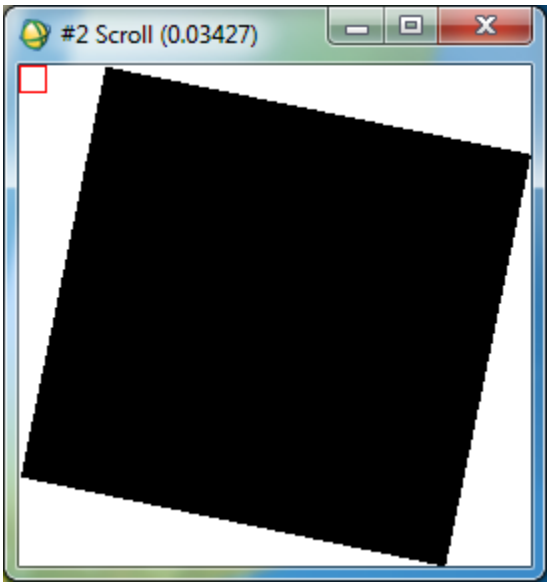
Landsat 8: Negative Reflectance Values

When the DN values were converted to the TOA reflectance values, there was a large number of negative reflectance values. Most of the pixels with negative reflectance values were in the triangular border regions (white pixels: DN=0 on ALL bands).



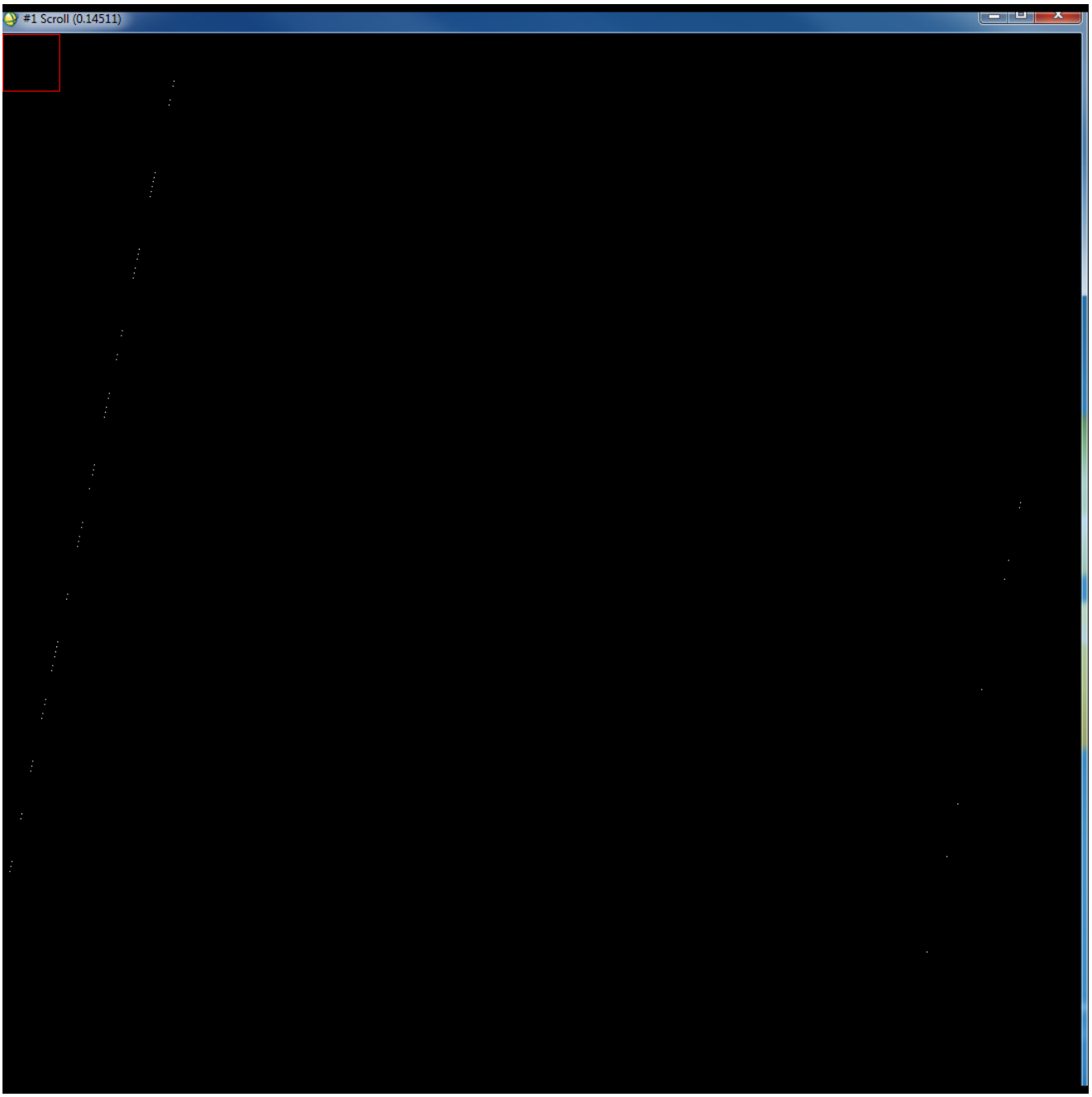
But, even after these border pixels have been masked out, there remained several thousands of pixels with negative reflectance values.

The following images show the attempts to locate these remaining pixels with negative reflectivity.

- **Dominica: 2013May05_Coastal_Negative**

Masking for pixels with negative reflectance values on ANY band while ignoring those in the triangular border regions.

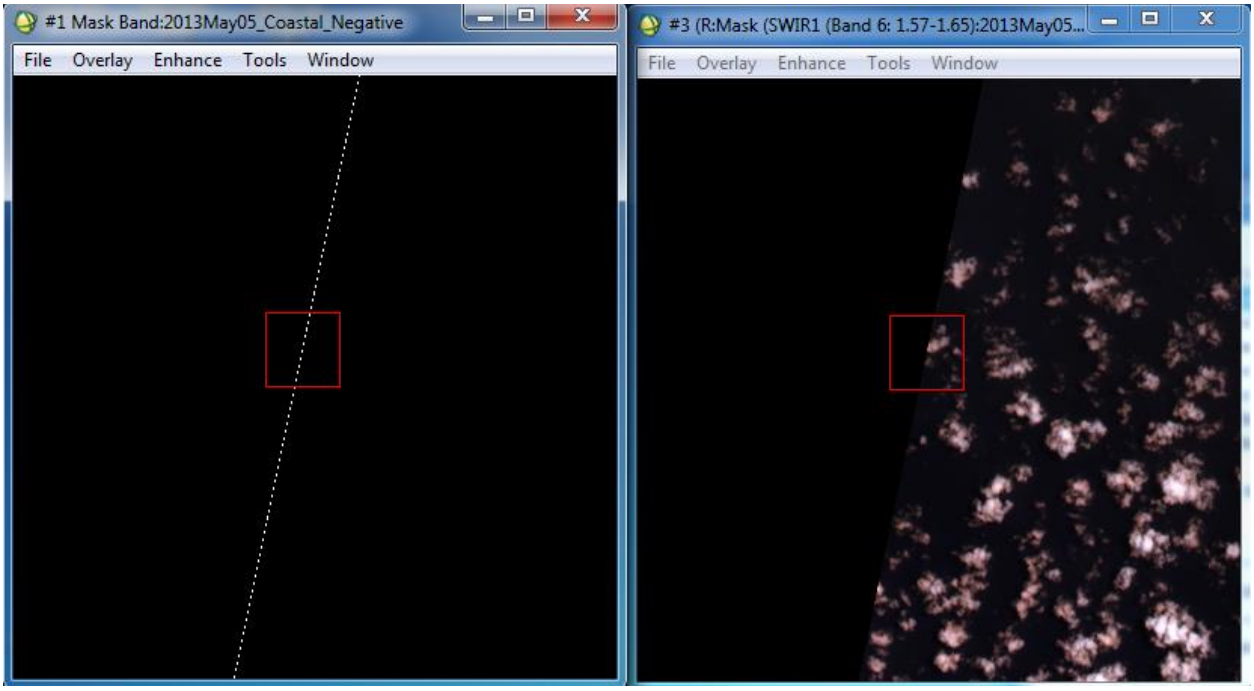
The white pixels are those that were identified as having negative reflectivity given the previously stated constraints.

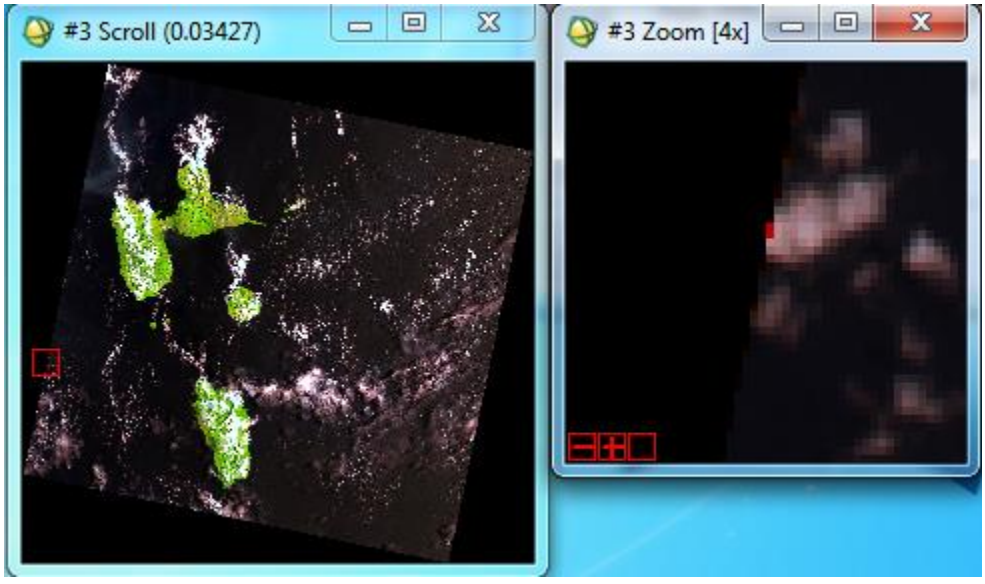


*Note: Coastal band was selected as an example because it had the highest number of negative reflectance values.

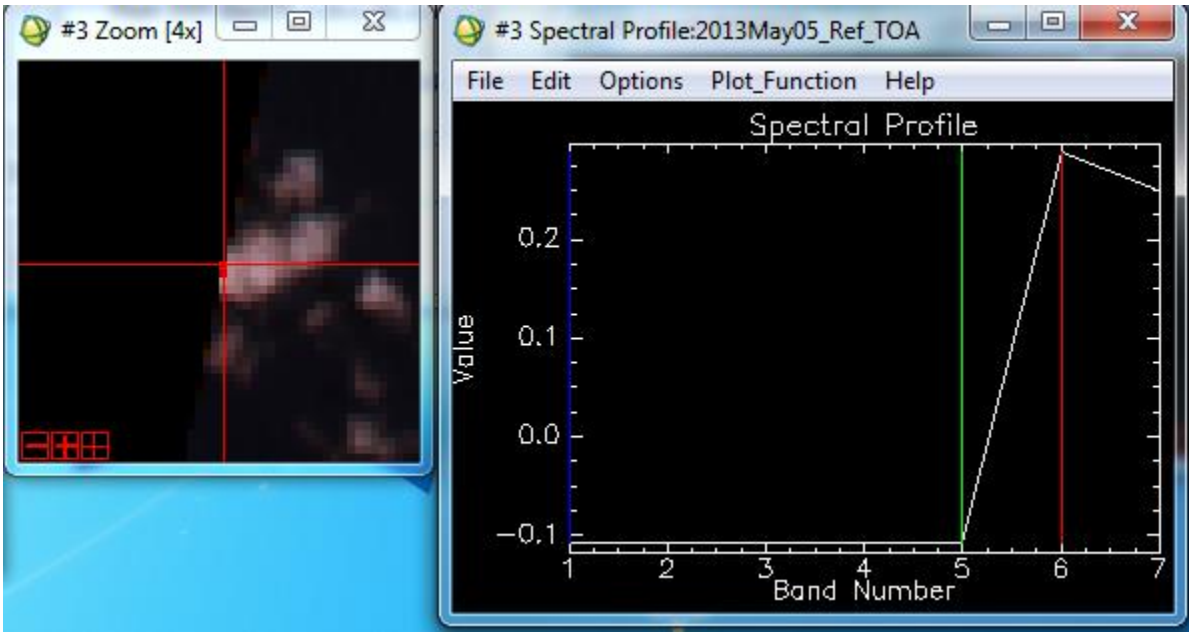
The white pixels are only along the western and eastern edges of the image for Bands 1-7.

The two Image windows immediately below are linked.

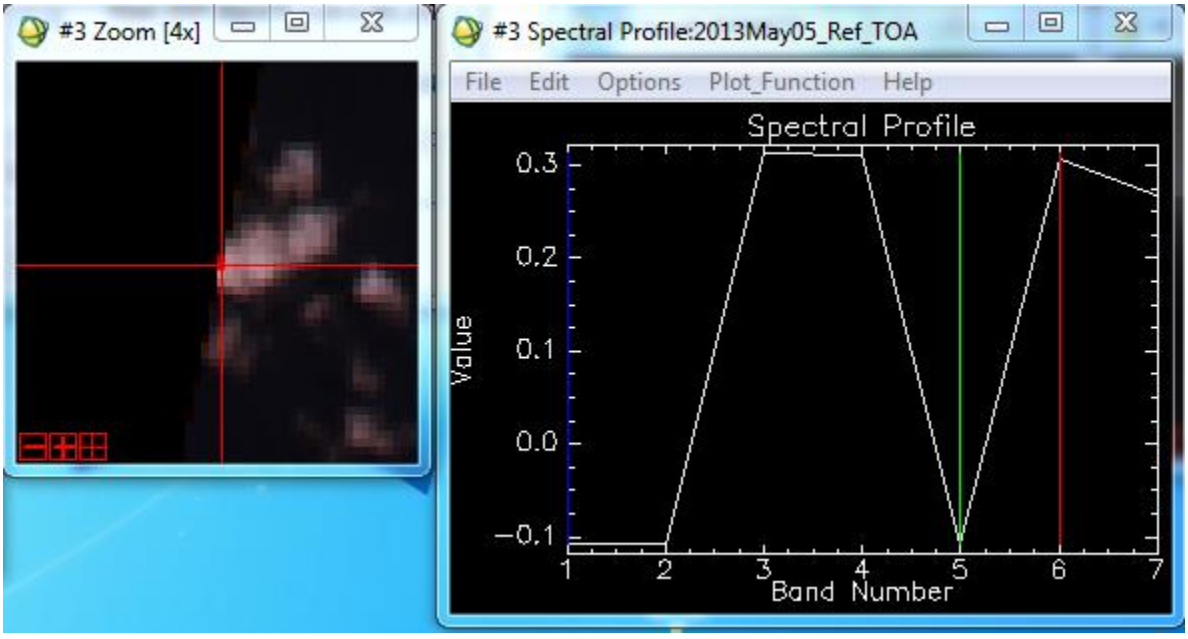




Using the Z-Profile tool, one can see that a funky pixel can have a DN value of zero (or negative reflectance value) on some bands while the other bands have true values (positive reflectance values). The pixel shown immediately below has positive reflectivity for only bands 6 and 7.



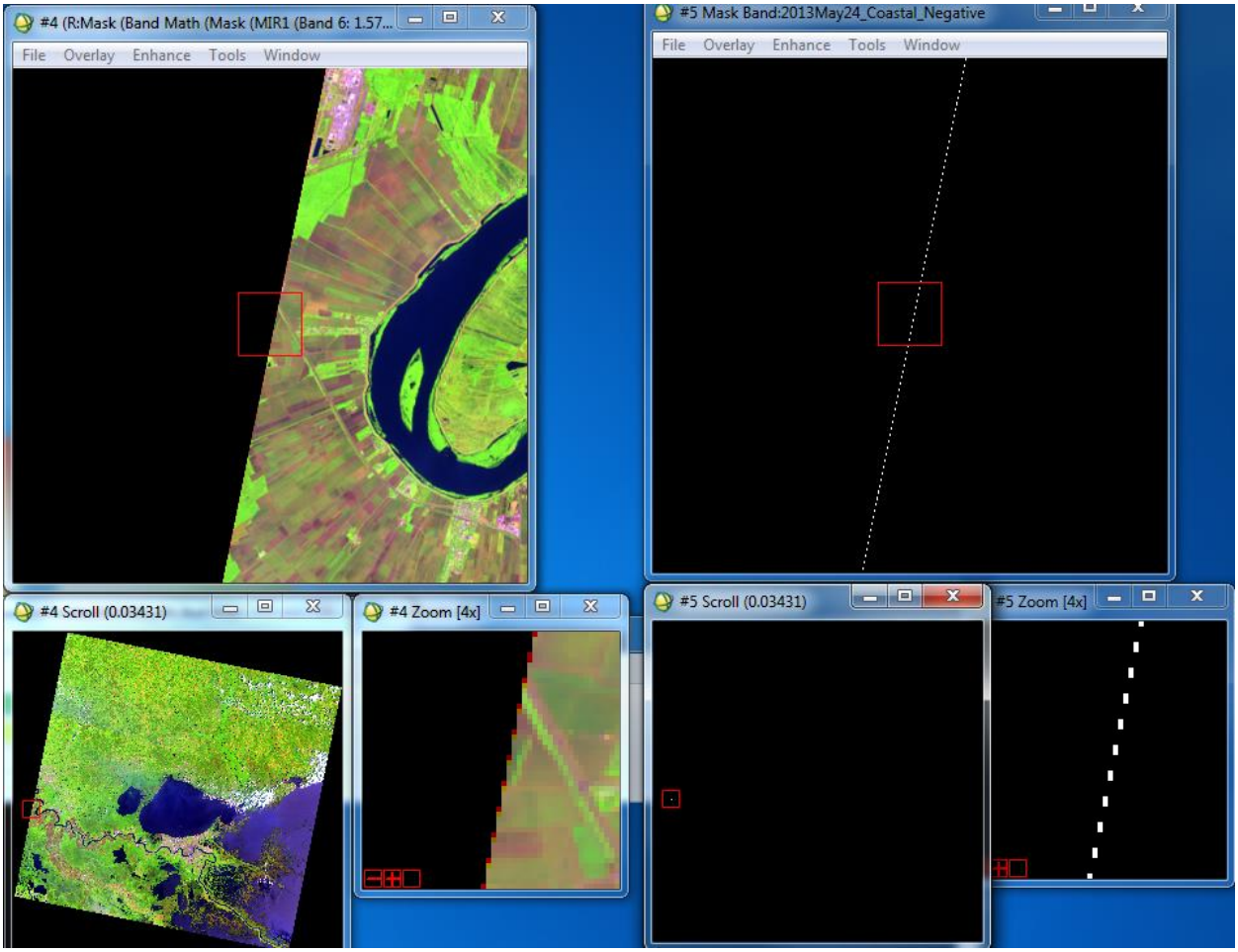
Another funky pixel along the edge has positive reflectivity for only bands 3, 4, 6, and 7.

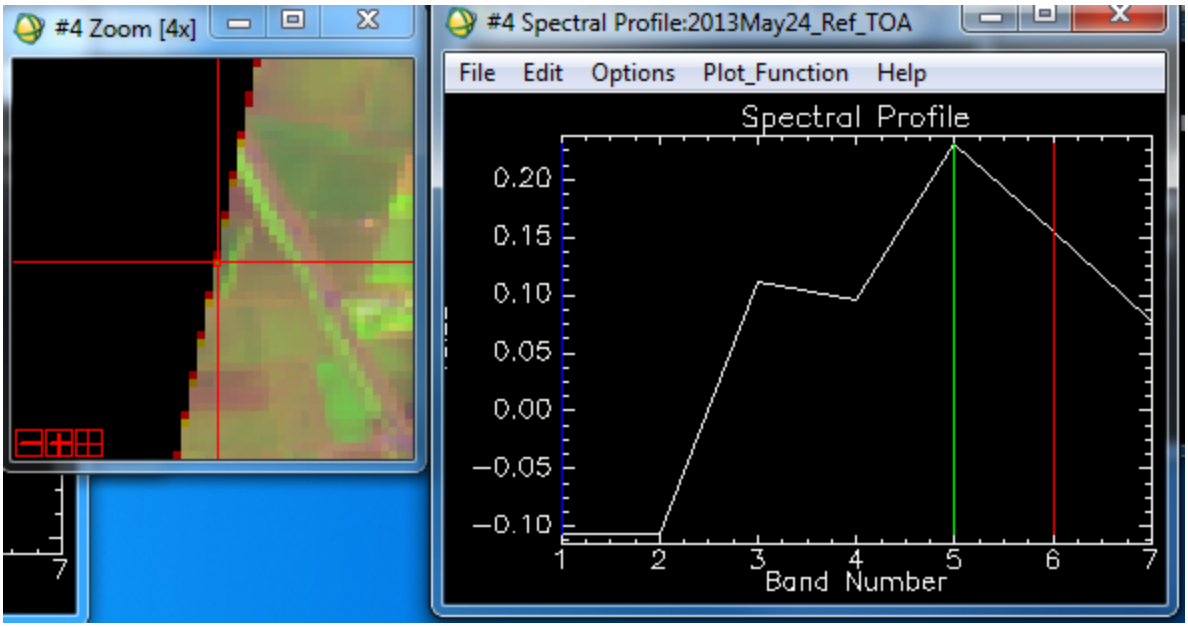


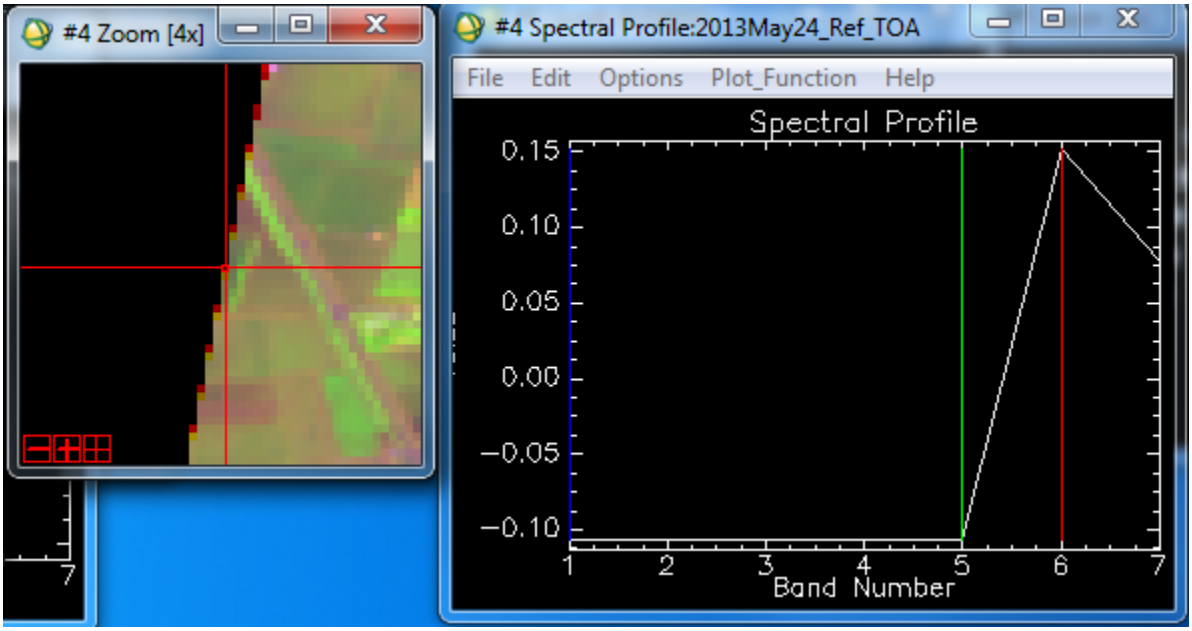
- **Mississippi: 2013May24_Coastal_Negative**

Masking for pixels with negative reflectance values on ANY band while ignoring those in the triangular border regions.

The white pixels are those that were identified as having negative reflectivity.




#4 Zoom [4x]
#4 Spectral Profile:2013May24_Ref_TOA
File Edit Options Plot_Function Help
Spectral Profile
0.20
0.15
0.10
0.05
0.00
−0.05
−0.10
1 2 3 4 5 6 7
Band Number

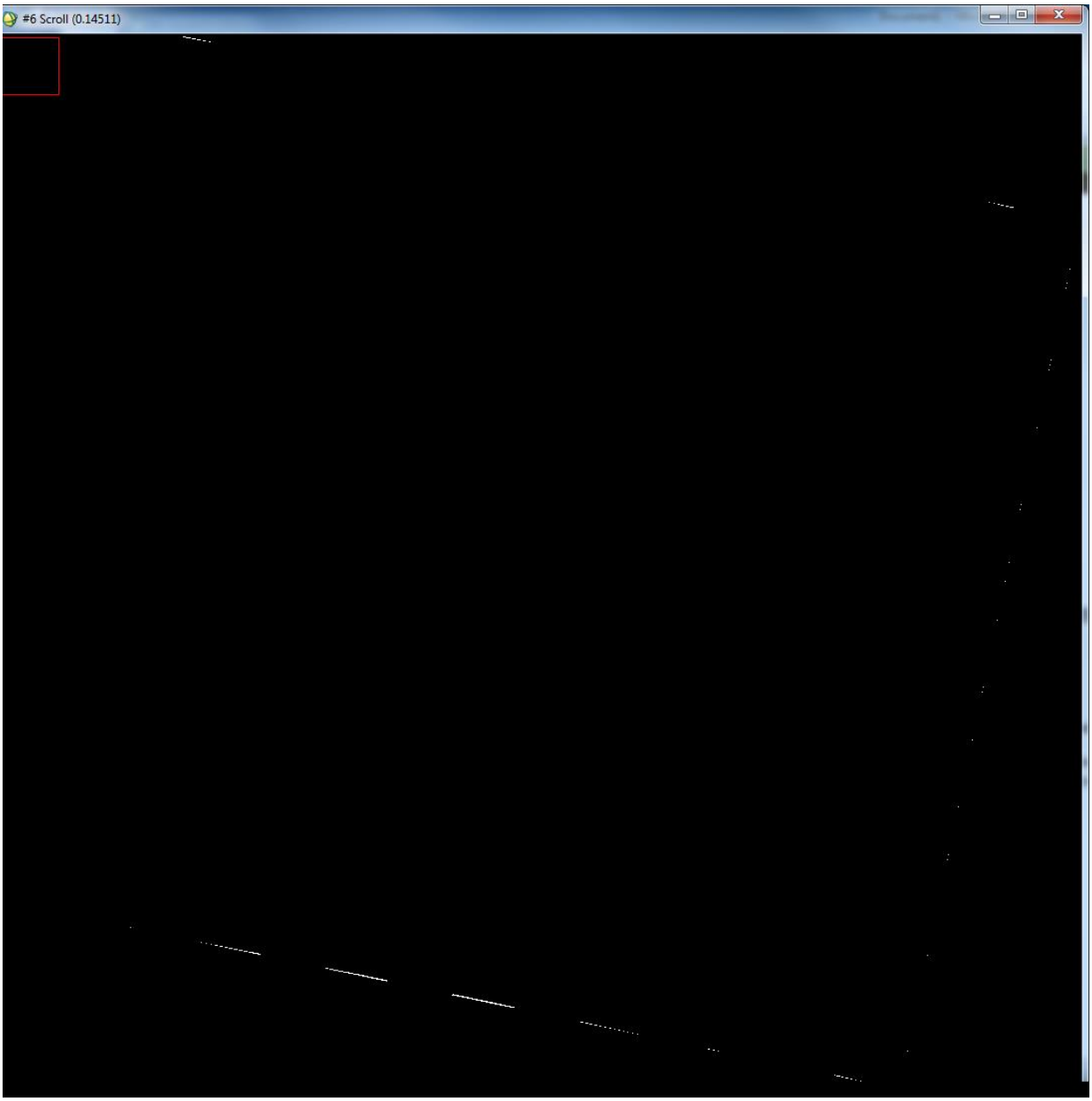

#4 Zoom [4x]
#4 Spectral Profile:2013May24_Ref_TOA
File Edit Options Plot_Function Help
Spectral Profile
0.15
0.10
0.05
0.00
−0.05
−0.10
1 2 3 4 5 6 7
Band Number

- **Dominica: 2013May05_Cirrus_Negative**

Masking for pixels with negative reflectance values on the cirrus band while ignoring those in the triangular border regions.

The white pixels are those that were identified as having negative reflectivity.

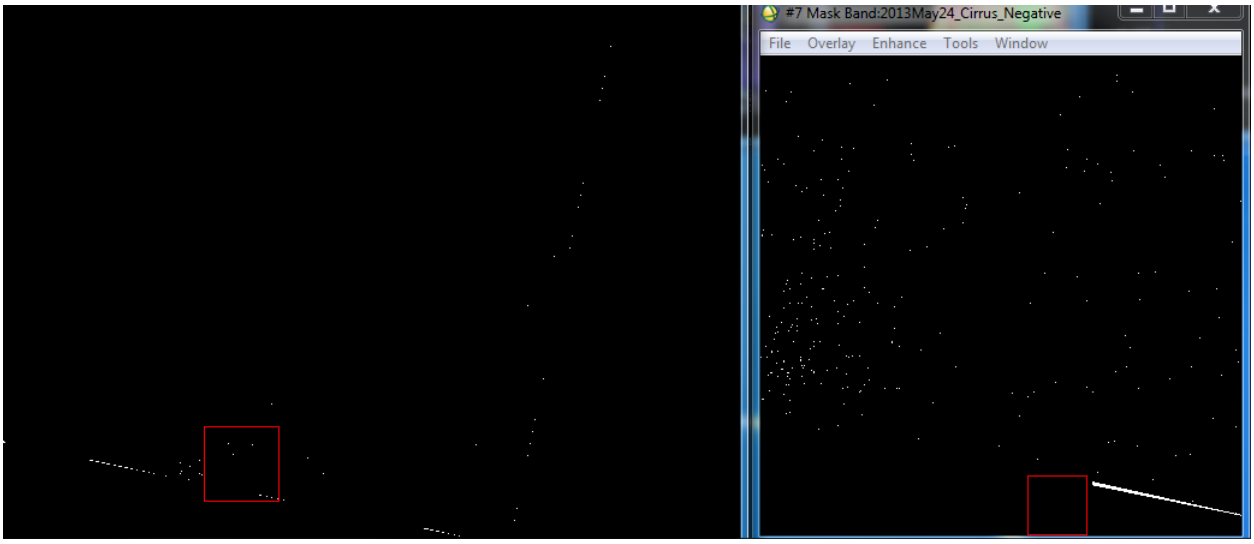
Unlike Bands 1-7, the funky pixels for the cirrus band are along each edge of the image: northern and southern as well as western and eastern sides.



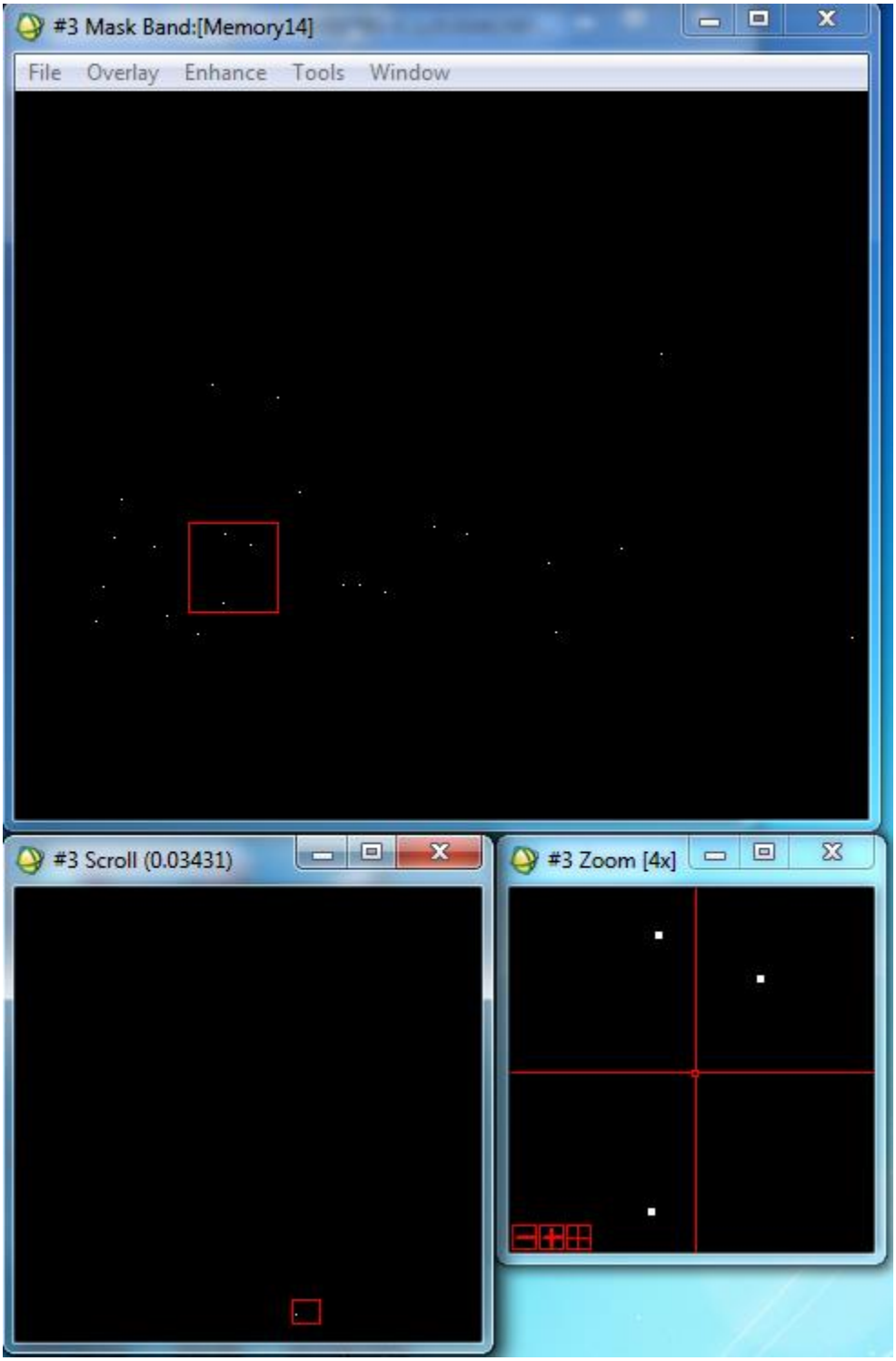
- **Mississippi: 2013May24_Cirrus_Negative**

Masking for pixels with negative reflectance values on the cirrus band while ignoring those in the triangular border regions.

For Mississippi image, the funky pixels are also found in the interior of the image as well, not just on the borders. These funky pixels in the interior of the image are only seen in the Mississippi's cirrus band. All other bands in both images have pixels of negative reflectivity only on the borders – the pixels adjacent to the borders have normal reflectance values.


#7 Mask Band:2013May24_Cirrus_Negative
File
Overlay
Enhance
Tools
Window

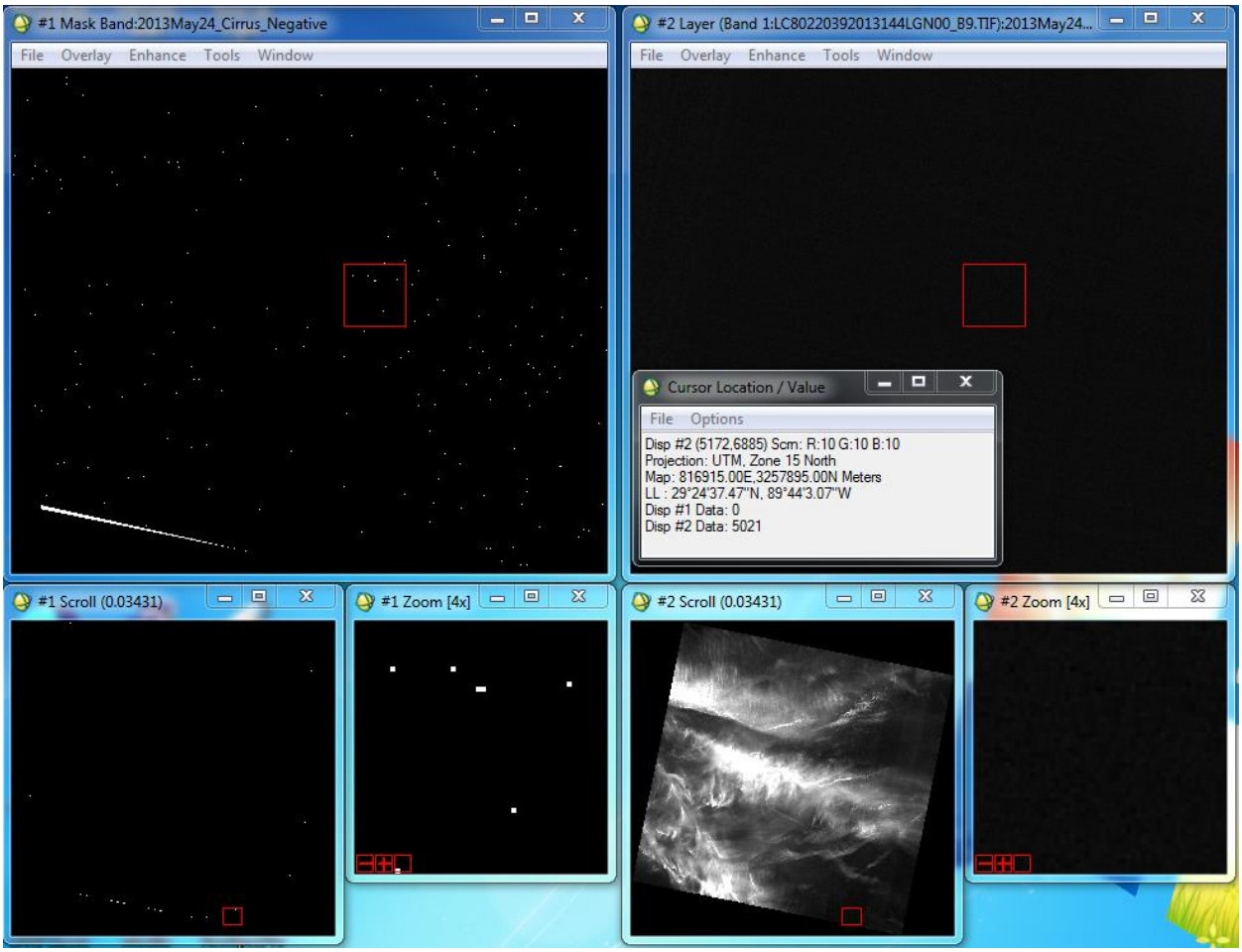
Once a mask that eliminates all the pixels of DN values of zero (N=172) has been applied, the remaining negative reflectance values were the funky pixels in the interior of the image.



These funky pixels in the interior are located among pixels of very low reflectance (DN value slightly greater than 5,000). Note that these interior pixels are located in the darkest parts of the image below.

Left: Mask for negative reflectivity in the Mississippi image's cirrus band.

Right: Cirrus band in Gray Scale. Pixel values are in DN.



For both the Dominica and Mississippi images, there remained few pixels of negative reflectivity even after a mask for DN=0 on ANY band was applied, in addition to the mask for DN=0 on ALL bands. These pixels do not have DN values of 0 but those less than 5,000. Any pixel with a DN value less than 5,000 for bands 1-7 will result in negative reflectivity. The following charts and images describe these remaining pixels for both the reflective bands and the cirrus band. In general, these remaining pixels of negative reflectivity were found in clusters in areas of low reflectivity. No pixel was immediately adjacent to pixels of high reflectivity.

Reflective Bands:

- *Dominica: 2013May05_Ref_TOA_ANY*

  No negative reflectance value found.

- *Mississippi: 2013May24_Ref_TOA_ANY*

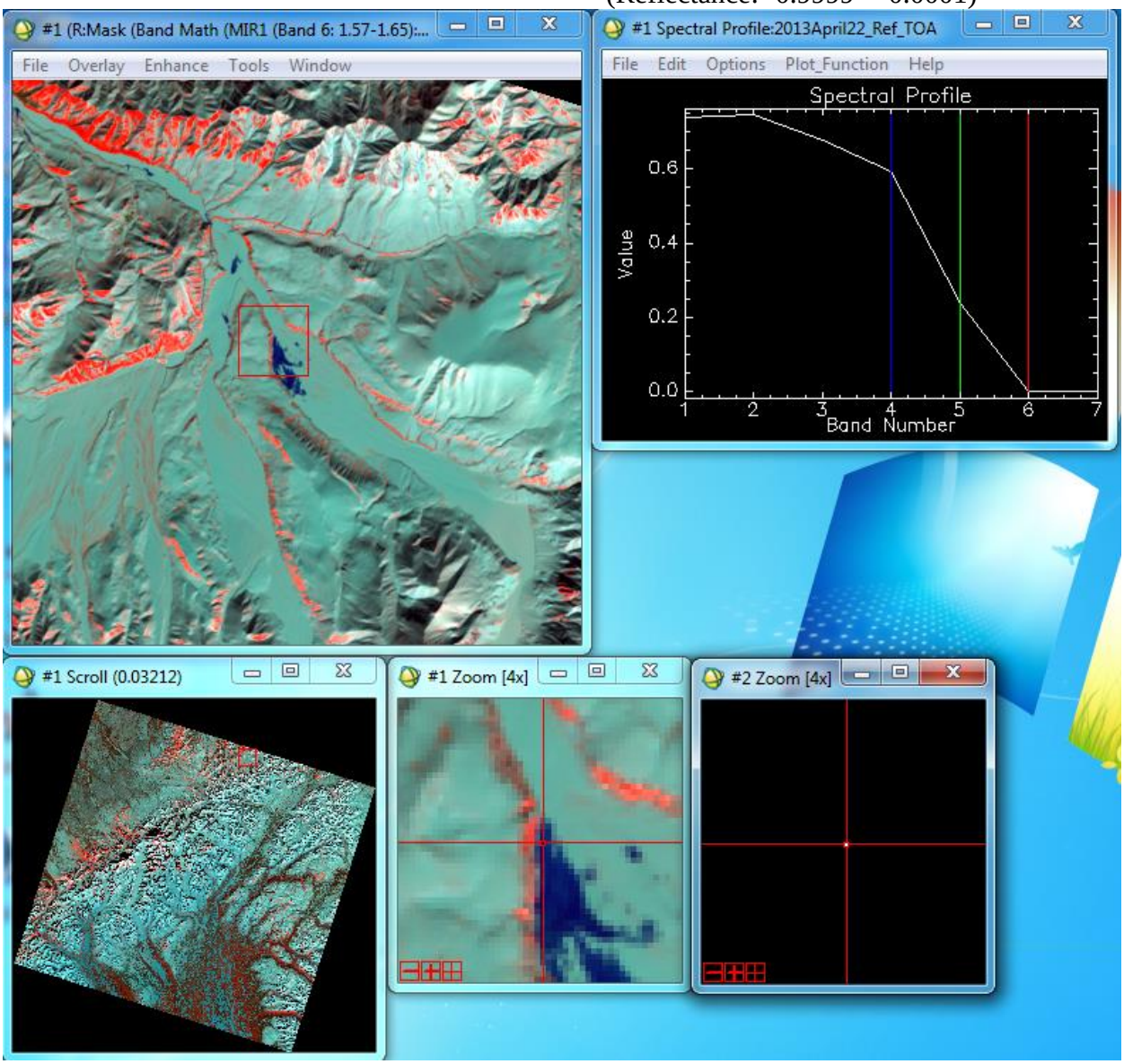
	Reflectance	**DN**	**# of Pixels**
Band 1	N/A	N/A	N/A
Band 2	N/A	N/A	N/A
Band 3	N/A	N/A	N/A
Band 4	N/A	N/A	N/A
Band 5	N/A	N/A	N/A
Band 6	-0.006059	4717	1
	-0.001043	4951	4
Band 7	N/A	N/A	N/A

  Could not locate where these five pixels of negative reflectivity were.

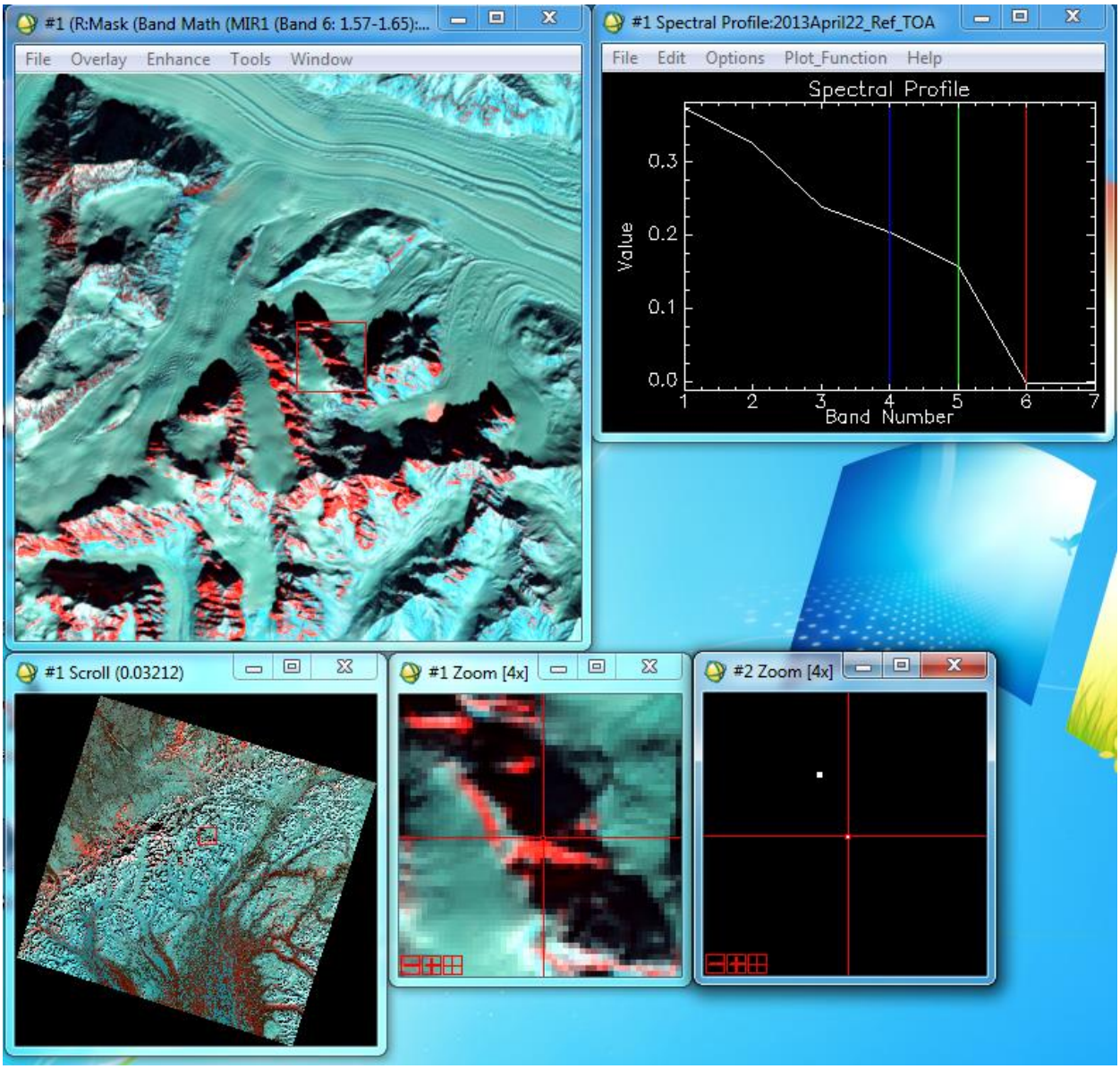
- *Alaska: 2013April22_Ref_TOA_ANY*

	Reflectance	**DN**	**# of Pixels**
Band 1	N/A	N/A	N/A
Band 2	N/A	N/A	N/A
Band 3	N/A	N/A	N/A
Band 4	N/A	N/A	N/A
Band 5	N/A	N/A	N/A
Band 6	-0.003253	4897	12
	-0.000314	4990	3,868
Band 7	-0.002905	4908	6
	-0.000249	4992	26,386

Left: 654 – RGB with Spectral Profile Bottom Right: Mask for negative reflectivity pixels (Reflectance: -0.9999 - -0.0001)



Band 7: A pixel with the reflectance of -0.0006 is surrounded by similarly low reflectivity pixels, in at least the MIR bands. These particular pixels are in the bodies of the water (above) or in the shadows (below).



❖ *Florida: 2013May23_Ref_TOA_ANY*

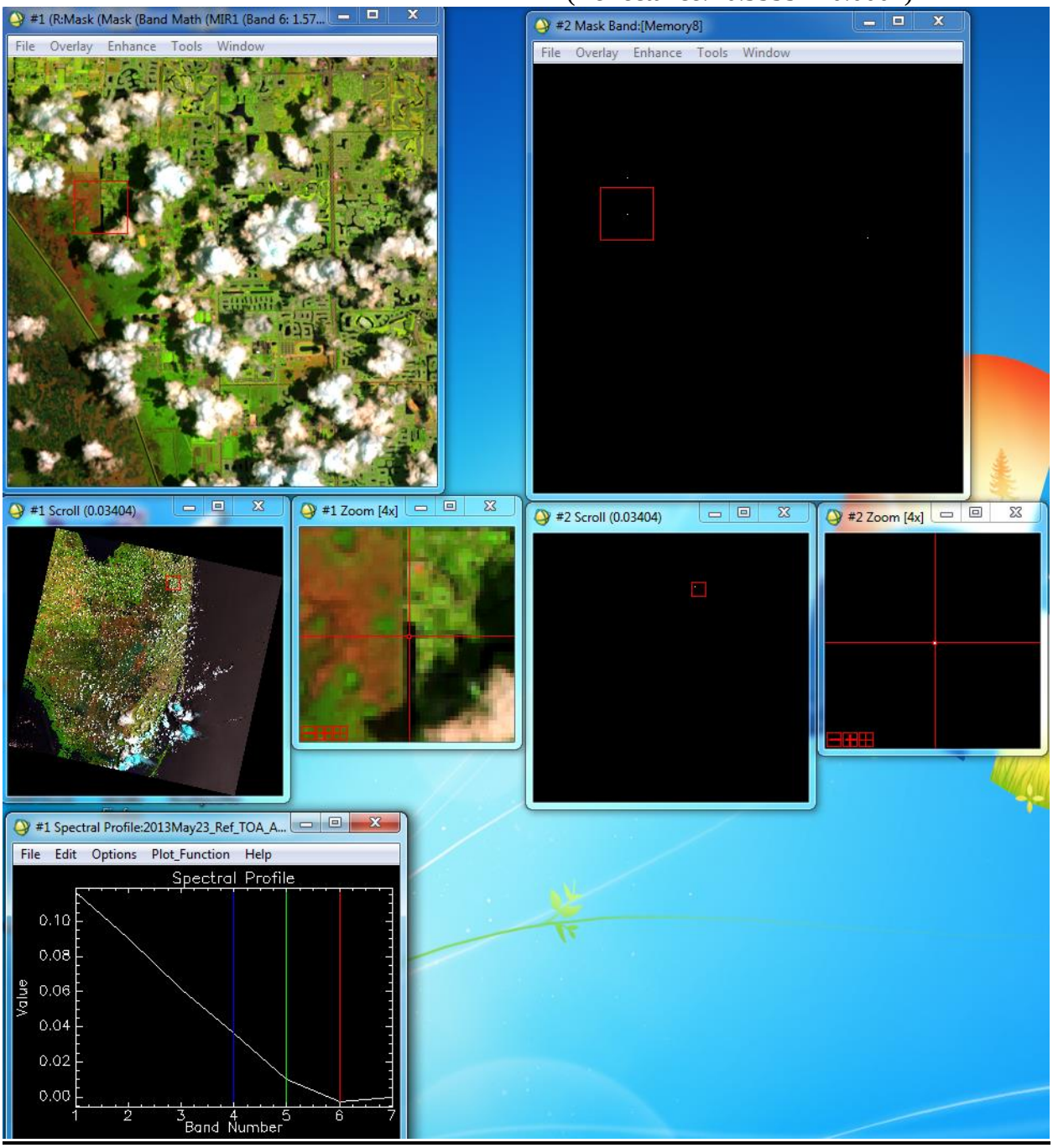
	Reflectance	**DN**	**# of Pixels**
Band 1	N/A	N/A	N/A
Band 2	N/A	N/A	N/A
Band 3	N/A	N/A	N/A
Band 4	N/A	N/A	N/A
Band 5	-0.013322	4376	4
	-0.008202	4616	9
	-0.003081	4856	26
Band 6	-0.015051	4295	3
	-0.009992	4532	15
	-0.004932	4769	55

Band 7	-0.007814	4634	8
	-0.003012	4859	684

In the Florida scene, most of the negative reflectivity pixels were located in the water channels.

Left: 654 – RGB

Right: Mask for negative reflectivity pixels (Reflectance: -0.9999 - -0.0001)



Cirrus Band

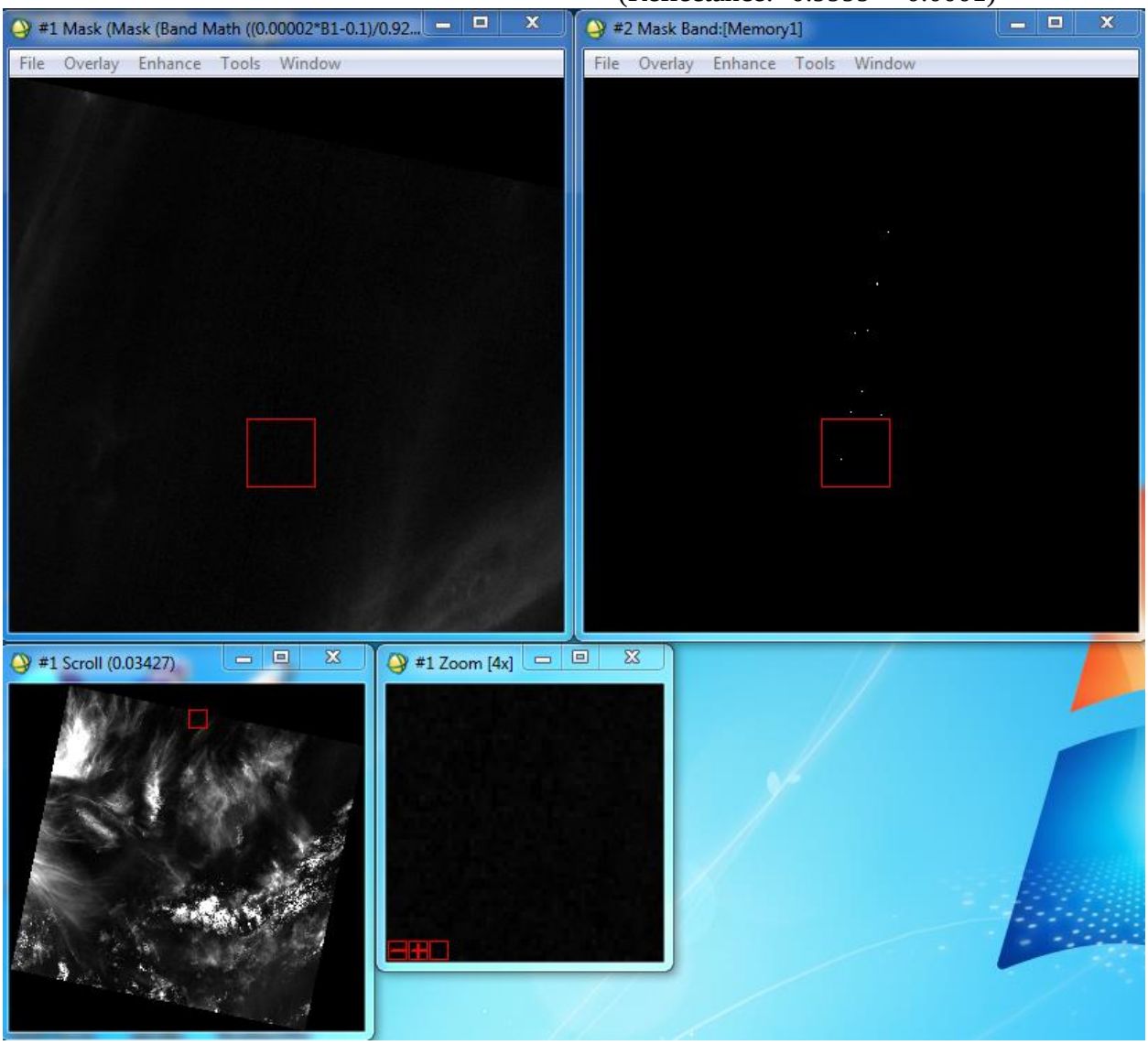
- *Dominica: 2013May05_Cirrus_Negative_ANY*

	Reflectance	DN	# of Pixels
Band 9	-0.000195	4990	243

The majority of the negative pixels (of reflectance from -0.9999 to -0.0001) were found in continuously large areas of low reflectivity.

Left: 2013May05_Cirrus_Negative_ANY

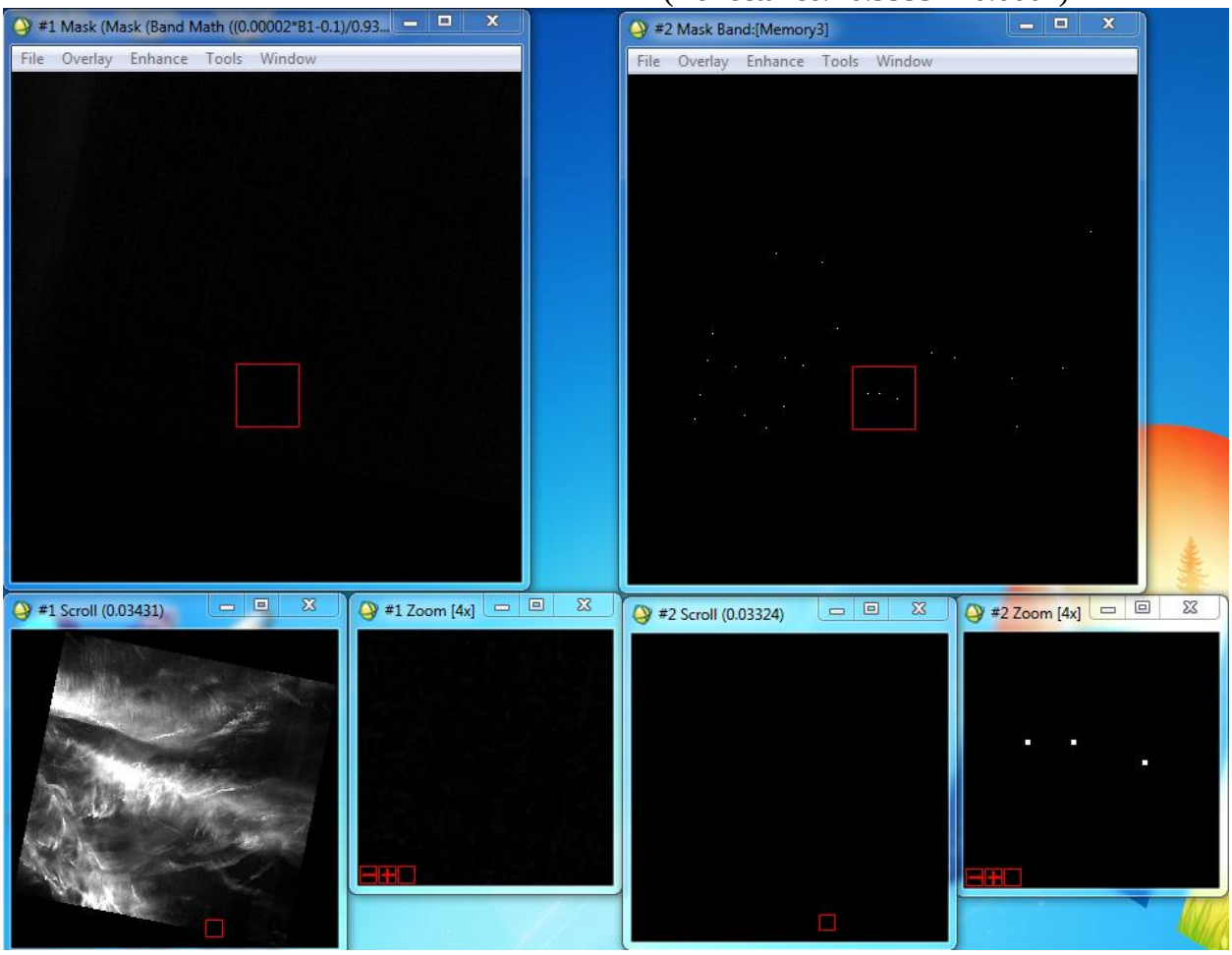
Right: Mask for negative reflectivity pixels (Reflectance: -0.9999 - -0.0001)



❖ *Mississippi: 2013May24_Cirrus_Negative_ANY*

	Reflectance	DN	# of Pixels
Band 9	-0.000685	4968	1
	-0.000451	4979	2
	-0.000217	4990	169

Left: 2013May24_Cirrus_Negative_ANY Right: Mask for negative reflectivity pixels (Reflectance: -0.9999 - -0.0001)

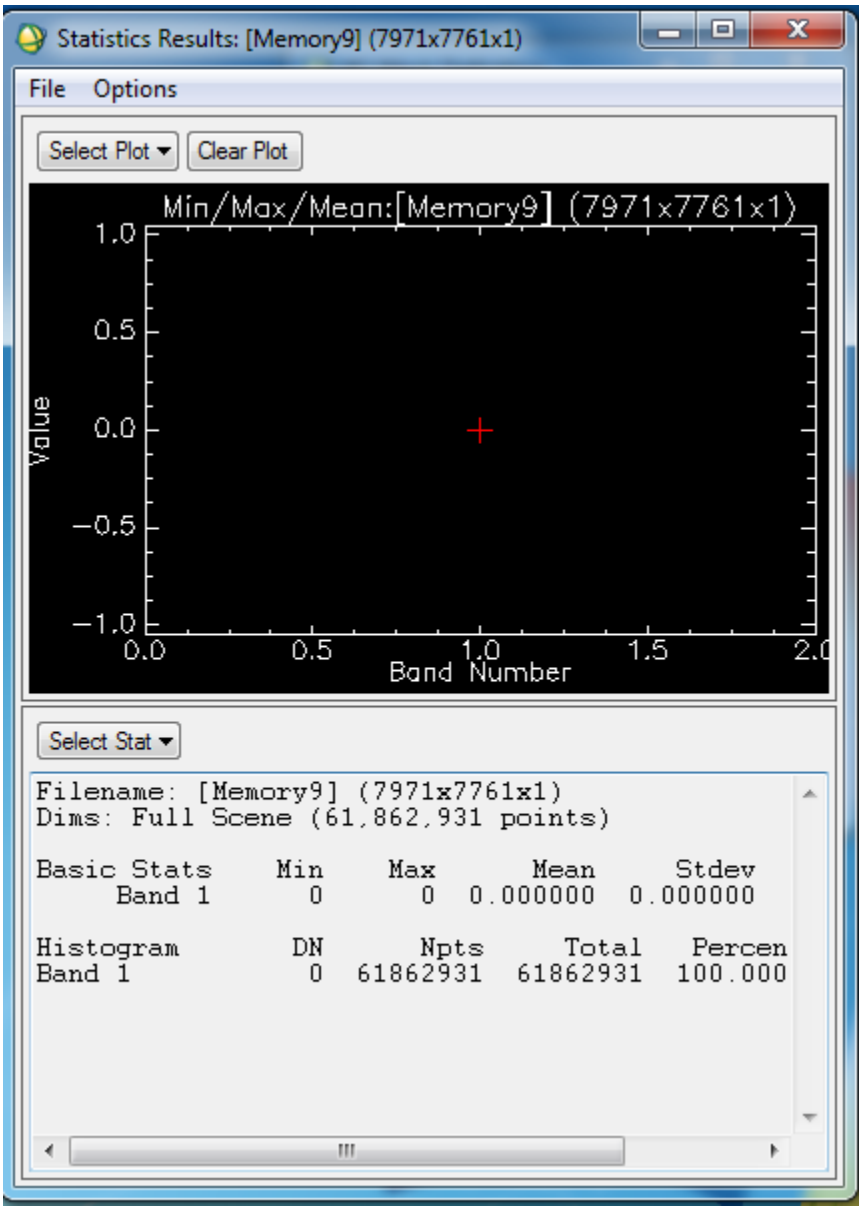


❖ *Alaska: 2013April22_Cirrus_Negative_ANY*

	Reflectance	DN	# of Pixels
Band 9	-0.000063	4998	4,193,774

Since I have defined negative reflectivity range as -0.9999 to -0.0001, none of the pixels in the Alaska Cirrus band appeared in the mask, since all of them are greater than the reflectance value of -0.0001 (See the Statistics Output for the mask below). The large number of pixels is not

alarming since the reflectance value is so close to zero in a scene where there does not seem to be any trace of cirrus clouds. Therefore, in this case, the negative reflectivity is most probably due to a tiny sensor error or an unfortunate byproduct of a number scaling process.



- *Florida: 2013May23_Cirrus_Negative_ANY*

	Reflectance	DN	# of Pixels
Band 9	-0.000961	4955	3,2185,801

In Florida, the negative reflectivity pixels are in the bodies of water, mainly in the ocean. Curiously, many of these pixels are not contained to large areas of low reflectivity due to

features such as water channels and small cloud shadows. Sometimes, these pixels are immediately adjacent to cloud pixels, perhaps in the cloud shadows. See below for an example.

Left: Florida Cirrus Band Middle: Mask for negative reflectivity pixels Right: 654 – RGB (Reflectance: -0.9999 - -0.0001)