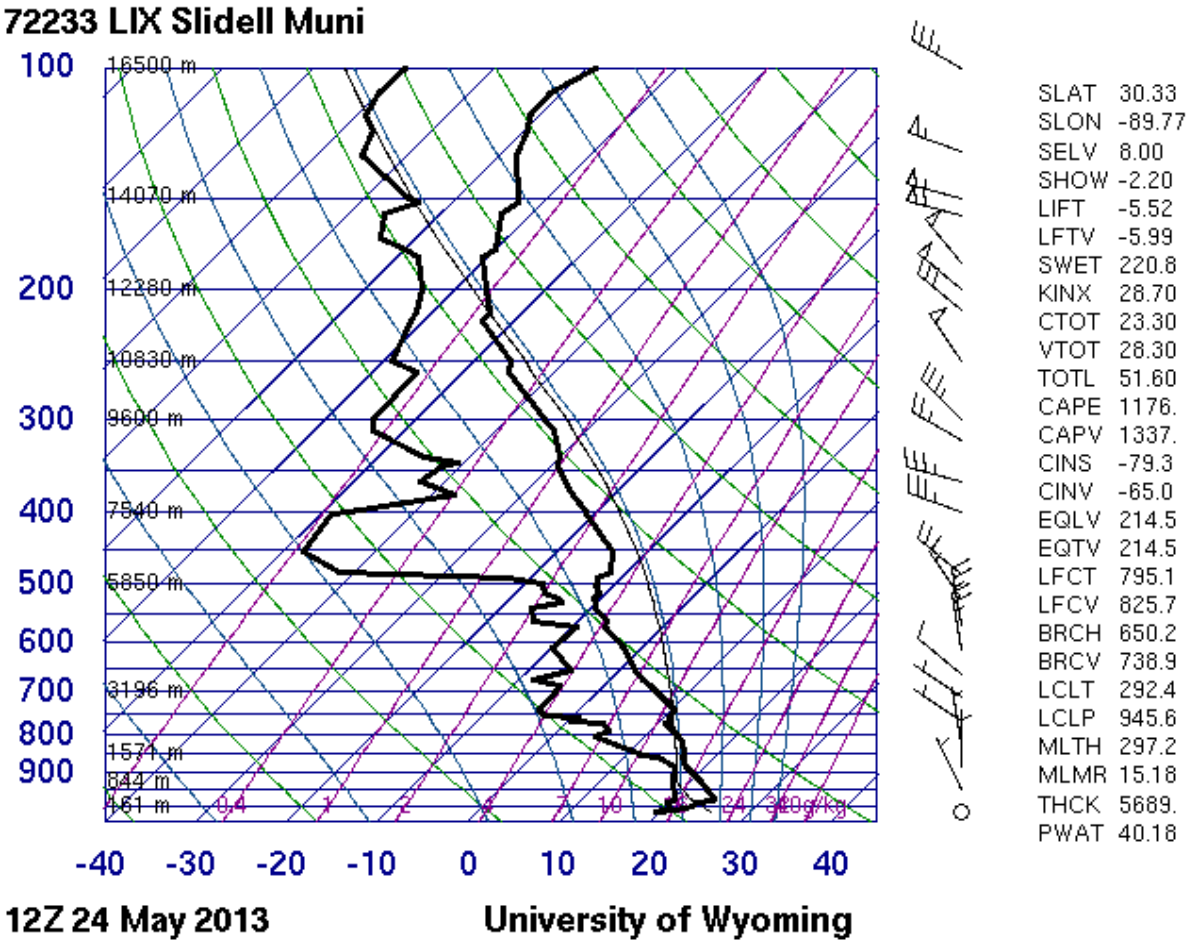


Florida WATER Substrate Statistics



- Mississippi: 2013May24_AerosolIndex

Wyoming Sounding



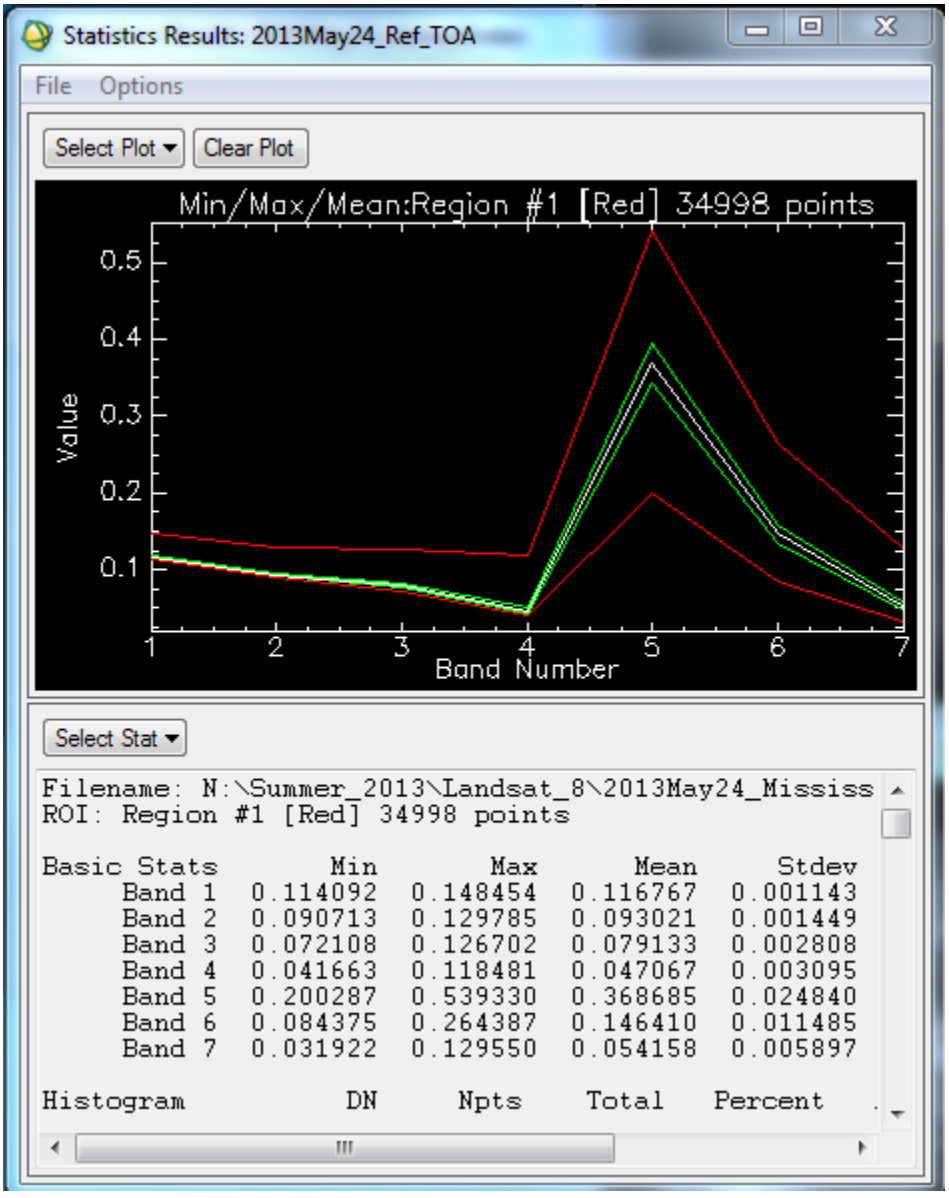
72233 LIX Slidell Muni Observations at 12Z 24 May 2013

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1018.0	8	20.0	19.5	97	14.22	0	0	291.7	332.0	294.1
1006.0	110	22.4	20.6	90	15.43	337	6	295.1	339.4	297.8
1000.0	161	22.8	20.4	86	15.33	325	9	295.9	340.2	298.7
991.0	240	23.2	19.9	82	14.99	342	8	297.1	340.6	299.8
983.7	305	24.3	20.1	77	15.26	355	8	298.9	343.5	301.6
982.0	320	24.6	20.1	76	15.33	354	8	299.3	344.2	302.1
974.0	392	24.4	20.1	77	15.46	349	7	299.8	345.2	302.6
950.1	610	22.9	19.1	80	14.91	335	3	300.4	344.3	303.1
925.0	844	21.2	18.1	82	14.34	225	1	301.0	343.3	303.6
917.5	914	20.6	17.8	84	14.21	35	1	301.1	343.1	303.6

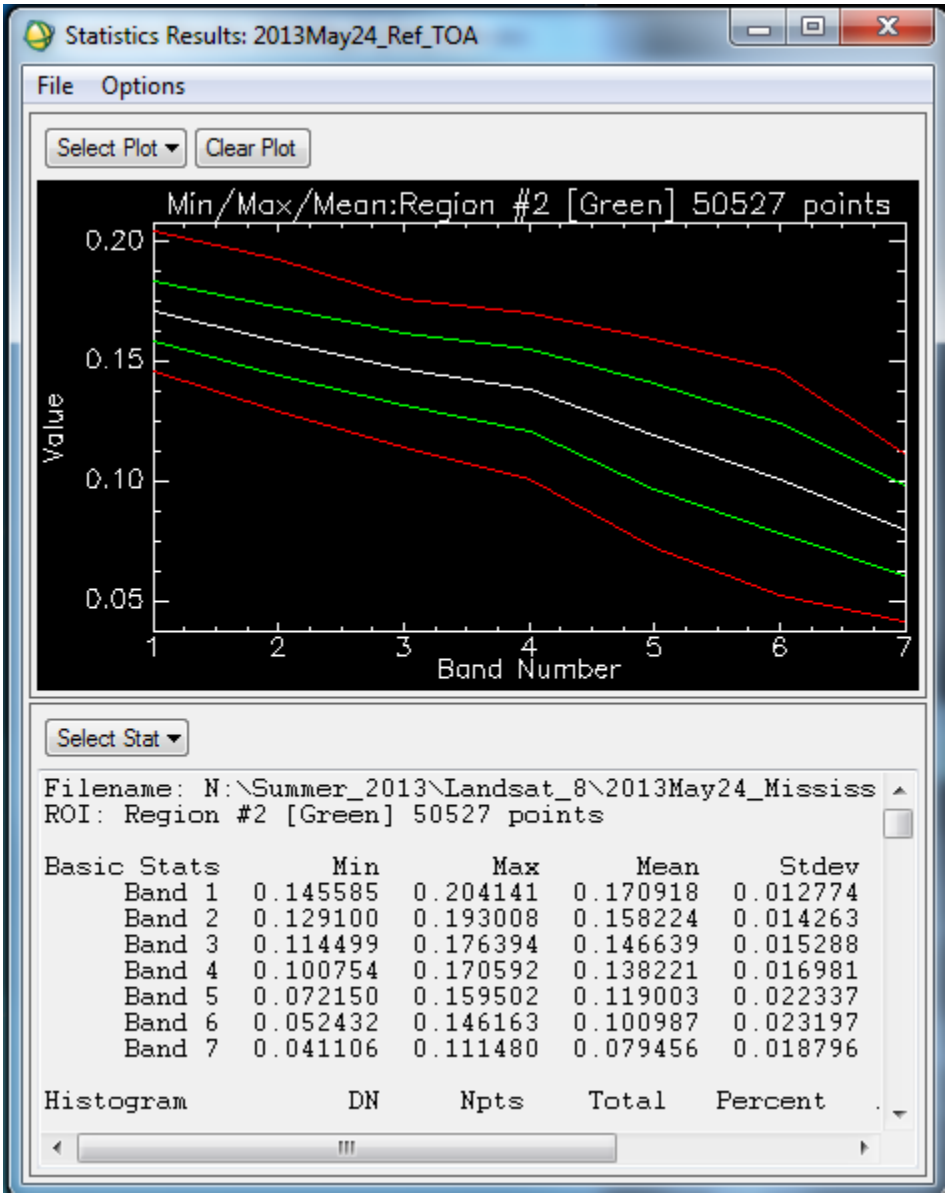
Table 10: Forest and Water Substrates Aerosol Index (B1-B2/B1+B2)

Substrate	Minimum	Maximum	Mean	StDev
Forest	0.060710	0.123825	0.113224	0.003460
Water	0.023771	0.061259	0.039220	0.008154

Mississippi FOREST Substrate Statistics

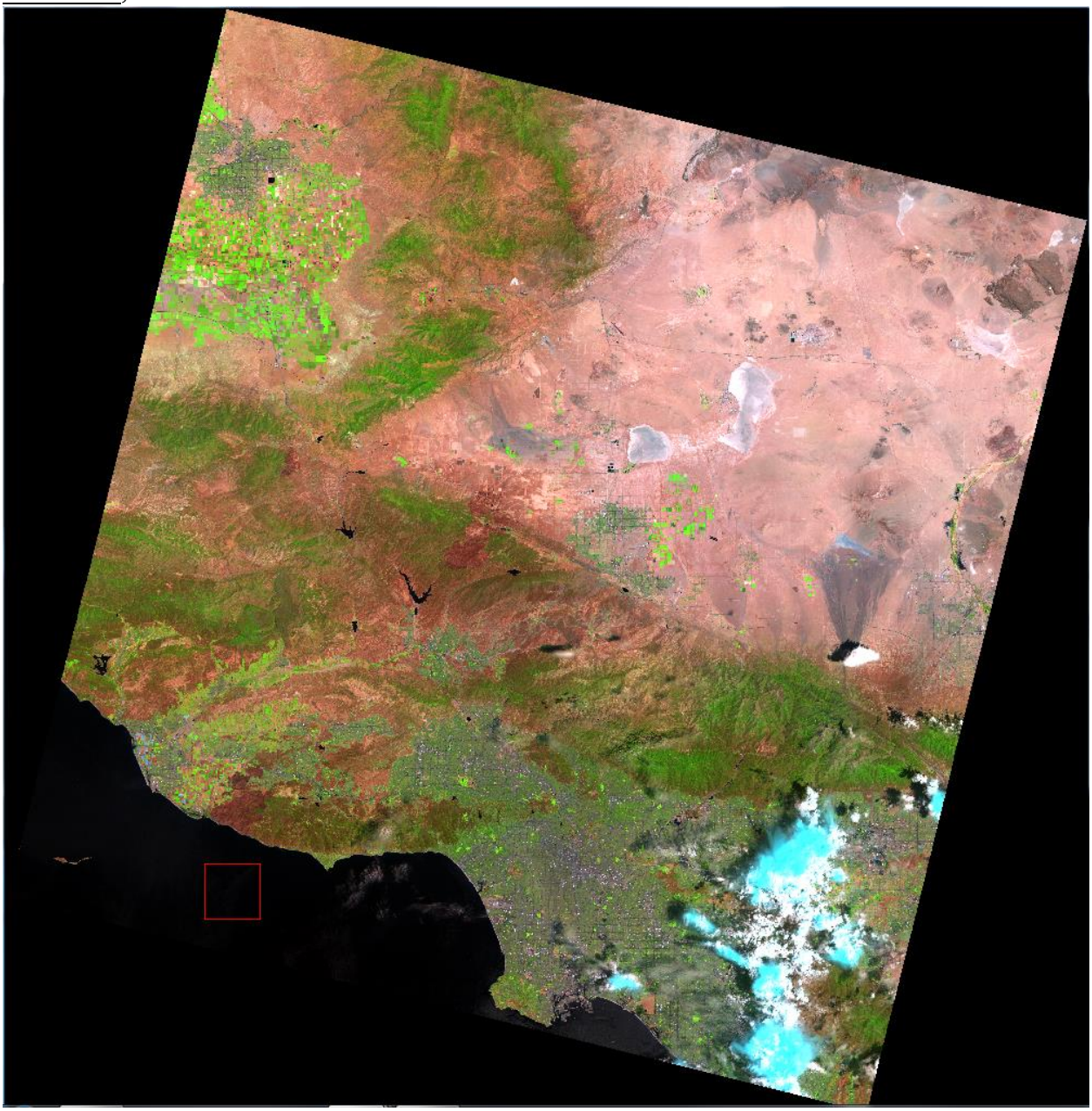


Mississippi WATER Substrate Statistics



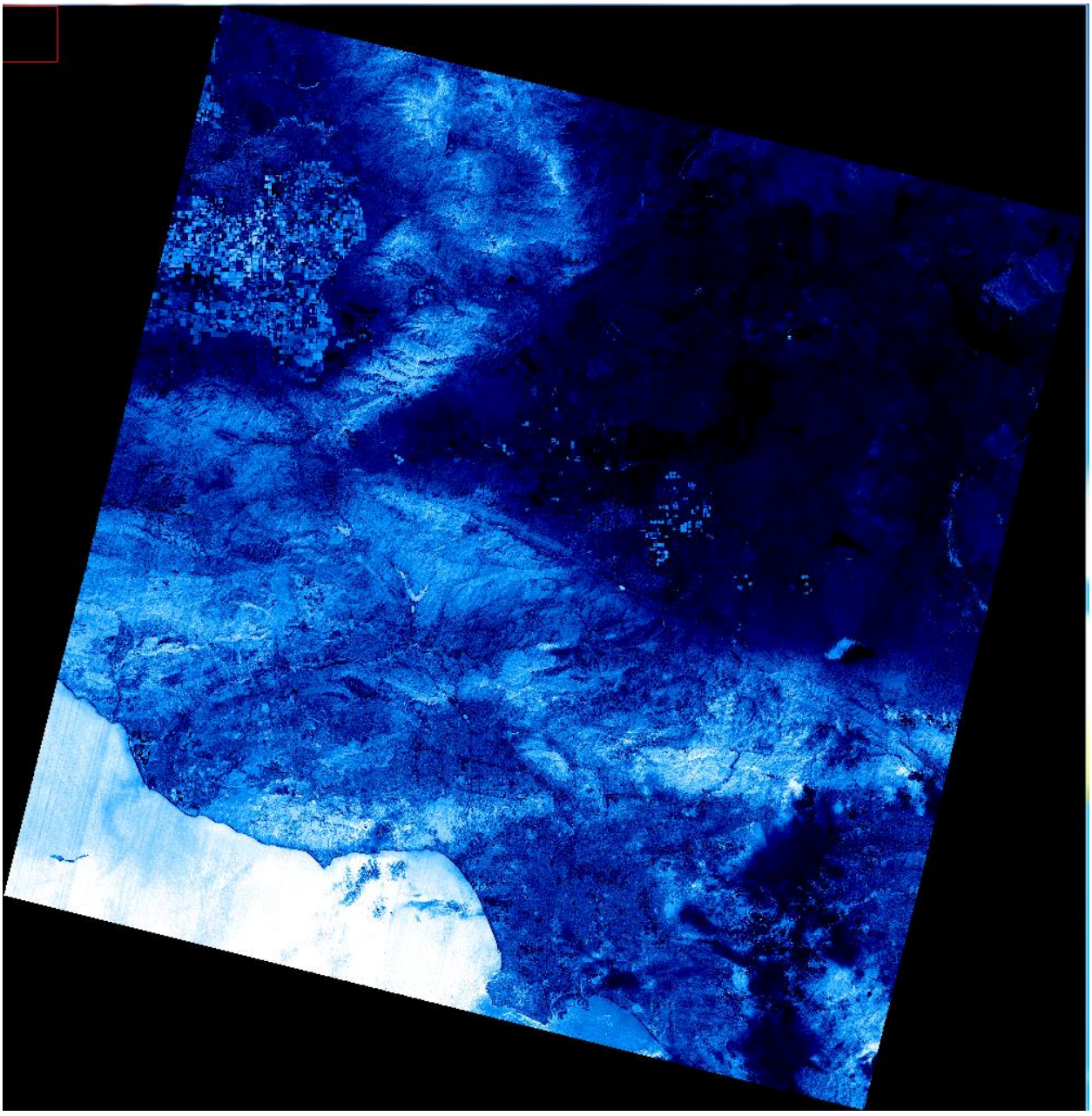
- Los Angeles: 2013June30_AerosolIndex

Full Scene; RGB – 654

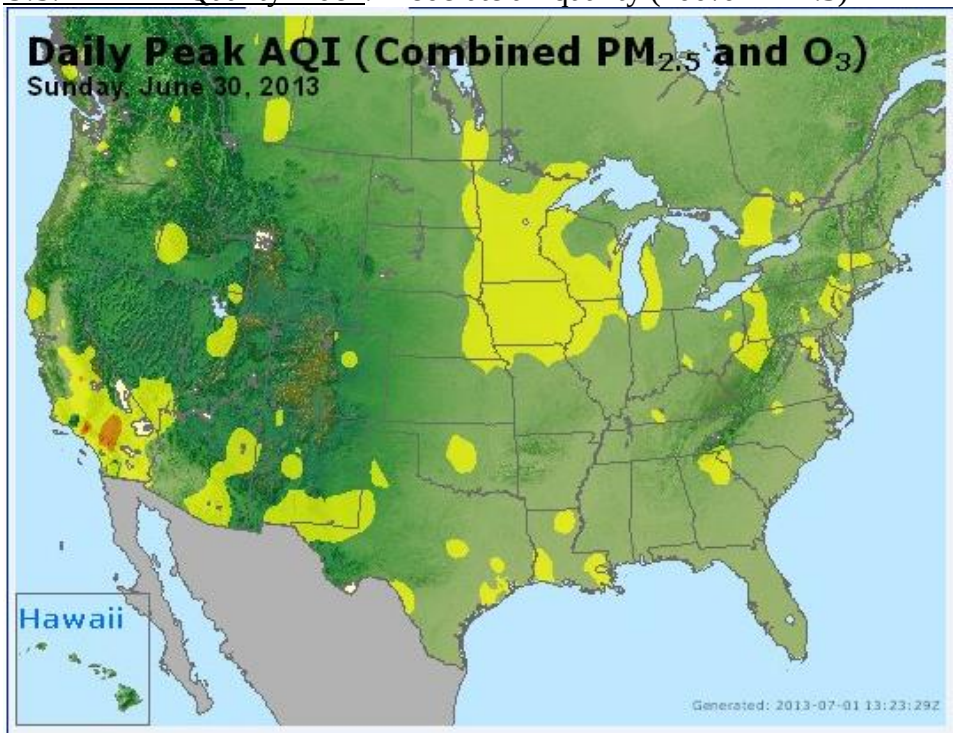


Full Scene: Aerosol Index (B1-B2/B1+B2)

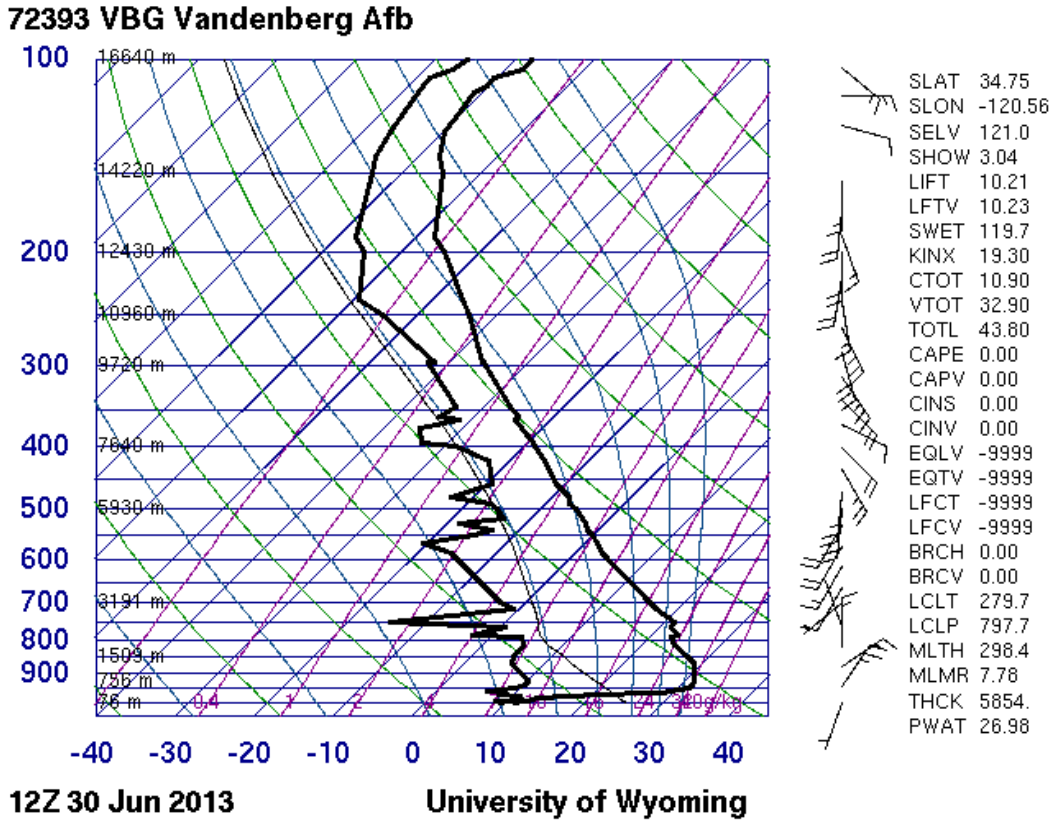
	Minimum	Maximum	Mean	StDev
Los Angeles	-0.202950	0.203088	0.033973	0.033632



U.S. EPA Air Quality Index: Moderate air quality (100% PM 2.5) in LA



Wyoming Sounding



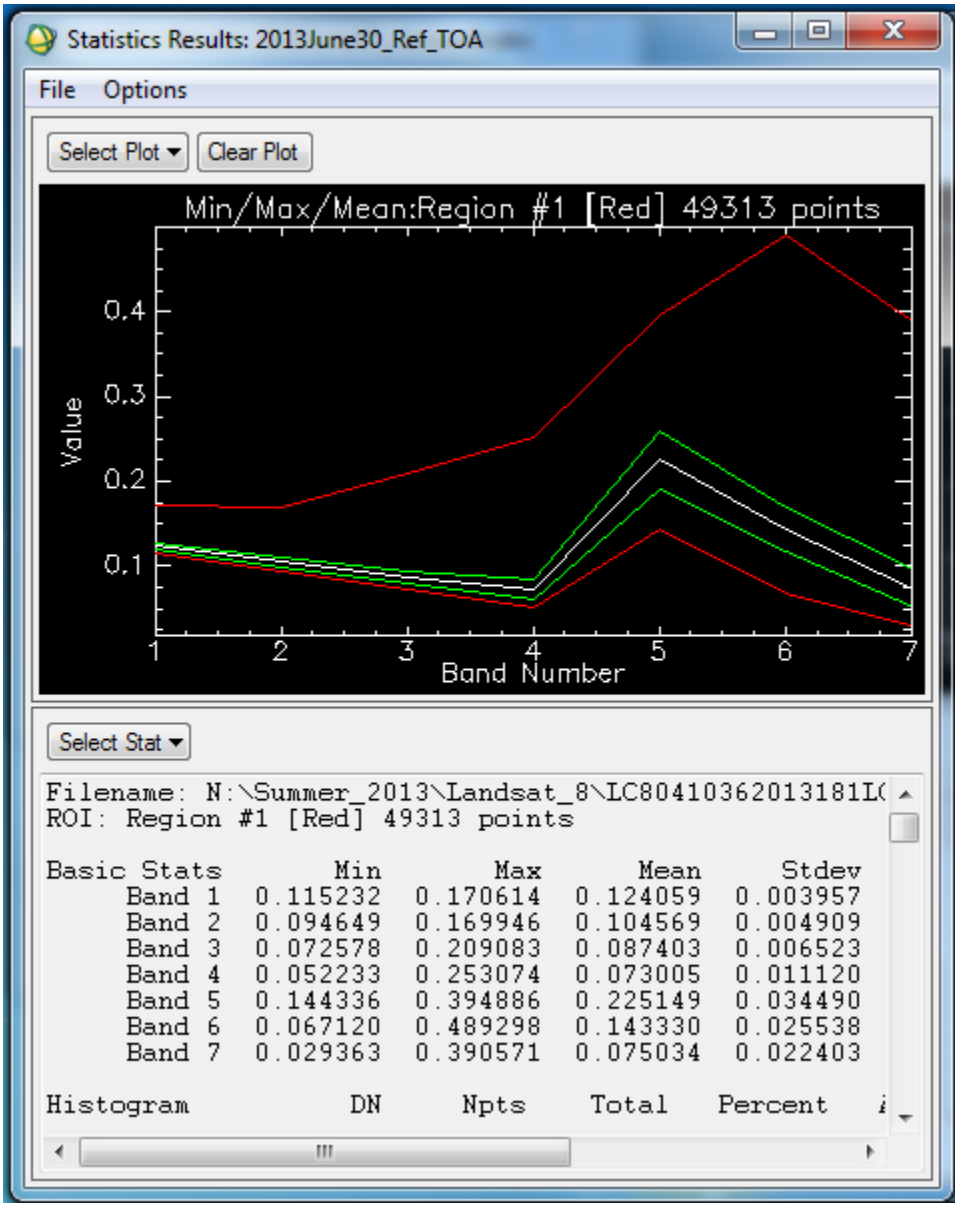
72393 VBG Vandenberg Afb Observations at 12Z 30 Jun 2013

PRES hPa	HGHT m	TEMP C	DWPT C	RELH %	MIXR g/kg	DRCT deg	SKNT knot	THTA K	THTE K	THTV K
1000.0	76									
997.0	121	11.2	9.5	89	7.53	200	4	284.6	305.6	285.9
996.0	129	12.2	8.6	79	7.08	207	5	285.7	305.6	286.9
992.0	162	12.6	12.0	96	8.95	236	9	286.4	311.5	287.9
987.0	203	12.8	11.7	93	8.82	272	13	287.0	311.8	288.6
983.0	236	13.6	11.2	85	8.56	301	17	288.2	312.4	289.6
979.0	270	17.2	11.2	68	8.60	330	21	292.1	316.9	293.6
974.8	305	18.8	9.9	56	7.90	0	25	294.1	317.0	295.5
969.0	355	21.0	8.0	43	6.99	6	25	296.8	317.5	298.1
965.0	390	26.8	8.8	32	7.41	10	26	303.0	325.5	304.4

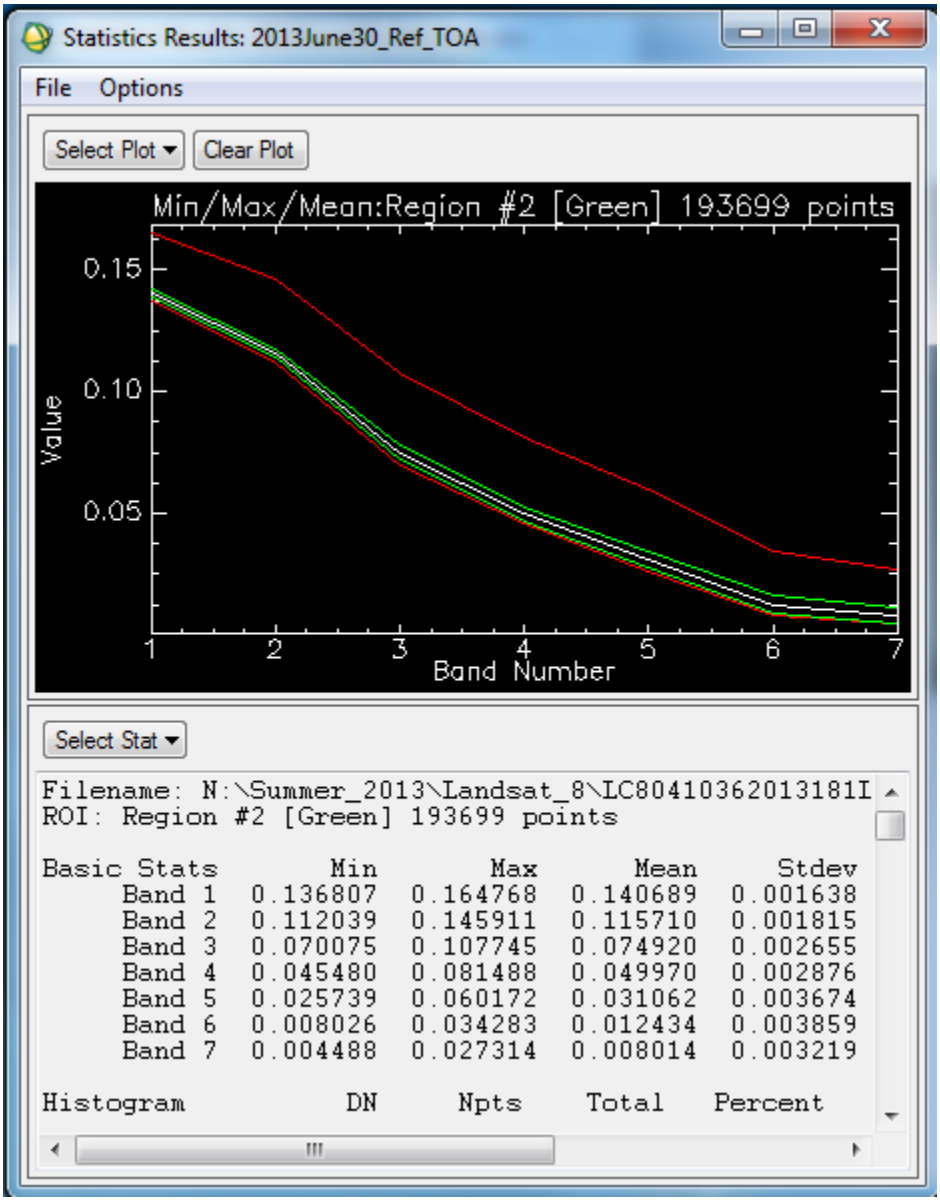
Table 11: Forest and Water Substrates Aerosol Index (B1-B2/B1+B2)

Substrate	Minimum	Maximum	Mean	StDev
Forest	-0.003951	0.103934	0.085527	0.008280
Water	0.060694	0.114329	0.097448	0.003147

Los Angeles FOREST Substrate Statistics



Los Angeles WATER Substrate Statistics



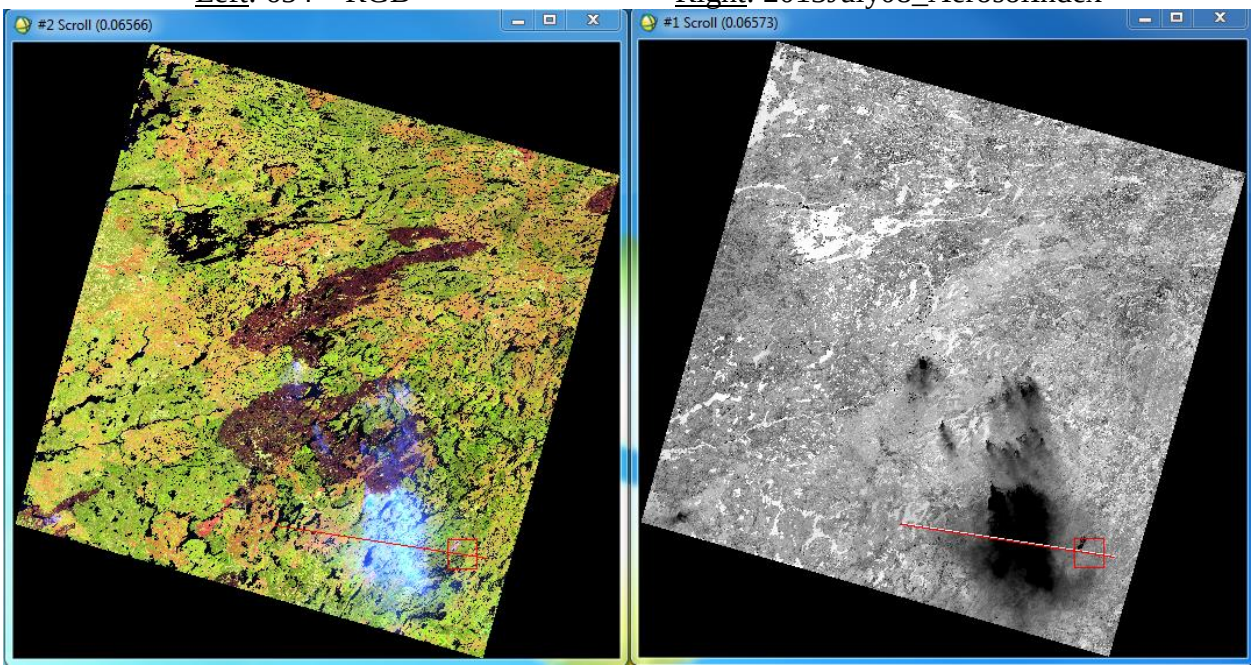
PART III

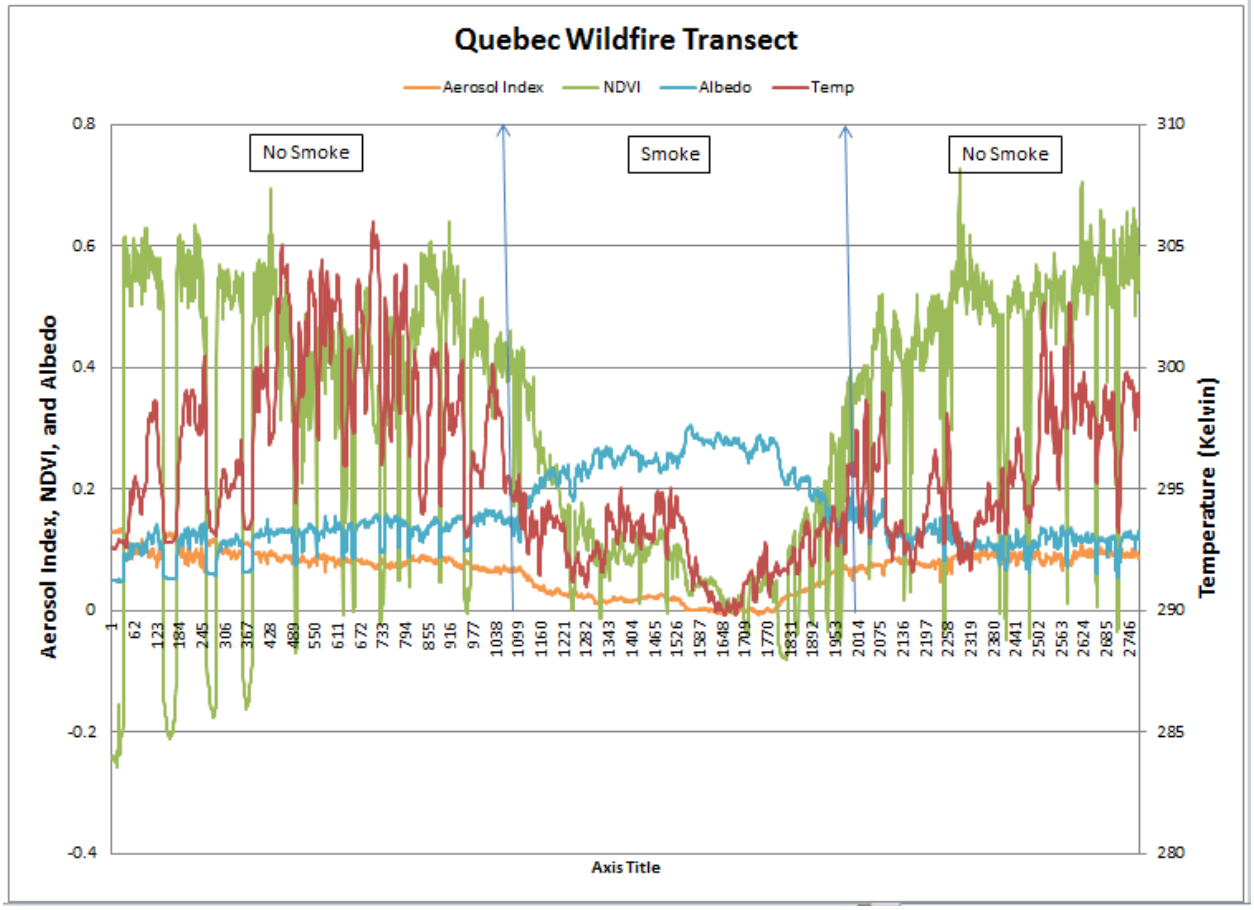
Smoke Particles: A study of a wildfire scene to examine how the aerosol band picks up the signal from smoke. The scene of interest is that of Quebec (2013July08).

Table 12: Mississippi Transect over Land (MississippiTrans1)

	Average Difference across Wildfire Smoke Plume (NoSmoke – Smoke)	Minimum	Maximum
Aerosol Index	0.100	-0.005	0.133
NDVI	0.350	-0.239	0.716
Albedo	-0.150	0.048	0.304
Temperature (Degrees)	8.0	290	306

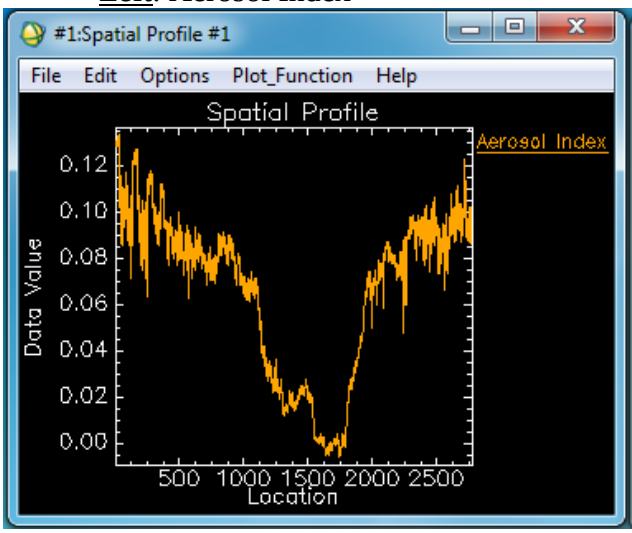
Left: 654 – RGB Right: 2013July08_AerosolIndex



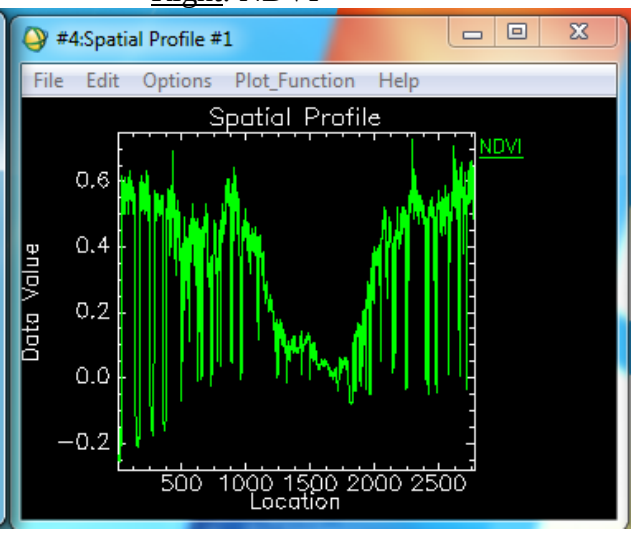


Spatial Profiles for QuebecTrans

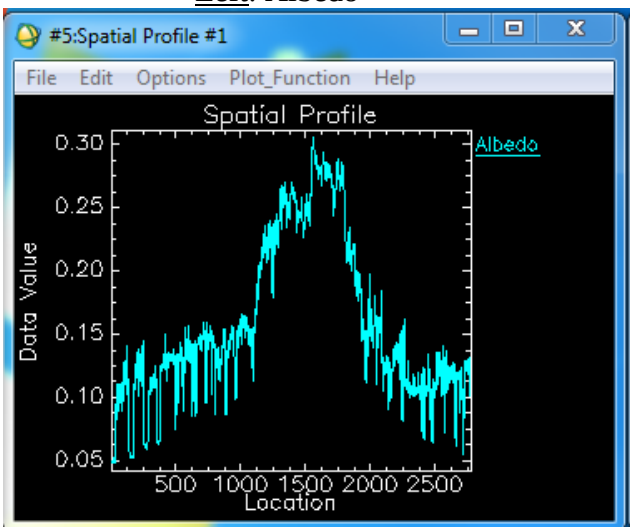
Left: Aerosol Index



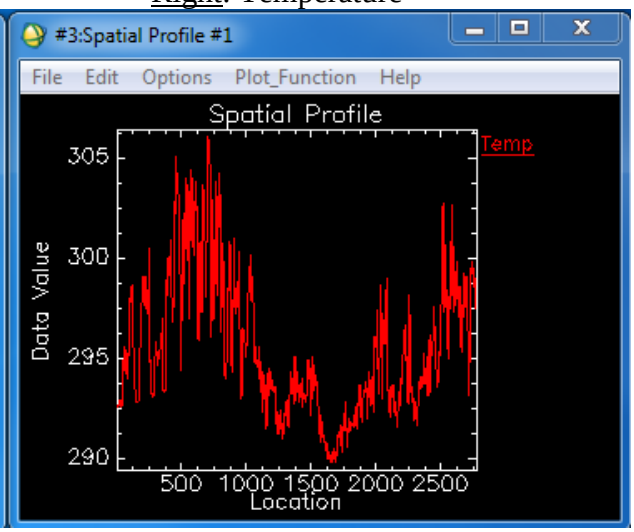
Right: NDVI



Left: Albedo



Right: Temperature



PART IV – Wildfire in Oregon

Case Study: In late July, a wildfire broke out on the West Coast near Medford, Oregon. I examined how aerosol index differ between two images of that area (Path = 45, Row = 31): Before wildfire on 2013July12 and During wildfire on 2013July28. These two images have ~0% cloud cover, and were acquired at the same time (18:53Z, 11:53AM local).

Table 13: Full Scene Coastal Blue Statistics

	Minimum	Maximum	Mean	StDev
2013July12	0.075694	0.819261	0.103435	0.015555
2013July28	0.063520	0.822800	0.099548	0.018330

Table 14: Full Scene Aerosol Index Statistics

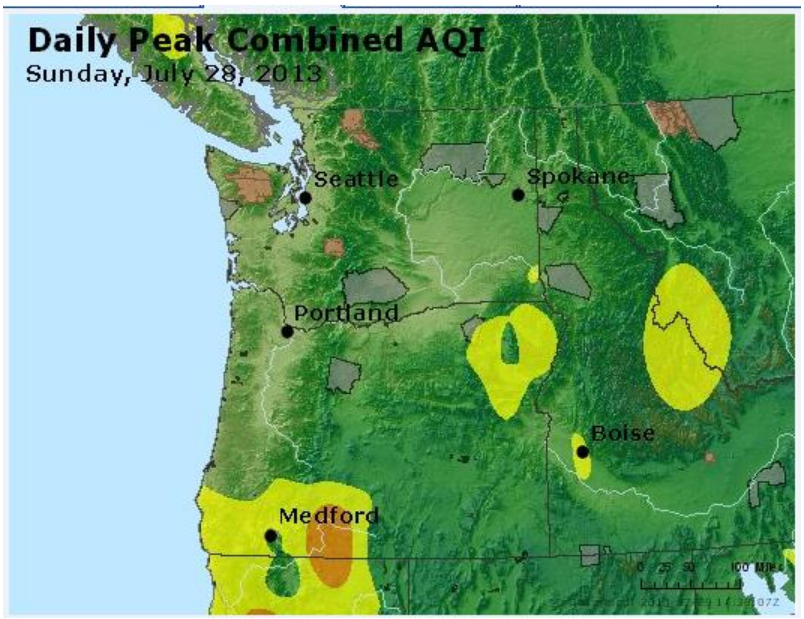
	Minimum	Maximum	Mean	StDev
2013July12	-0.152591	0.331842	0.087721	0.029763
2013July28	-0.237307	0.481467	0.085428	0.027633

While the smoke takes up only a small portion of the scene, something caused the average aerosol index to go down by 0.002 in the After scene. Could that drop have been caused by small clouds and/or smoke in the After scene? Or, it may be too small of difference.

To address the limitations of analyzing full scenes, transect analysis was conducted in strategic locations in the scene to compare how the readings may differ across the two time periods.

❖ **Air Quality Index (airnow.gov)**

AQI for Medford, Oregon, on July 12th is Good.

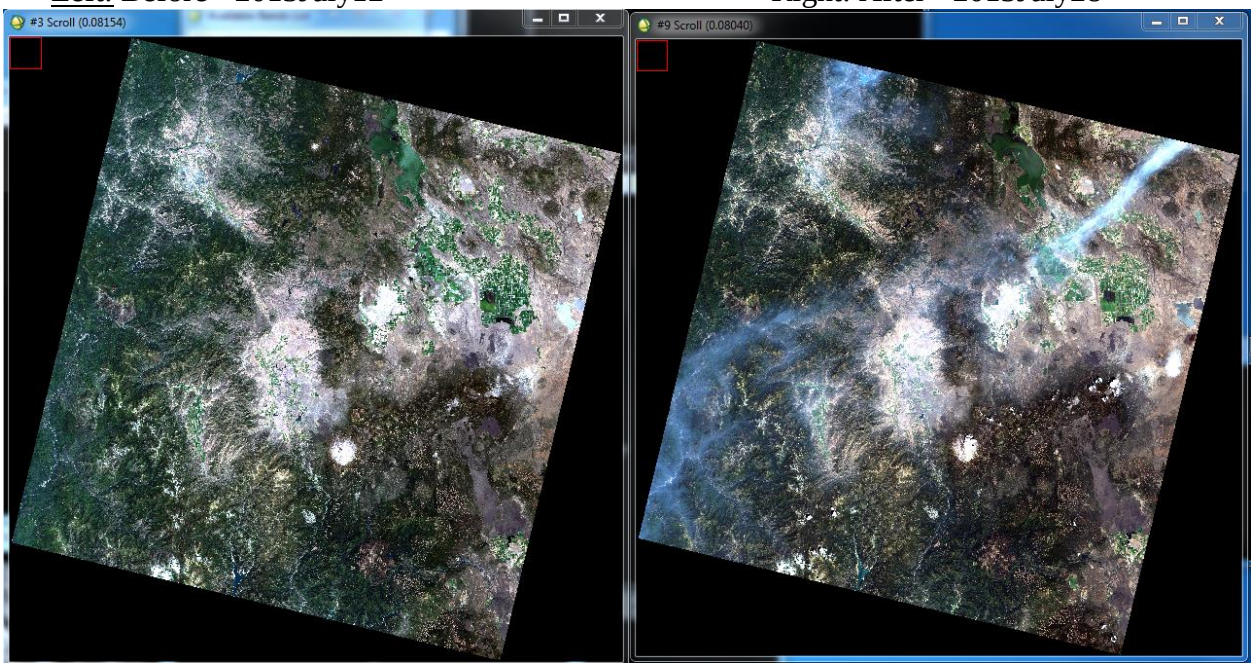


AQI for Medford, Oregon, on July 28th is Moderate. But, it is interesting to note that the day after had AQI of Very Unhealthy.[5]

[5] See http://www.airnow.gov/index.cfm?action=airnow.mapsarchivecalendar

❖ **RGB - 432**

Left: Before - 2013July12 Right: After - 2013July28



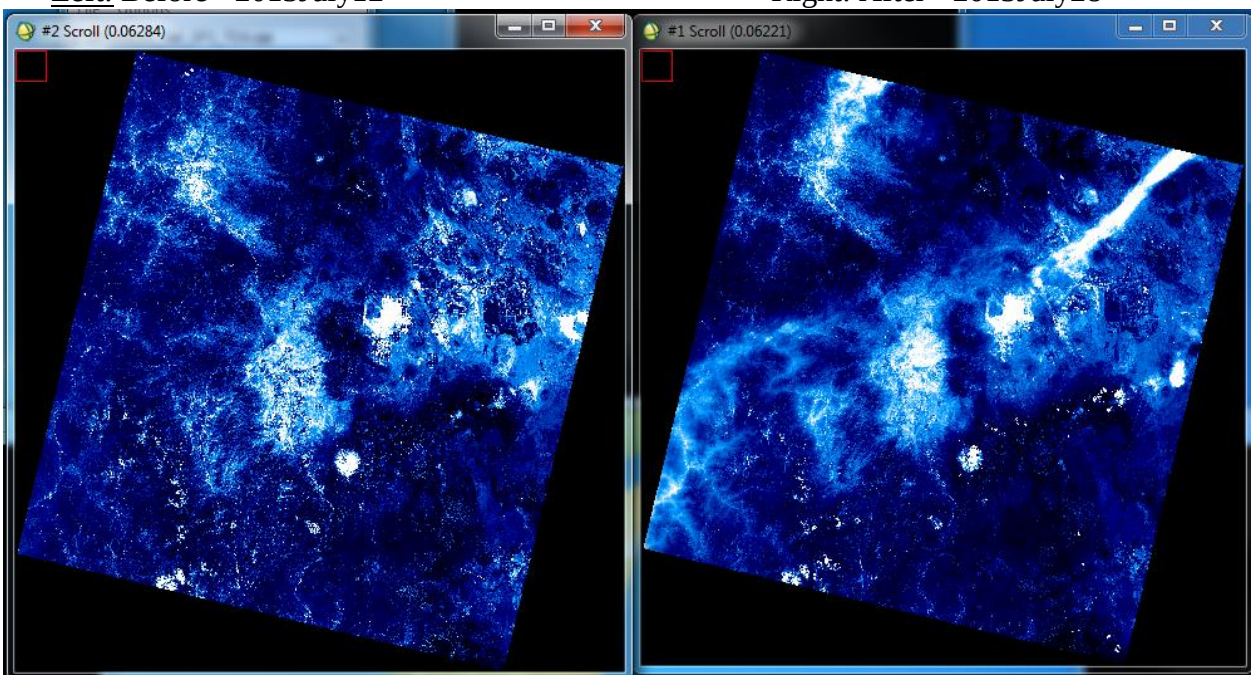
❖ **Cirrus Band**

Left: Before - 2013July12 Right: After - 2013July28

Note: The red box trains on a mountain top that pops out in the cirrus band. Other than three small cumulous cloud clusters in the After scene, there are no clouds that can interfere with the Aerosol Index readings.

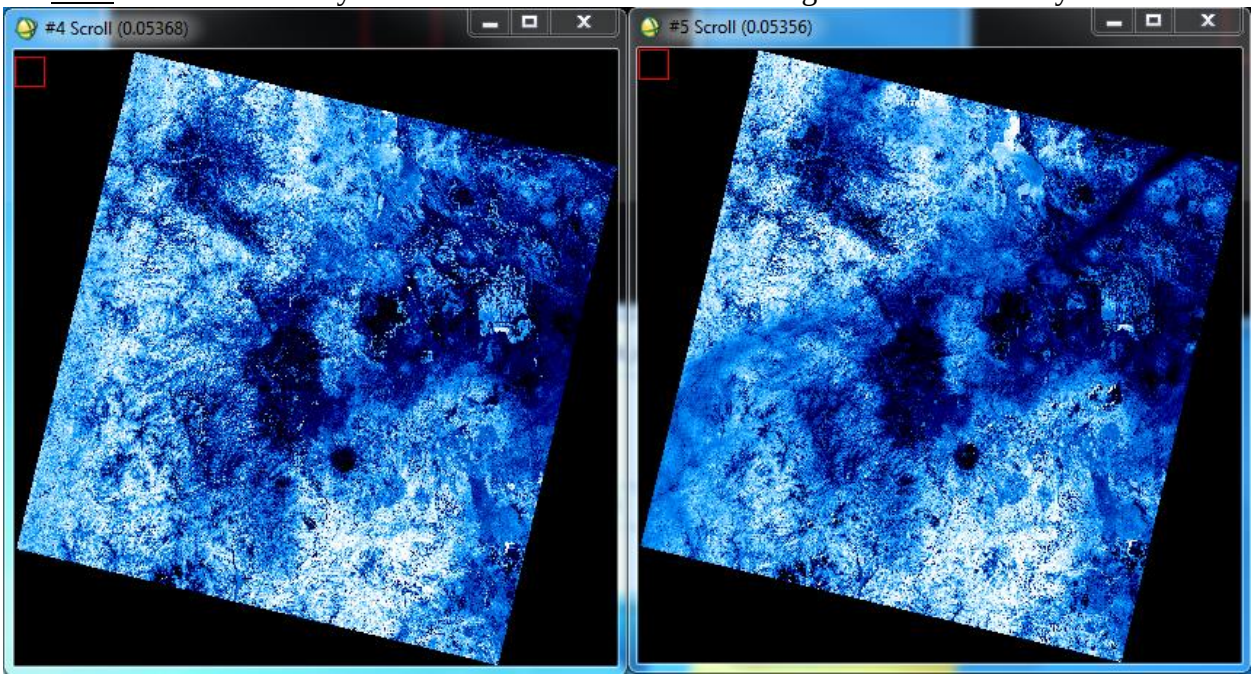
❖ **Coastal Aerosol Band**

Left: Before - 2013July12 Right: After - 2013July28



❖ **Aerosol Index (B1-B2/B1+B2)**

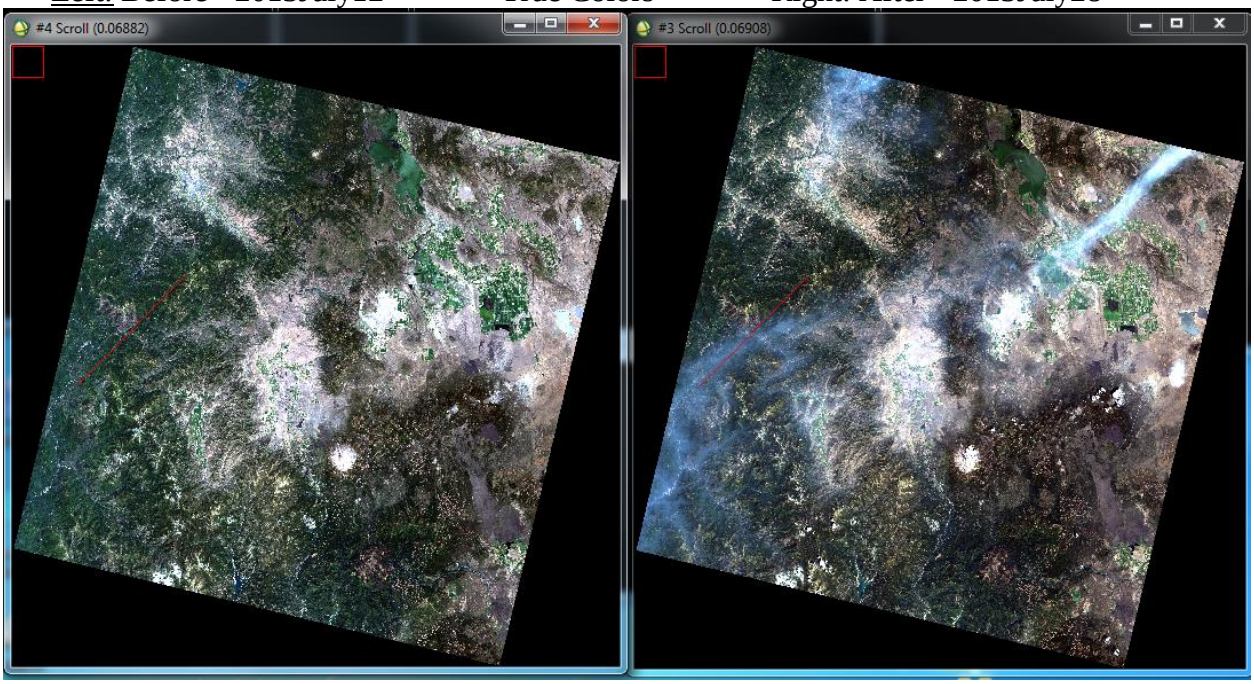
Left: Before - 2013July12 Right: After - 2013July28



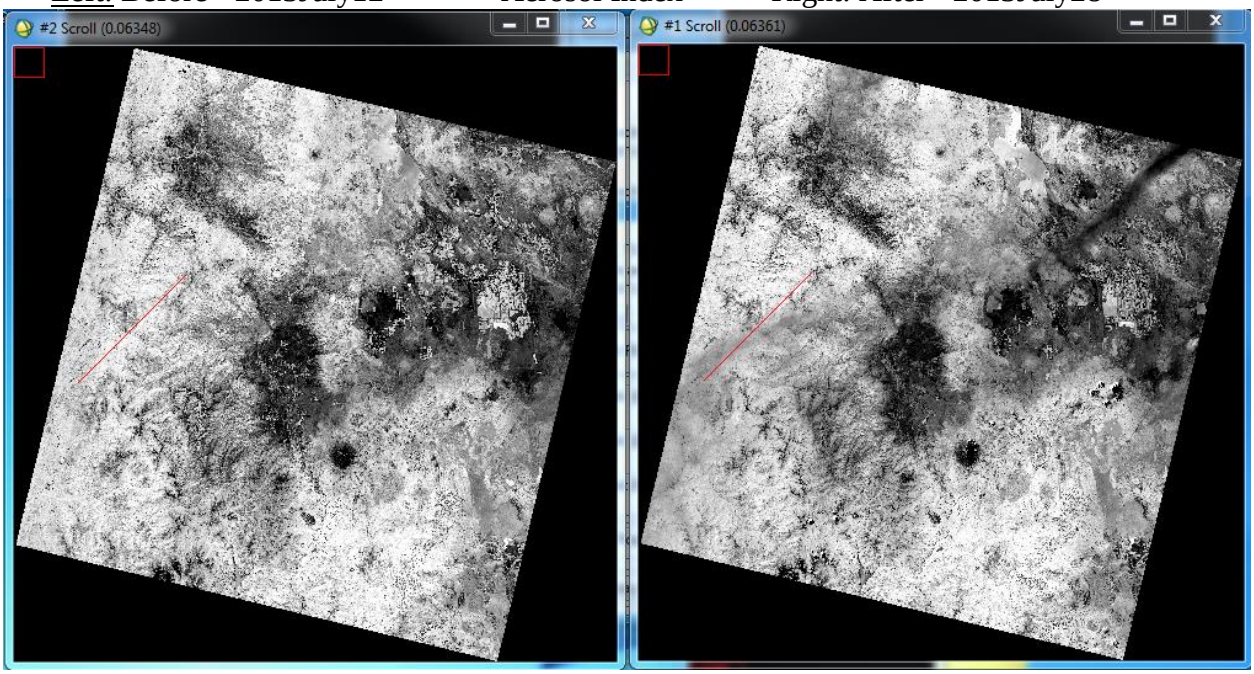
❖ **Oregon_Transect1**

Note: The red line denotes the transect line Oregon_Trans1 (left middle).

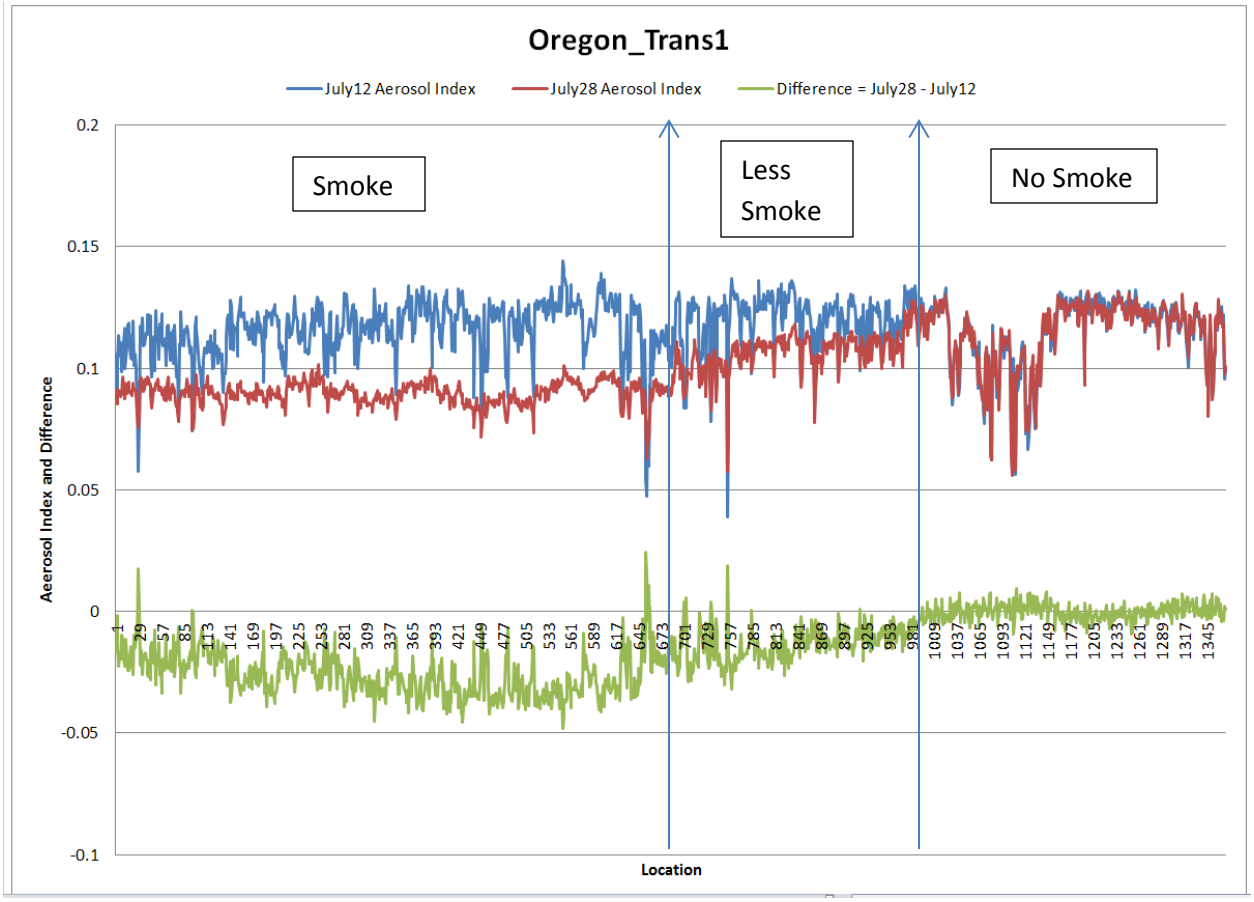
Left: Before - 2013July12 <True Colors> Right: After - 2013July28



Left: Before - 2013July12 <Aerosol Index> Right: After - 2013July28

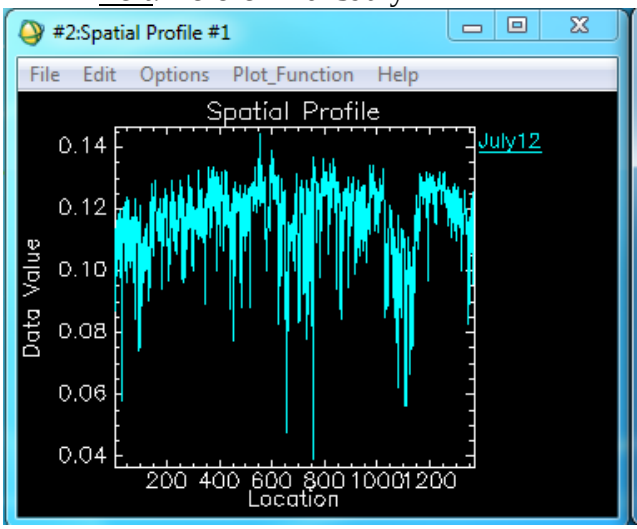


The smoke lowers the aerosol index by an average of 0.025. For areas that do not have smoke hanging above, the aerosol values are extremely similar.

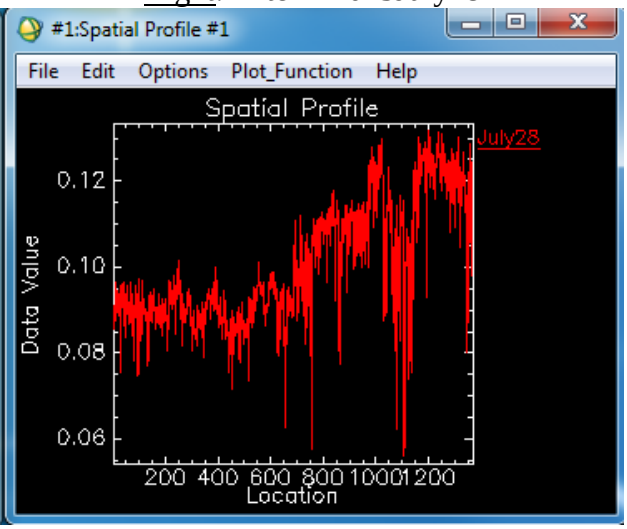


Spatial Profiles for Aerosol Index

Left: Before – 2013July12



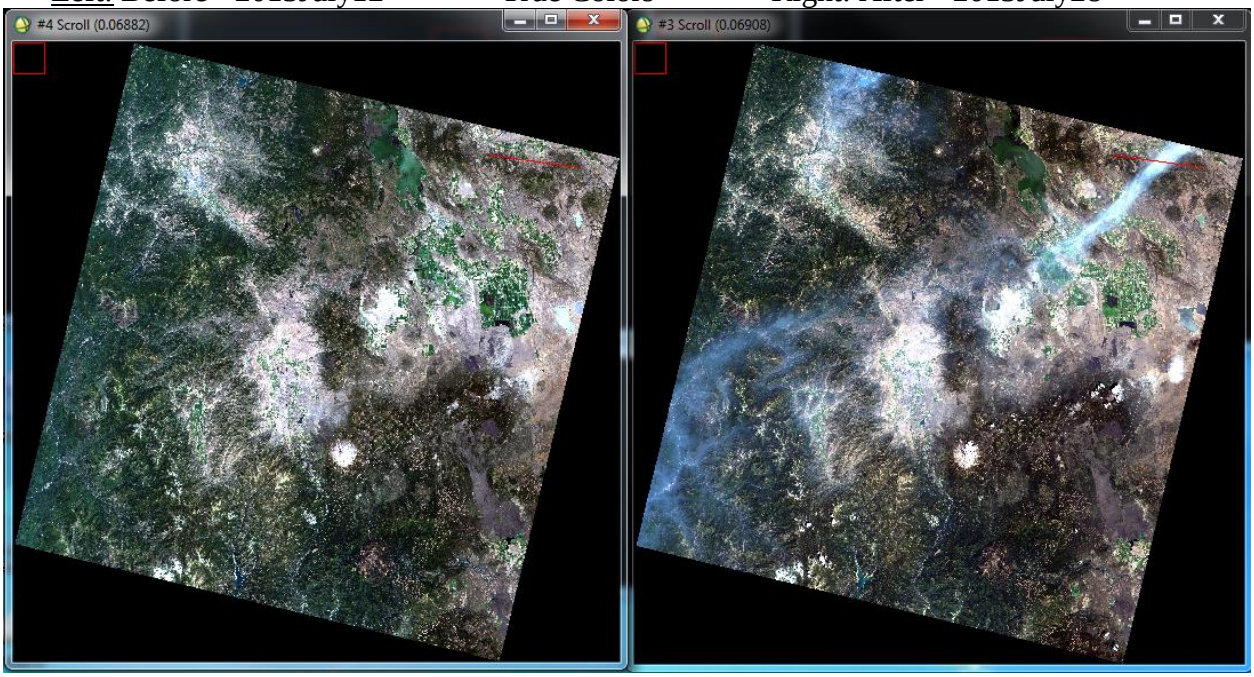
Right: After – 2013July28



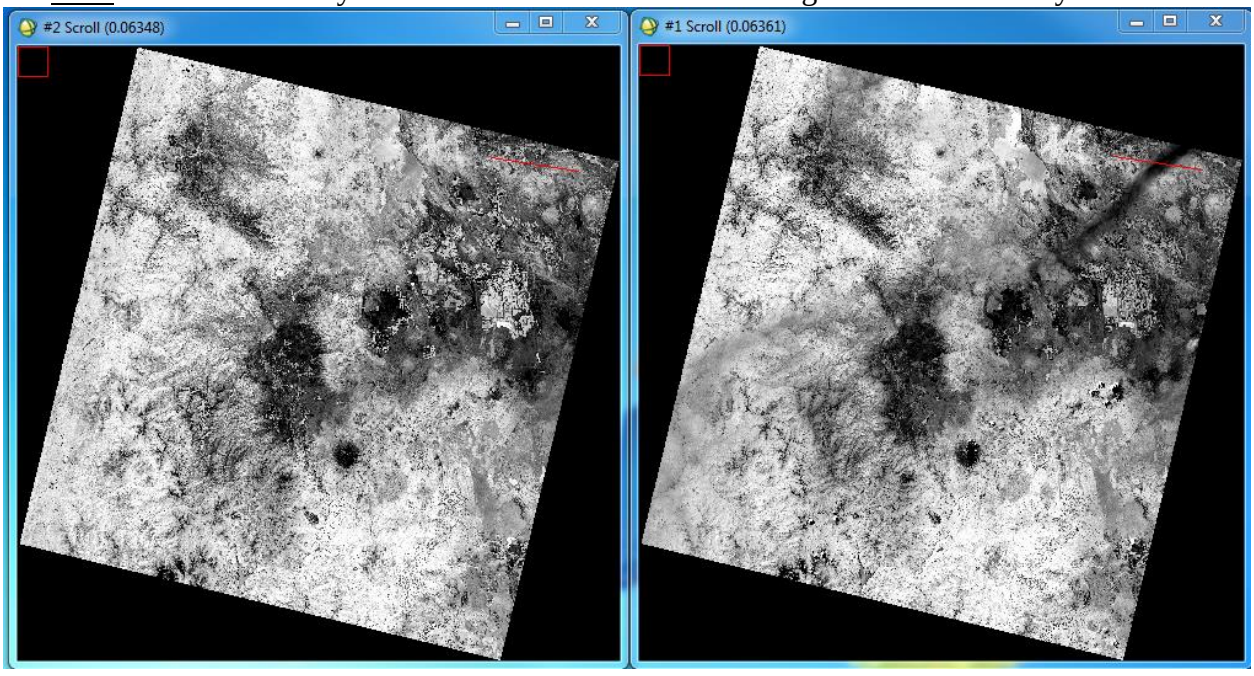
❖ **Oregon_Transect2**

Note: The red line denotes the transect line Oregon_Trans2 (upper right hand corner).

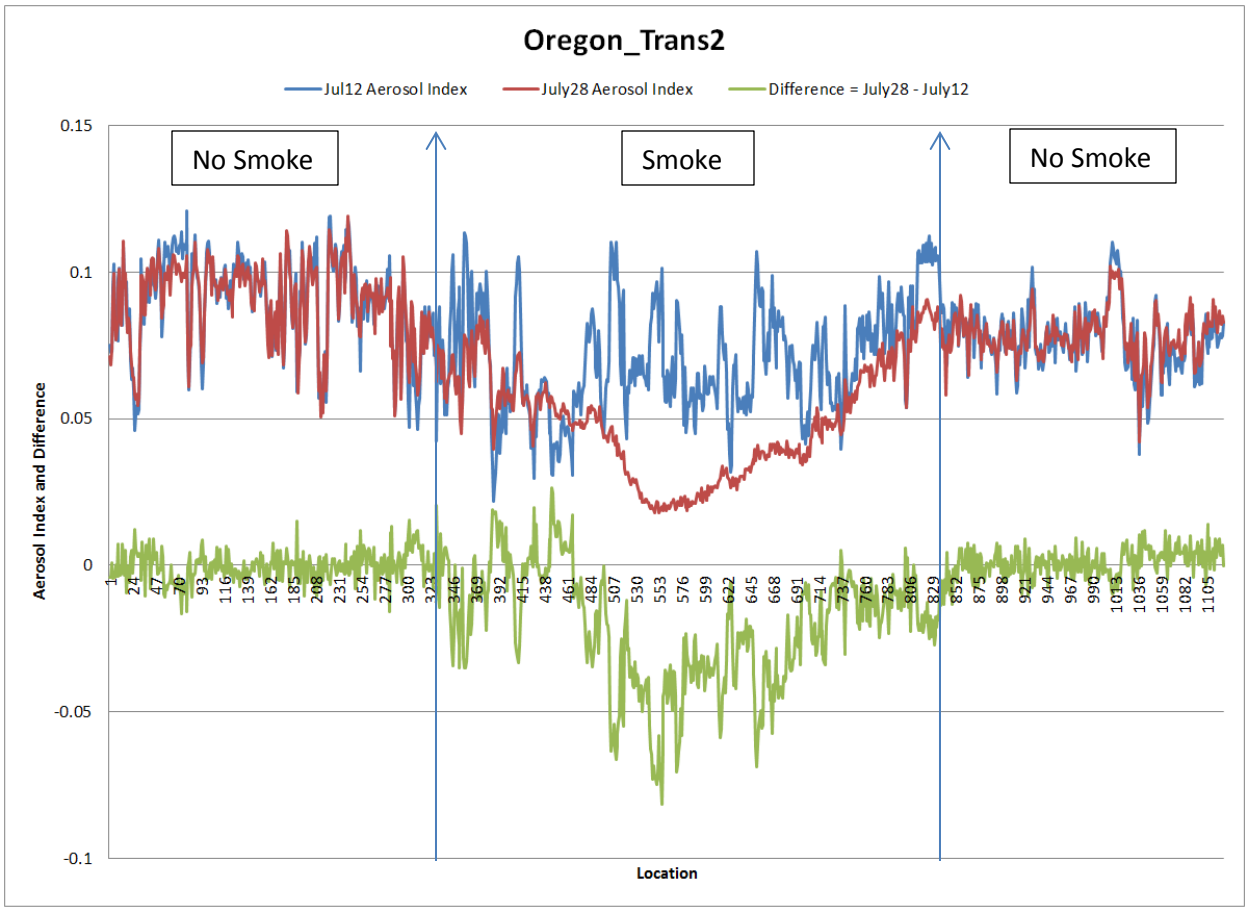
Left: Before - 2013July12 <True Colors> Right: After - 2013July28



Left: Before - 2013July12 <Aerosol Index> Right: After - 2013July28

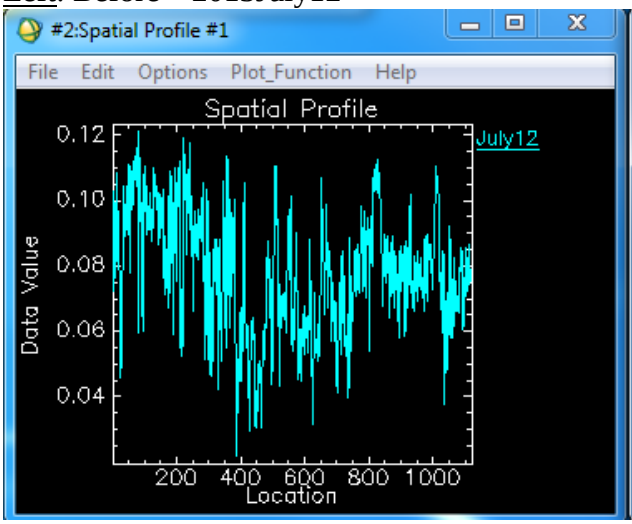


Again, the non-smoky areas are very similar in aerosol index values for two different dates, and this time, the smoke lowers the aerosol index by 0.04.

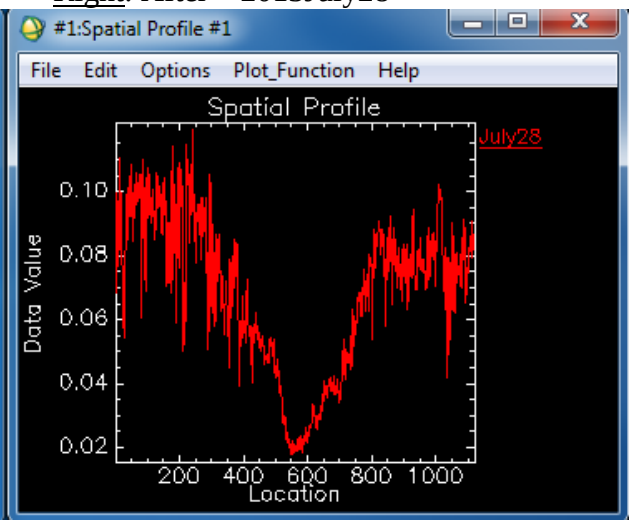


Spatial Profiles for Aerosol Index

Left: Before – 2013July12



Right: After – 2013July28



PART V – Haze in Los Angeles

Case Study: This case study looks at haze not from wildfire smoke. Los Angeles lies in a basin, and is susceptible to high levels of accumulated pollution. To see if the coastal aerosol band picks up the differences in pollution levels, I examined High Pollution (2013June30) and Low Pollution (2013July16) in Los Angeles.[6] These two images have less than 5% cloud cover, and were taken at the same time.

Table 15: Full Scene Coastal Blue Statistics

	Minimum	Maximum	Mean	StDev
2013June30	0.104013	1.031497	0.173848	0.068252
2013July16	0.088526	1.161921	0.153892	0.030076

Table 16: Full Scene Aerosol Index Statistics

	Minimum	Maximum	Mean	StDev
2013June30	-0.202950	0.203088	0.033973	0.033632
2013July16	-0.241386	0.262179	0.033435	0.036902

Contrary to expectations, the High Pollution (2013June30) scene has higher aerosol index value than the Low Pollution (2013July16). Few cumulous clouds in the High Pollution (2013June30) should have lowered the aerosol index value in addition the aerosols as was the case for smoke particles. But again, perhaps the capability of the aerosol band is lost because of the large spatial extent of analyzing a full scene.

[6] High and Low terms in naming these scenes are relative.

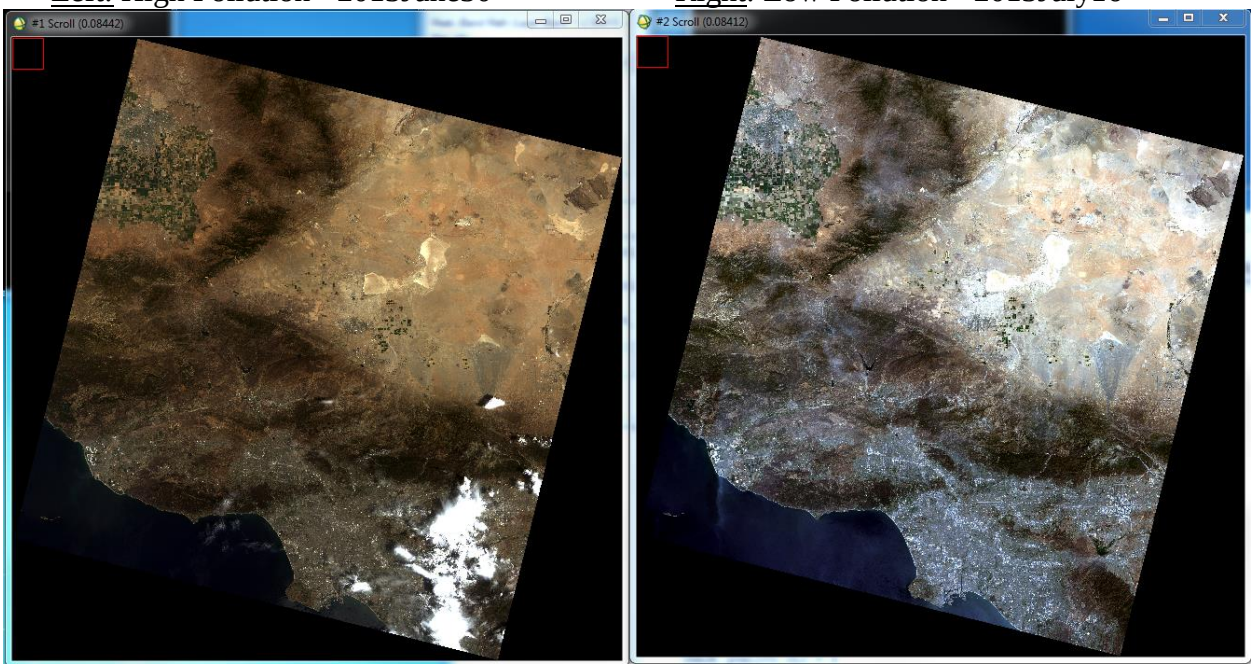
❖ **Air Quality Index (airnow.gov)**

AQI for LA on June 30th is Moderate.

AQI for LA on July 16th is Good.

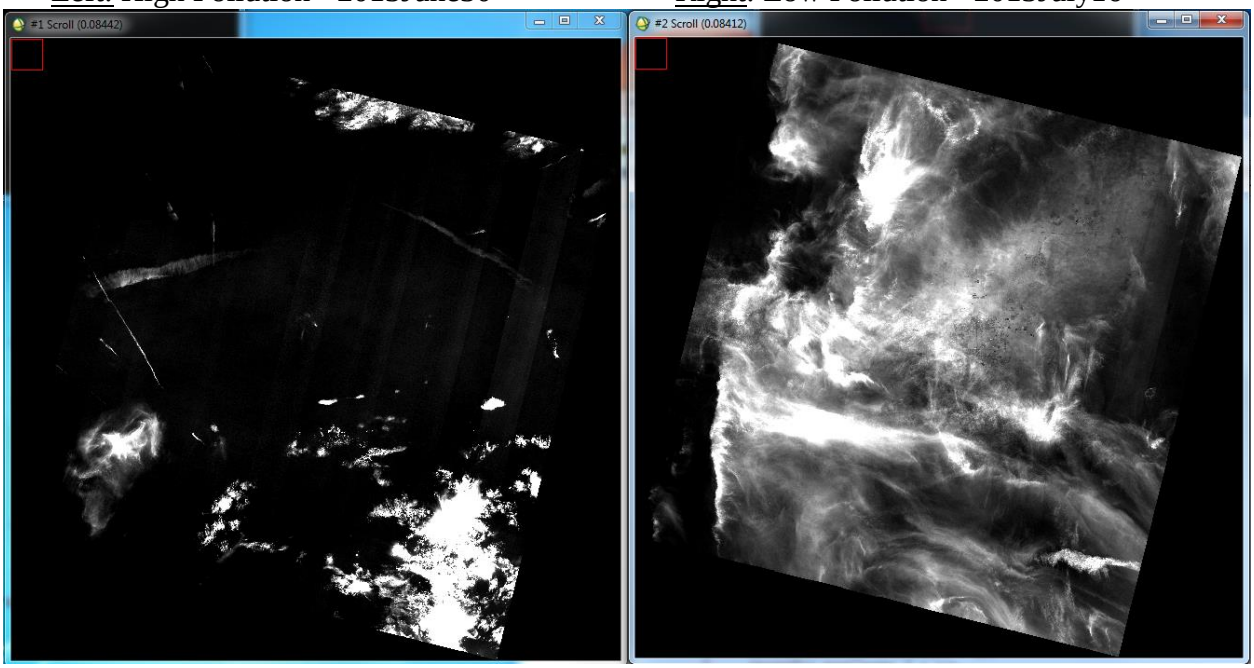
❖ **RGB - 432**

Left: High Pollution - 2013June30 Right: Low Pollution - 2013July16



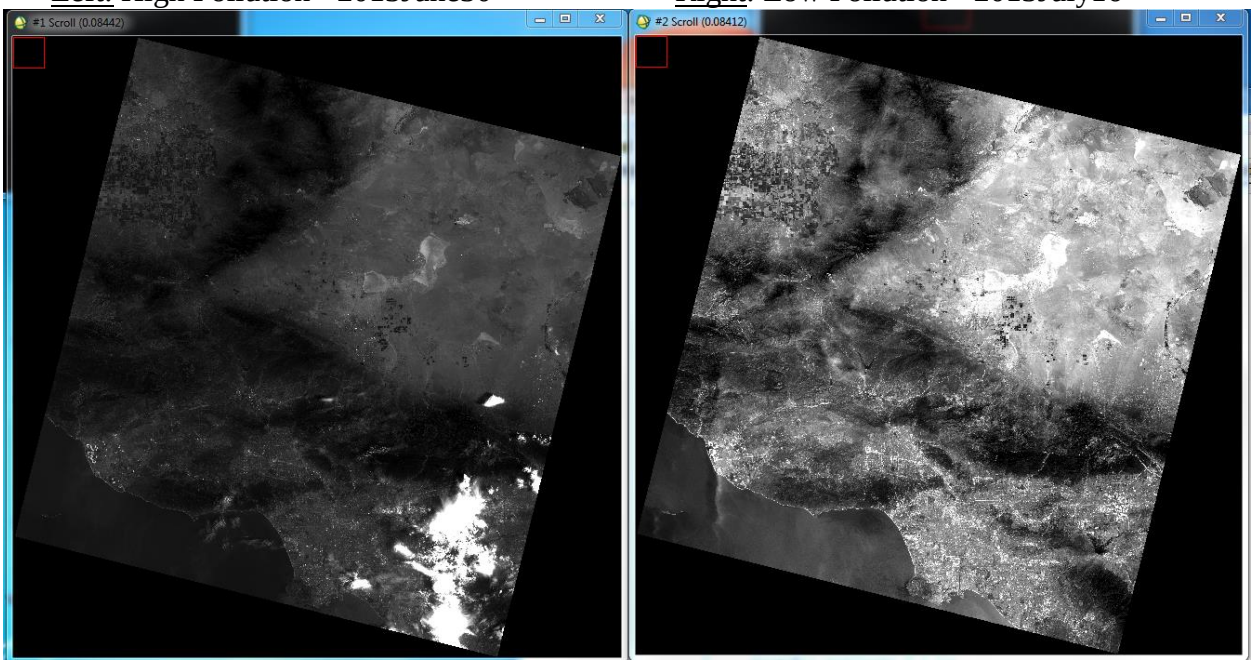
❖ **Cirrus Band**

Left: High Pollution - 2013June30 Right: Low Pollution - 2013July16



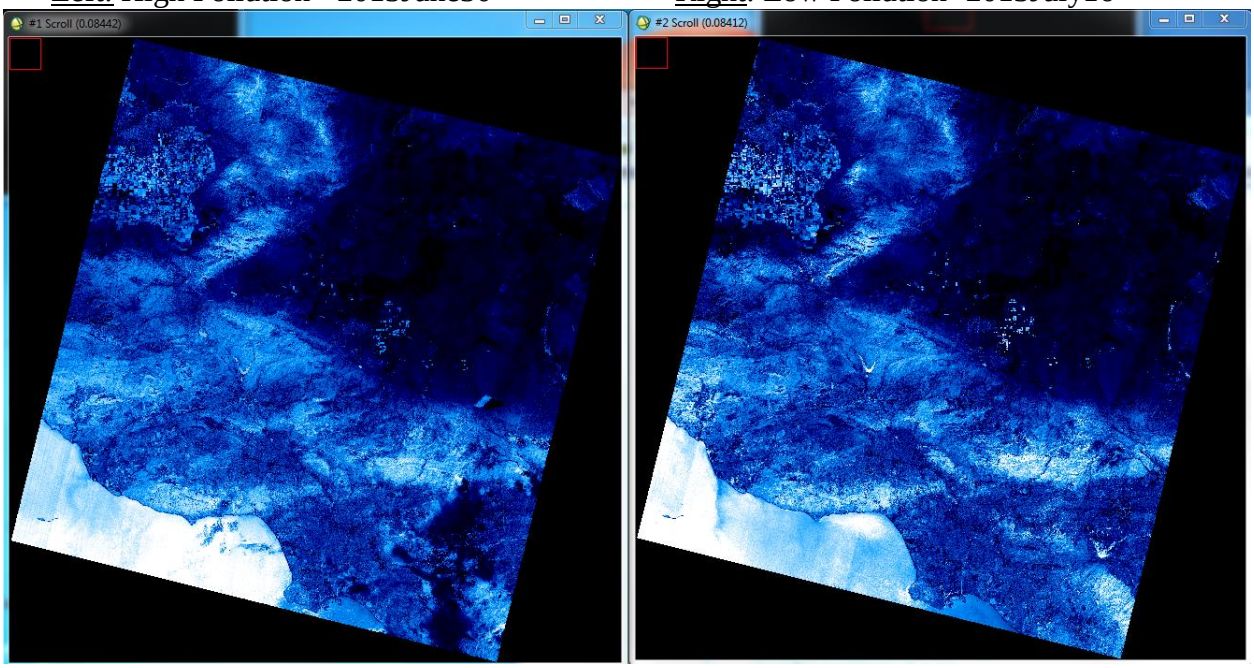
❖ **Coastal Aerosol Band**

Left: High Pollution - 2013June30 Right: Low Pollution - 2013July16



❖ **Aerosol Index (B1-B2/B1+B2)**

Left: High Pollution - 2013June30 Right: Low Pollution- 2013July16

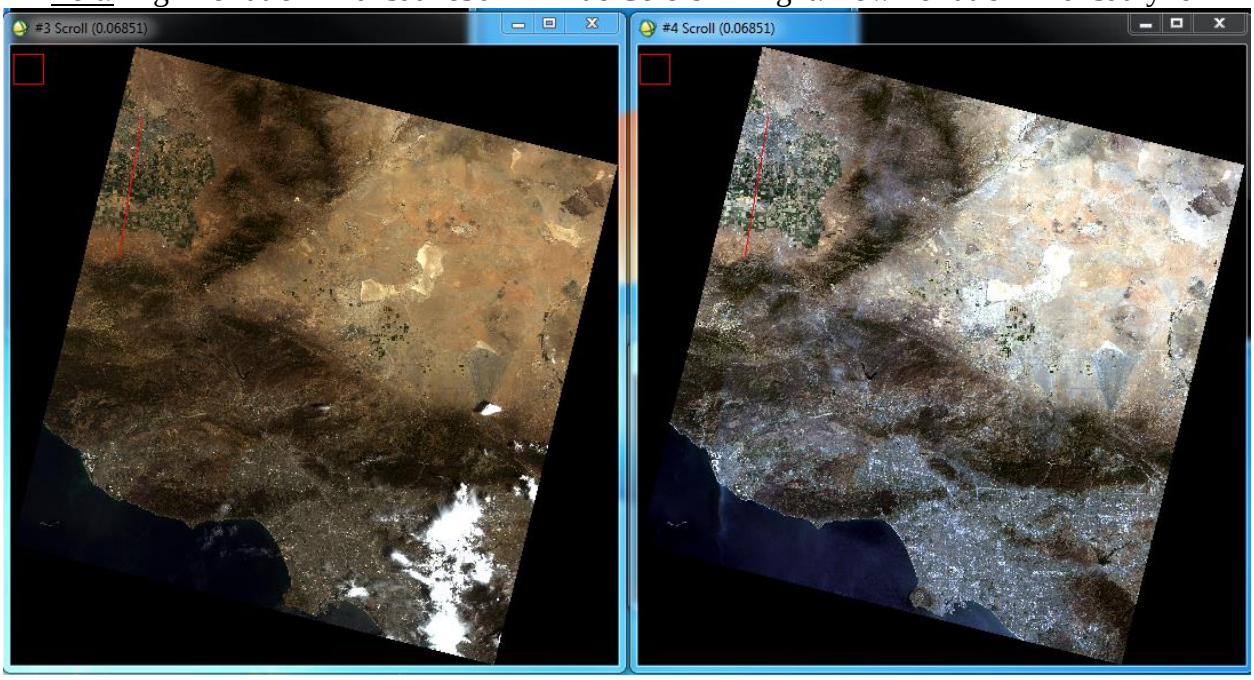


❖ **LA_Trans1: Over Land**

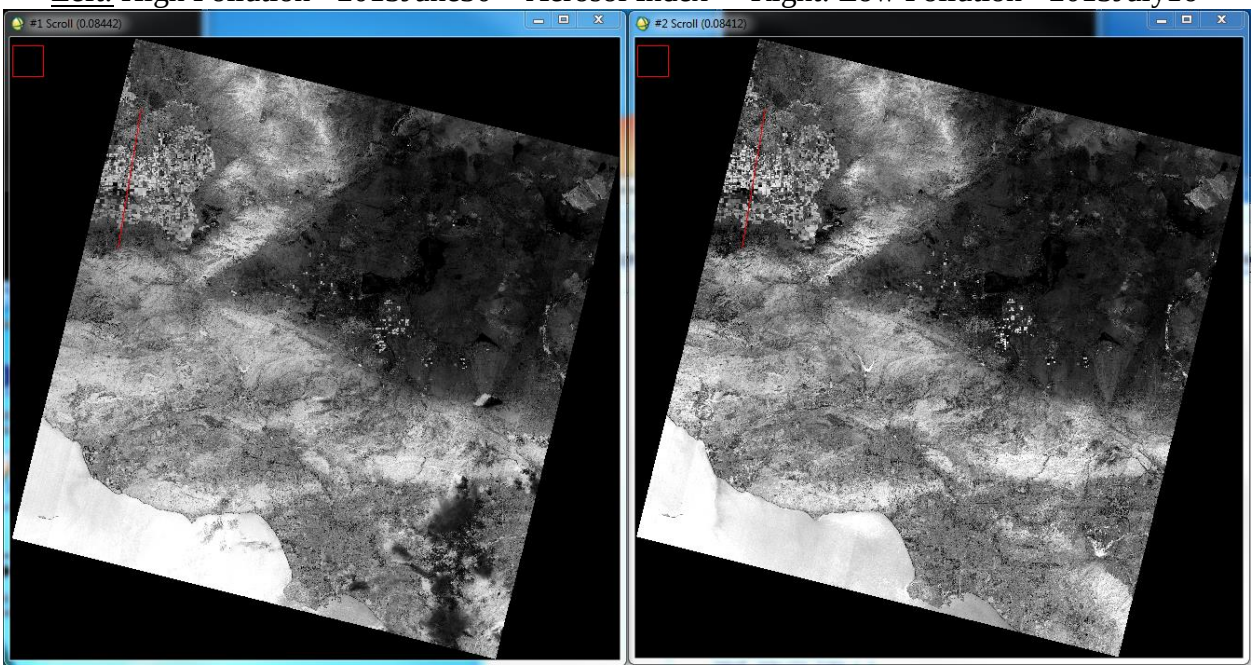
Note: The red line denotes the transect line LA_Trans1 (upper left side).

The transect is over urban areas, agriculture fields, and bare soil.

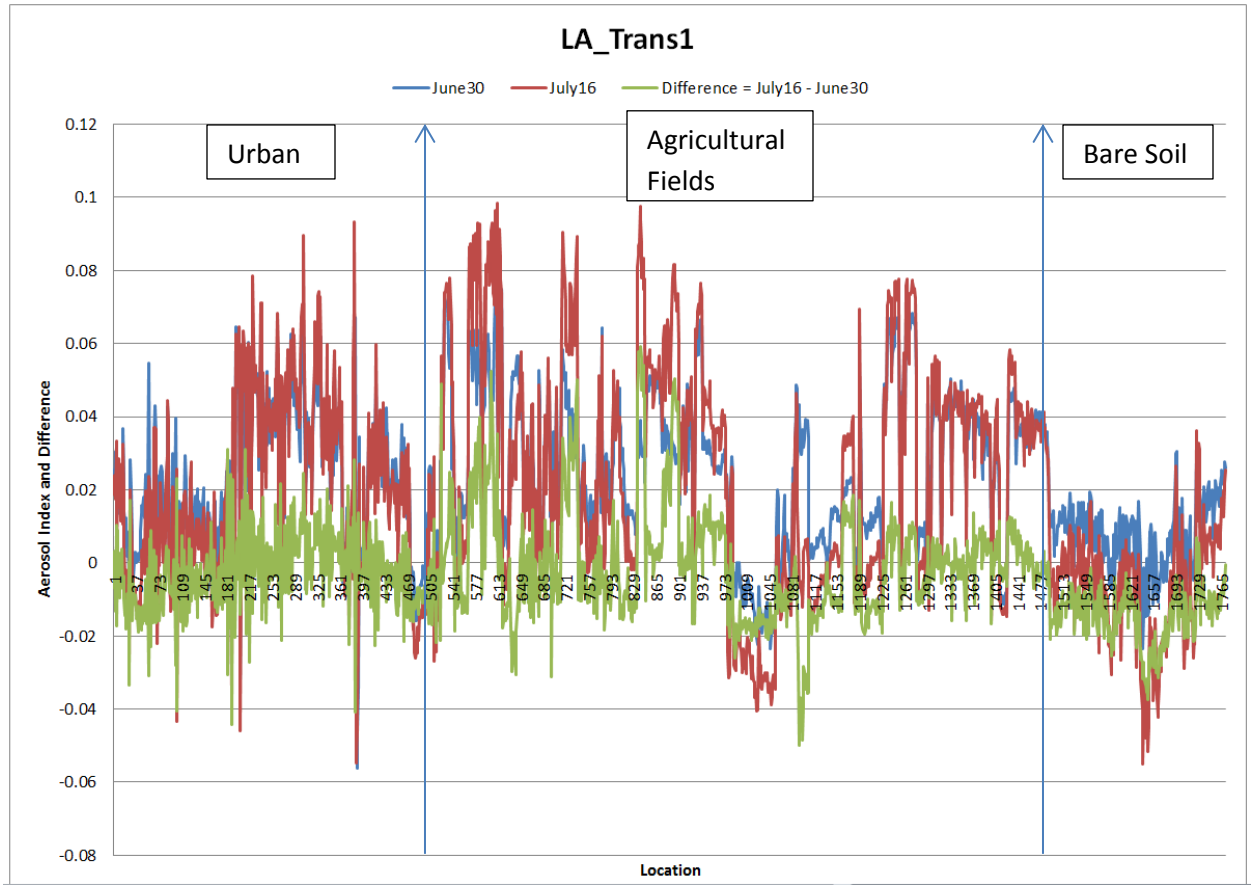
Left: High Pollution - 2013June30 <True Colors> Right: Low Pollution - 2013July16



Left: High Pollution - 2013June30 <Aerosol Index> Right: Low Pollution - 2013July16

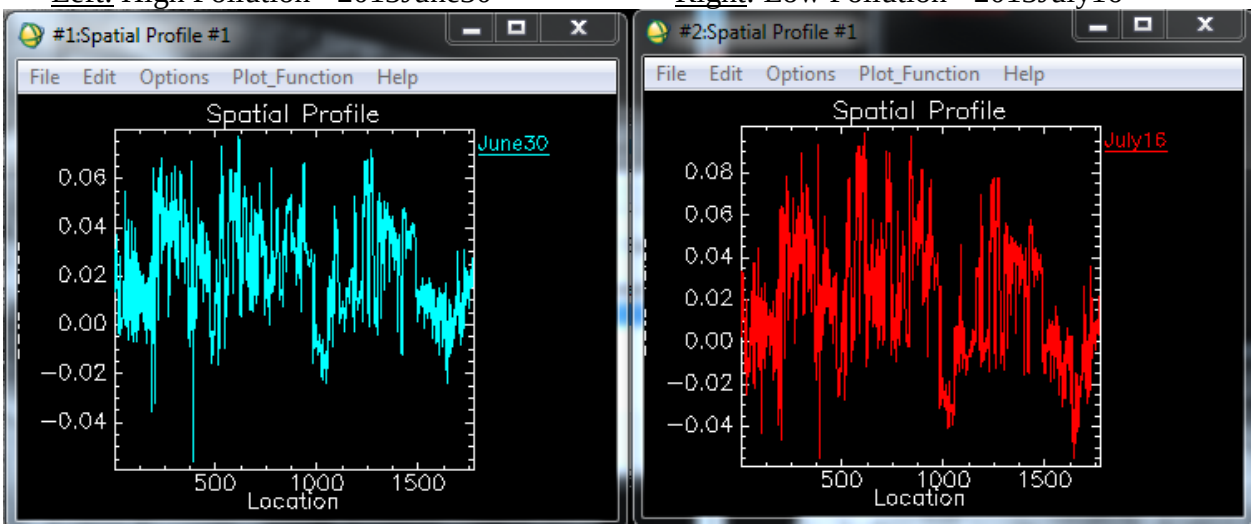


There are two areas where there consistently are huge differences in aerosol index values of the two days. Unfortunately, I believe those are associated with changes in land cover rather than atmospheric aerosols. For example, the biggest discrepancies between June30 and July16 images are due to changes in vegetation cover in the agricultural fields.

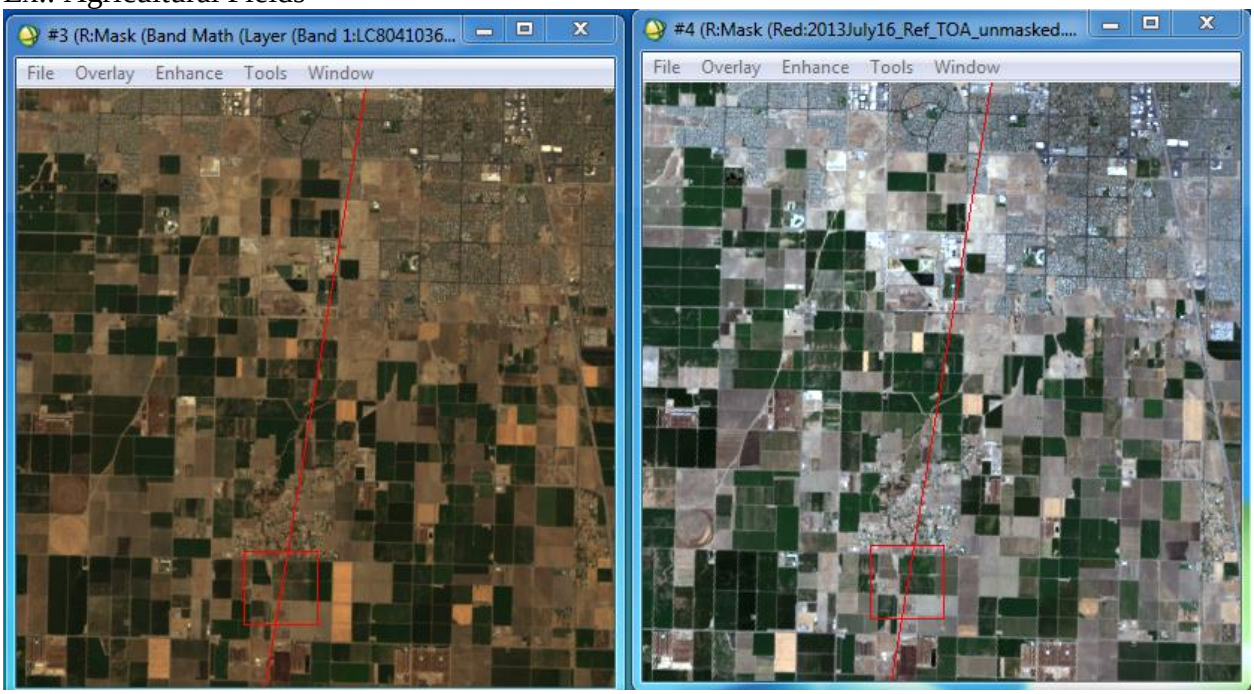


Spatial Profiles for Aerosol Index

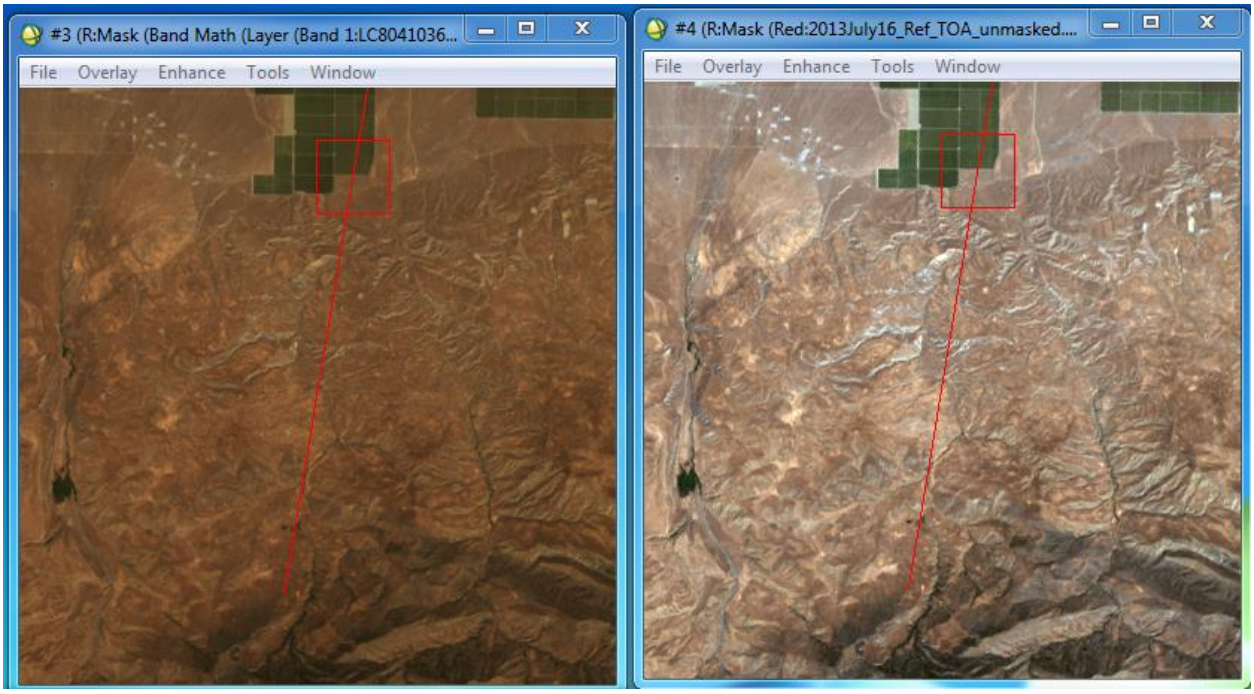
<u>Left:</u> High Pollution - 2013June30 <u>Right</u>: Low Pollution - 2013July16



Ex.: Agricultural Fields



Ex. Bare Soil

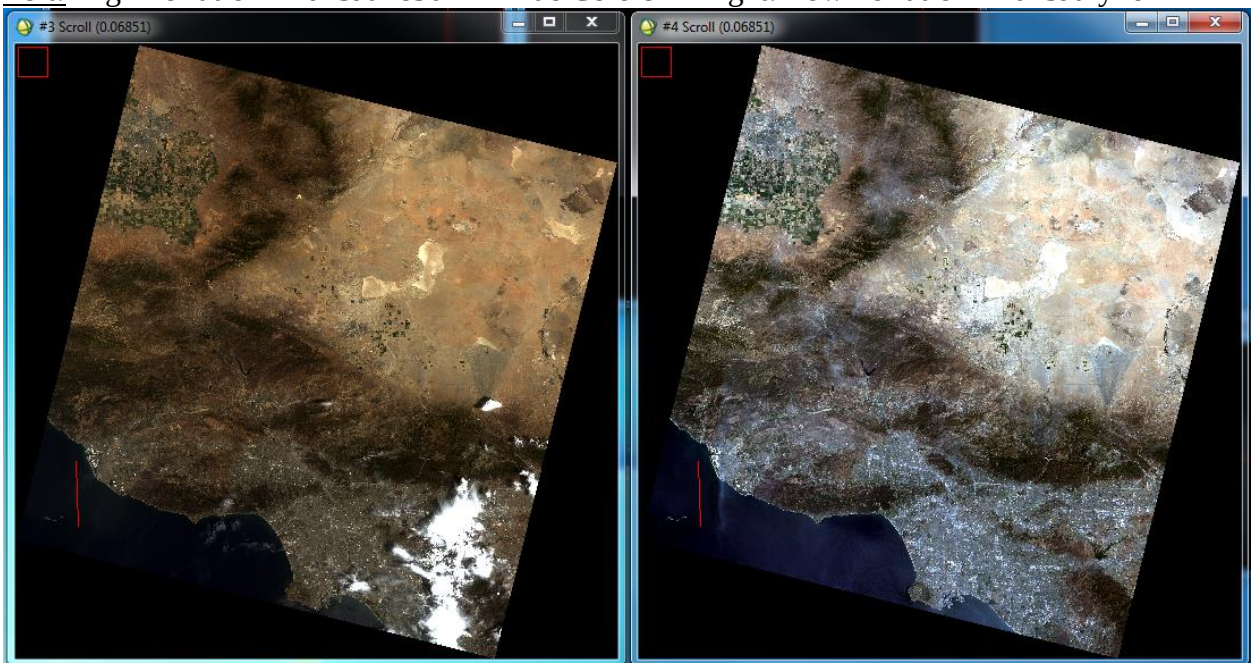


- **LA_Trans2: Over Water**

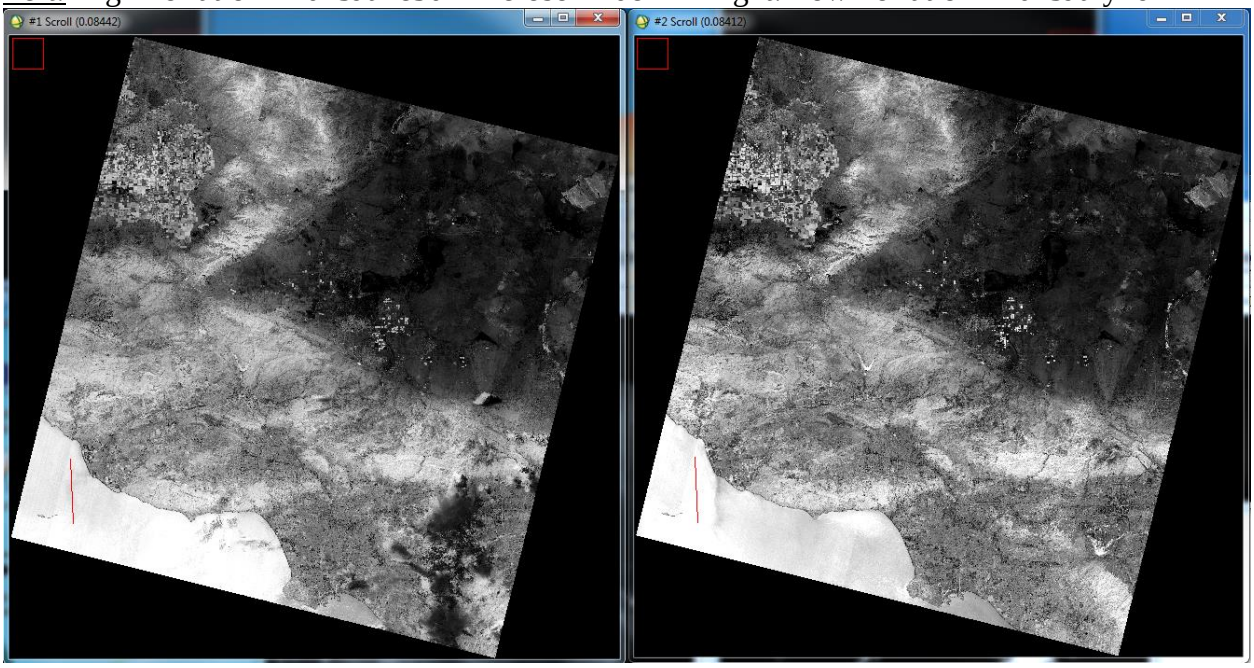
Note: The red line denotes the transect line LA_Trans1 (lower left side).

The transect is over coastal waters.

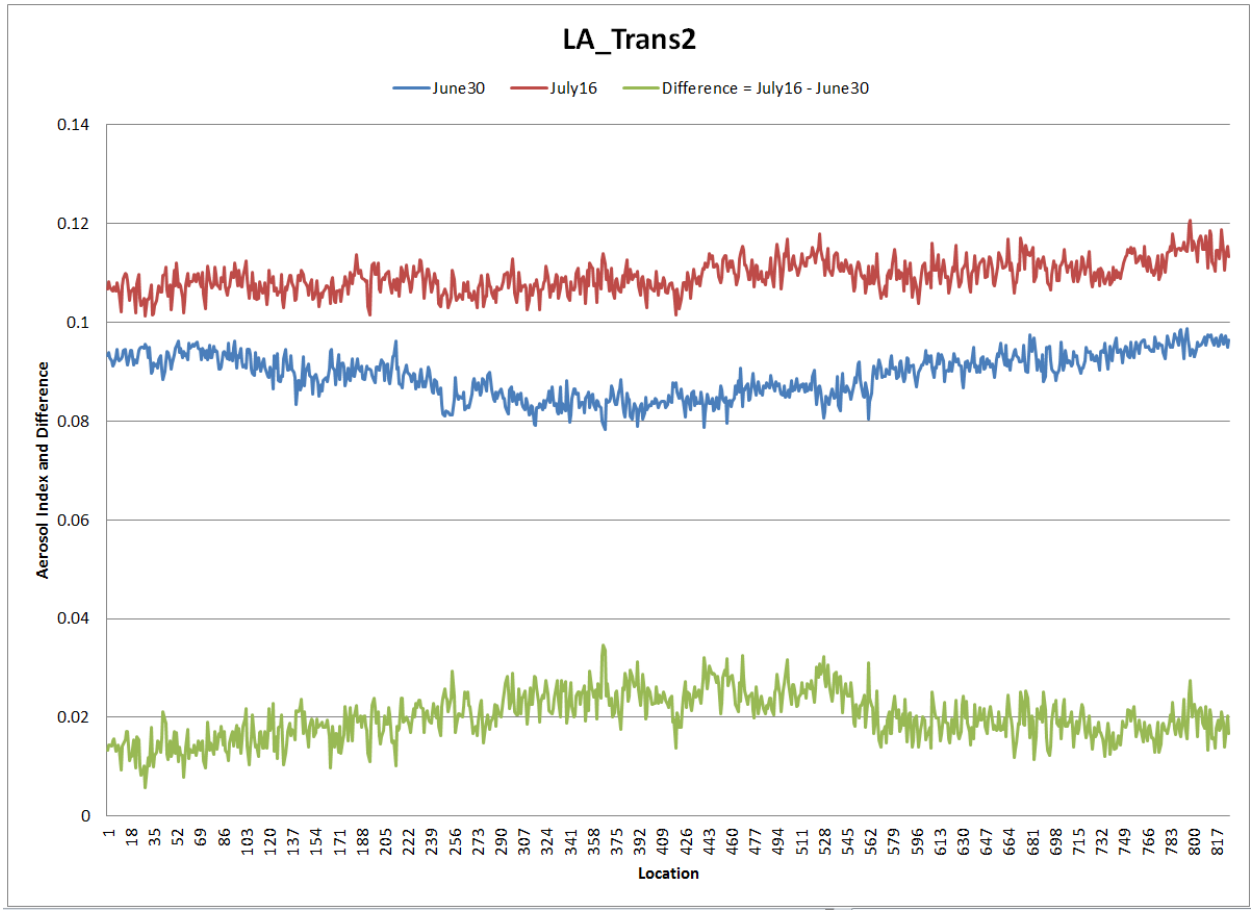
Left: High Pollution - 2013June30 <True Colors> Right: Low Pollution - 2013July16



Left: High Pollution - 2013June30 <Aerosol Index> Right: Low Pollution - 2013July16

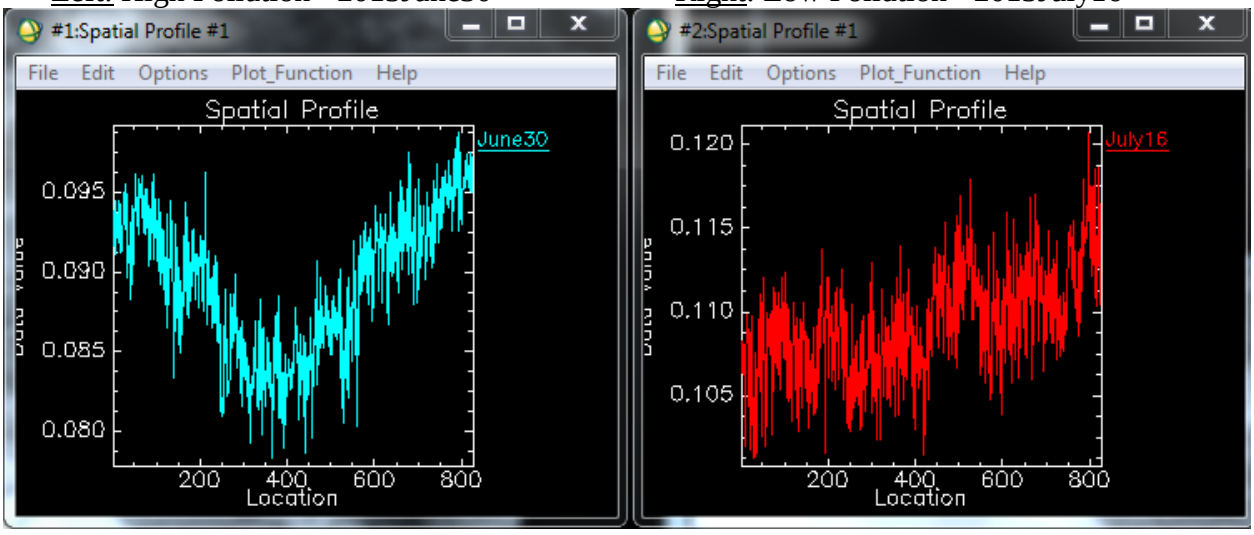


Under the assumption that the aerosols in the atmosphere lower the aerosol index value, the graph below makes sense.



Spatial Profiles for Aerosol Index

Left: High Pollution - 2013June30 Right: Low Pollution - 2013July16



Wyoming Sounding