## Landsat 8: Cirrus Band

**Purpose:** The new cirrus band (Band 9: 1.36-1.39  $\mu$ m) allows for better detection of cirrus cloud contamination. The old Landsat sensors included bands that made it hard to detect these high-altitude, cold, and wispy clouds. This new cirrus band with center wavelength of 1.375 microns attempts to detect the light, which is reflected by the high-altitude clouds but is absorbed by the water vapor closer to the ground.<sup>1</sup>

In this band, cirrus clouds will appear bright while most land surfaces will appear dark through the atmospheres that contain water vapor. If the atmosphere is relatively dry, the one risks having some of the land surfaces appear bright as well.<sup>2</sup>

This was the case for the Alaska scene with little water vapor, and its high-altitude terrain also helped the land surfaces appear bright. High altitude clouds such as the tops of thunderstorms will appear bright too. Using the cirrus band requires careful interpretation to recognize cirrus clouds.

This band is not to be used together with other multispectral bands; its sole purpose is to screen for any cloud contamination from the difficult-to-detect cirrus clouds.

Examination of various scenes with their corresponding cirrus bands show possible errors that may arise from cirrus cloud contamination:

#### LAND:

<u>NDVI</u> - The relationship is negative. For every change of +0.010 reflectance in cirrus, the NDVI **decreases** by  $\sim 0.06$ .

<u>Albedo</u> – The relationship is positive. For every change of +0.010 reflectance in cirrus, the albedo **increases** by  $\sim 0.01$ .

<u>Temperature</u> – The relationship is negatively linear. For every change of +0.01 reflectance in cirrus, the temperature **decreases** by ~**5** degrees.

#### WATER:

<u>NDVI</u> - Contrary to the transects over land, the relationship is positive. For every change of +0.010 reflectance in cirrus, the NDVI **increases** by  $\sim 0.05$ .

<u>Albedo</u> – The relationship for albedo is still positive. For every change of +0.010 reflectance in cirrus, the albedo **increases** by  $\sim 0.01$ .

<u>Temperature</u> - The relationship is negative but not as linear. For every change of +0.01 reflectance in cirrus, the temperature **decreases** by ~5 degrees.

<sup>&</sup>lt;sup>1</sup> <u>http://earthobservatory.nasa.gov/IOTD/view.php?id=81210</u>

<sup>&</sup>lt;sup>2</sup> http://landsat.usgs.gov/L8 band 9.php

> The summary tables of the trend lines over land and water are presented below.

The more heterogeneous the land cover, the smaller the R<sup>2</sup> value.

The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data. This removal of outliers was done for relatively homogeneous land cover.

## LAND

Summary Table: Trend Lines – Over Land				
	NDVI	Albedo	Temperature	
MississippiTrans1*	y = -6.0944x + 0.7165	y = 0.8581x + 0.1205	y = -484.07x + 298.66	
	$R^2 = 0.3565$	$R^2 = 0.1362$	$R^2 = 0.9173$	
FloridaTrans1	y = -4.6488x + 0.4695	y = 0.489x + 0.1154	y = -269.73x + 299.7	
	$R^2 = 0.0268$	$R^2 = 0.0024$	$R^2 = 0.2142$	
DominicaTrans1	y = -5.3382x + 0.5934	y = 0.9906x + 0.1507	y = -423.92x + 298.99	
	$R^2 = 0.2516$	$R^2 = 0.1822$	$R^2 = 0.9559$	
AlaskaTrans1	y = -1.9361x + 0.1638	y = 0.3572x + 0.2777	y = -289.33x + 281.81	
	$R^2 = 0.0208$	$R^2 = 0.0009$	$R^2 = 0.4315$	
AlaskaTrans11	y = -0.928x + 0.0355	y = 11.693x + 0.3666	y = -429.37x + 276.62	
	$R^2 = 0.0018$	$R^2 = 0.0597$	$R^2 = 0.1284$	

#### a Table. T лт:

#### WATER

#### Summary Table<sup>.</sup> Trend Lines – Over Water

Summary Table. Trend Lines – Over Water				
	NDVI	Albedo	Temperature	
MississippiTrans2*	y = -4.1199x - 0.0199	y = 0.2303x + 0.1368	y = -467.28x + 297.42	
	$R^2 = 0.103$	$R^2 = 0.0047$	$R^2 = 0.8217$	
FloridaTrans2*	y = 8.848x - 0.2177	y = 1.5789x + 0.0822	y = -464.02x + 298.75	
	$R^2 = 0.7876$	$R^2 = 0.8093$	$R^2 = 0.8652$	
DominicaTrans2*	y = 2.1189x - 0.1356	y = 1.1768x + 0.066	y = -405.38x + 295.12	
	$R^2 = 0.8819$	$R^2 = 0.9706$	$R^2 = 0.9425$	
DominicaTrans22*	y = 2.1653x - 0.1279	y = 1.2269x + 0.0691	y = -453.31x + 295.53	
	$R^2 = 0.4229$	$R^2 = 0.6582$	$R^2 = 0.9769$	
AlaskaTrans2	y = -0.6839x - 0.0231	y = 2.0224x + 0.4803	y = -174.82x + 273.81	
	$R^2 = 0.0108$	$R^2 = 0.012$	$R^2 = 0.5097$	

Notes: 1. The AlaskaTrans2 is across an icy river while all other transects are over liquid water. 2. Both MississippiTrans2 and AlaskaTrans2 were not homogeneous in their land cover. The MississippiTrans2 included scattered land patches while the AlaskaTrans2 included melting ice patches.

- The summary tables of the findings for each scene are listed below according to two categories:
- 1. Transect over Land 2. Transect over Water.

I looked at one transect over both land and water in each of the three scenes.<sup>3</sup> The only exceptions are where I looked at two transects instead of one for Dominica over Water and Alaska over Land.

## LAND

#### Summary Table: Mississippi Transect over Land (MississippiTrans1)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.020	0.003	0.029
NDVI	-0.200	0.194	0.760
Albedo	0.030	0.090	0.430
Temperature (Degrees)	-10.0	283	300

#### Summary Table: Florida Transect over Land (FloridaTrans1)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.001	0.023
NDVI	-0.070	0.116	0.754
Albedo	0.025	0.068	0.462
Temperature (Degrees)	-5.0	289	303

<sup>&</sup>lt;sup>3</sup> The three scenes are Mississippi, Florida, and Dominica. The usual Alaska scene was left out since the cloud cover was only 4.54% and the bright terrain made it hard to detect cirrus clouds. Instead, an alternate Alaska scene was analyzed.

## **Summary Table: Dominica Transect over Land (DominicaTrans1)**

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.030	0.002	0.042
NDVI	-0.250	0.278	0.771
Albedo	0.150	0.112	0.269
Temperature (Degrees)	-15.0	281	299

## Summary Table: Alaska Transect over Land (AlaskaTrans1)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.025	0.003	0.0385
NDVI	-0.175	-0.066	0.385
Albedo	0.150	0.132	0.598
Temperature (Degrees)	-12.0	270	287

# Summary Table: Alaska Transect over Land (AlaskaTrans11)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.002	0.011
NDVI	0.000	-0.046	0.267
Albedo	0.050	0.186	0.678
Temperature (Degrees)	-2.0	269	288

## WATER

## Summary Table: Mississippi Transect over Water (MississippiTrans2)

	Average Difference across Cirrus Cloud Boundaries	Minimum	Maximum
Reflectance for	(Cirrus-NonCirrus) 0.005	0.001	0.012
Cirrus Band NDVI	0.000	-0.225	0.450
Albedo Temperature (Degrees)	0.000 -3.0	0.078 293	0.152 301

## Summary Table: Florida Transect over Water (FloridaTrans2)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.001	0.016
NDVI	0.100	-0.262	-0.021
Albedo	0.015	0.078	0.129
Temperature (Degrees)	-5.0	292	299

## Summary Table: Dominica Transect over Water (DominicaTrans2)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.050	0.002	0.058
NDVI	0.100	-0.164	0.035
Albedo	0.050	0.065	0.260
Temperature (Degrees)	-17.0	272	295

## Summary Table: Dominica Transect over Water (DominicaTrans22)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.030	0.001	0.035
NDVI	0.050	-0.165	0.022
Albedo	0.035	0.065	0.213
Temperature (Degrees)	-15.0	280	295

## Summary Table: Alaska Transect over Water (AlaskaTrans2)

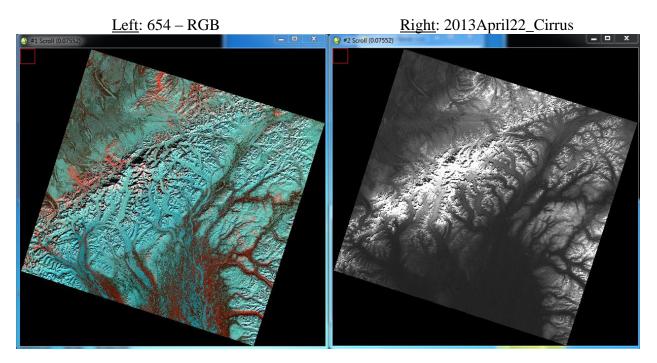
	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.020	0.003	0.003
NDVI	0.010	-0.075	0.137
Albedo	0.025	0.194	0.9639
Temperature (Degrees)	-5.0	267	275

On the following pages are the side-by-side comparisons of the false color (654-RGB) and their corresponding cirrus band images.

## ✤ Alaska: 2013April22\_Cirrus

In the Alaska scene, there are no apparent cirrus clouds. With low water vapor in the atmosphere and high altitude terrain, the background pops out in the cirrus band image.

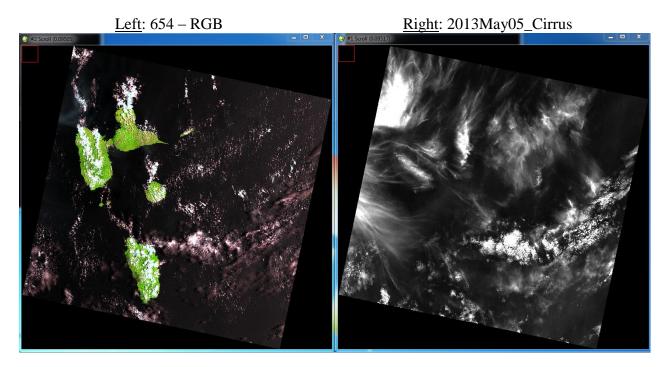
#### PWAT = 5.57



## ✤ Dominica: 2013May05\_Cirrus

In the Dominica scene, there are a lot of cirrus clouds across the entire image. But, in addition to these cirrus clouds, several big cumulous clouds also show up. These are cumulonimbus clouds that are at high altitude, and thus are showing up in the cirrus band image.

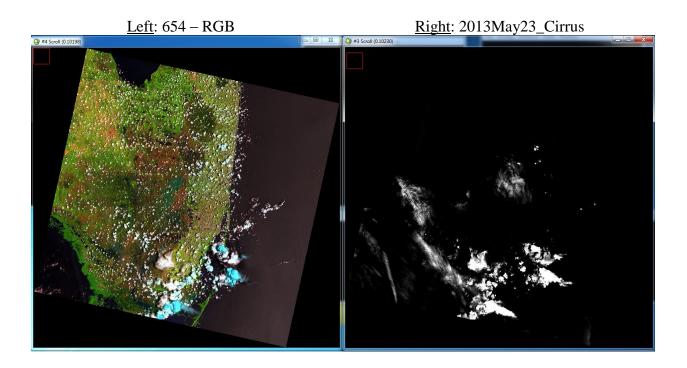
PWAT = 53.29



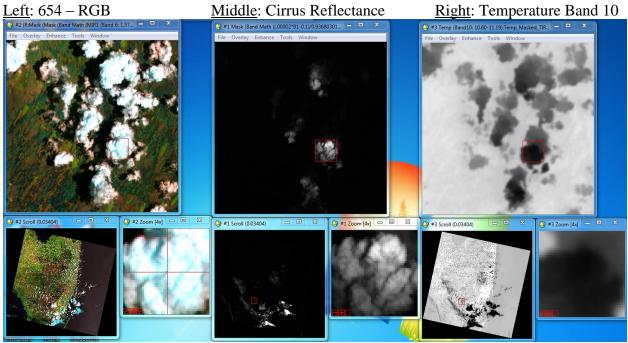
✤ Florida: 2013May23\_Cirrus

The Florida scene does not have as much clouds as the Dominica scene. Regardless, it also exhibits both cirrus and cumulonimbus clouds in its cirrus band image. It is important to note that warm clouds at lower altitudes are not showing up in the cirrus band. Another important observation is small cumulous clouds with occasional cyan pixels do show up well in the cirrus cloud image.

PWAT = 36.25



## Shadows or Large Droplets?

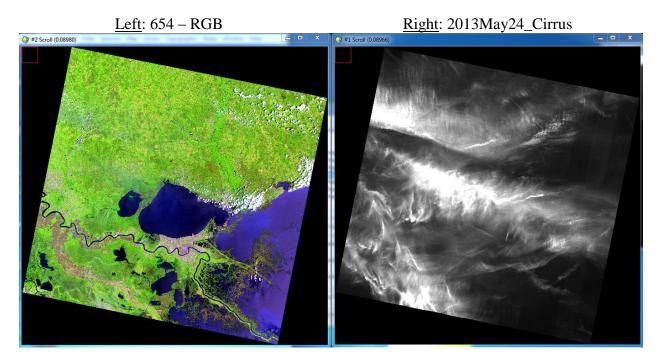


The cyan pixels do not show up as well in the cirrus band image. But, are they not showing up as well because they are in the shadow or because they are larger droplets?

## ✤ Mississippi: 2013May24\_Cirrus

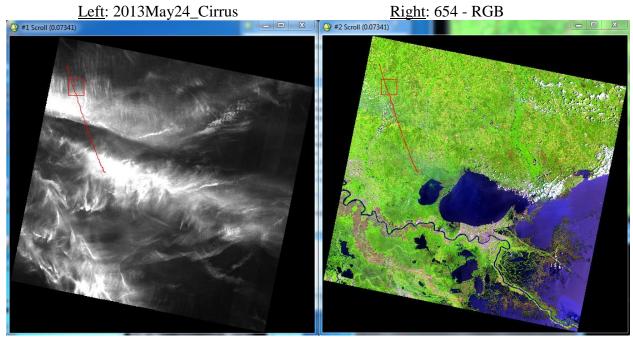
In the Mississippi scene, there are broad swaths of cirrus clouds that were not at all detected in other bands. Note that the cumulous clouds in the northeastern portion of the RGB image are nowhere to be seen in the cirrus band image.

PWAT = 40.18



## **Transects**

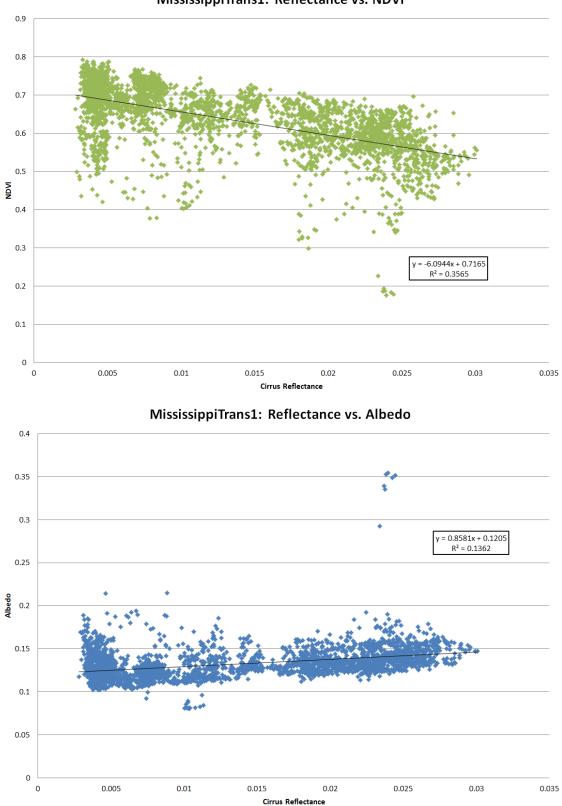
MississippiTransect1: Transect over Land



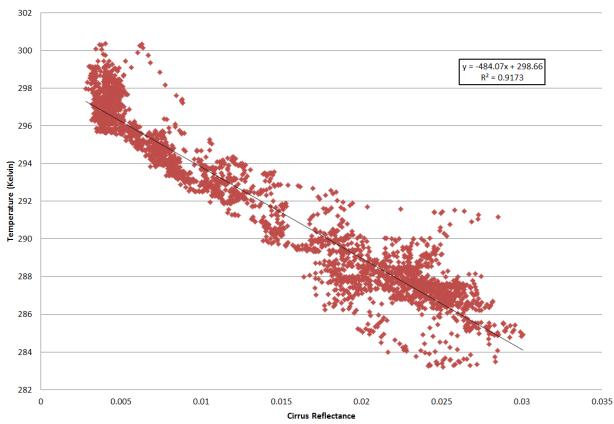
Note: The red line indicates the transect line used for analysis.

	NDVI	Albedo	Temperature
MississippiTrans1*	y = -6.0944x + 0.7165	y = 0.8581x + 0.1205	y = -484.07x + 298.66
	$R^2 = 0.3565$	$R^2 = 0.1362$	$R^2 = 0.9173$

<u>Note</u>: The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data.



MississippiTrans1: Reflectance vs. NDVI

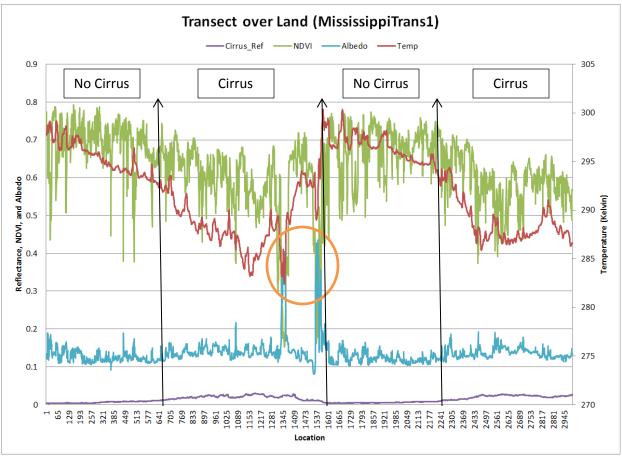


#### MississippiTrans1: Reflectance vs. Temperature

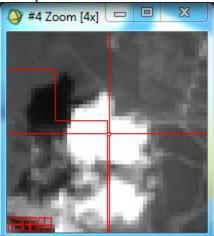
Summary Table: Mississippi Transect over Land (MississippiTrans1)

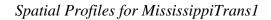
	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.020	0.003	0.029
NDVI	-0.200	0.194	0.760
Albedo	0.030	0.090	0.430
Temperature (Degrees)	-10.0	283	300

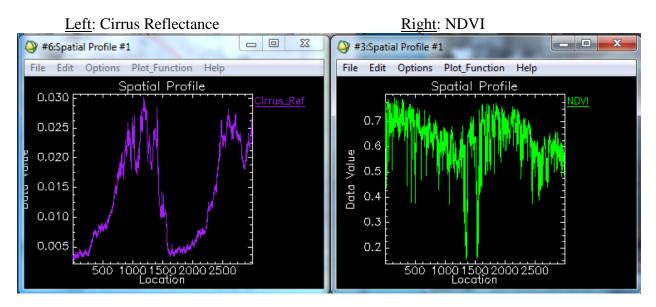
<u>Note</u>: For average difference, note that the positive values indicate higher values in the cirrus cloud regions than in the areas with no cirrus clouds. Negative values, lower values in the cirrus cloud regions.



<u>Note</u>: The orange circle indicates two sharp peaks in the indicators such as NDVI that correspond to two stray cumulous clouds that are along the transect line. See below for an example.

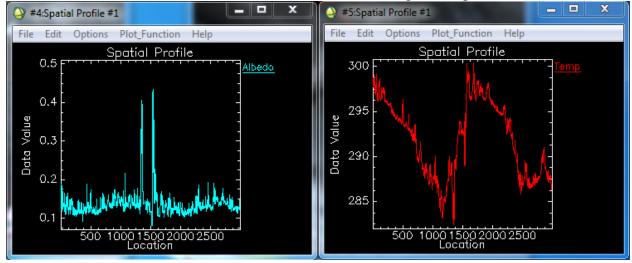




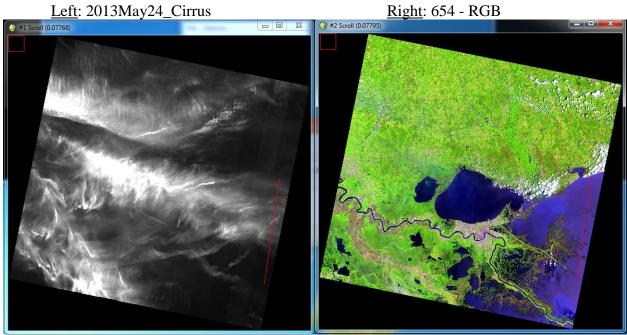


## Left: Albedo

#### **<u>Right</u>**: Temperature



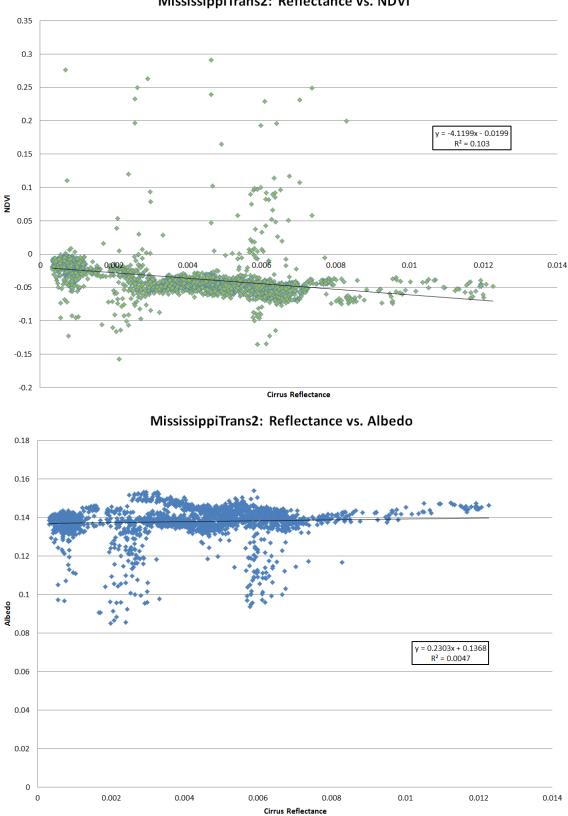
MississippiTransect2: Transect over Water



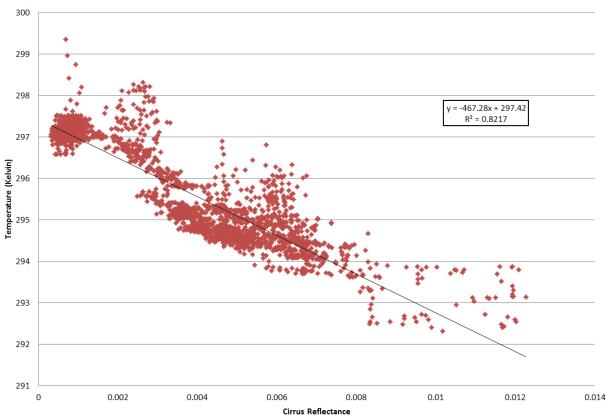
Note: The red line indicates the transect line used for analysis.

I rend Lines: Mississippi I ransect over water (Mississippi I rans2)				
NDVI Albedo Temperature				
MississippiTrans2*	y = -4.1199x - 0.0199	y = 0.2303x + 0.1368	y = -467.28x + 297.42	
	$R^2 = 0.103$	$R^2 = 0.0047$	$R^2 = 0.8217$	

<u>Note</u>: The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data.



MississippiTrans2: Reflectance vs. NDVI

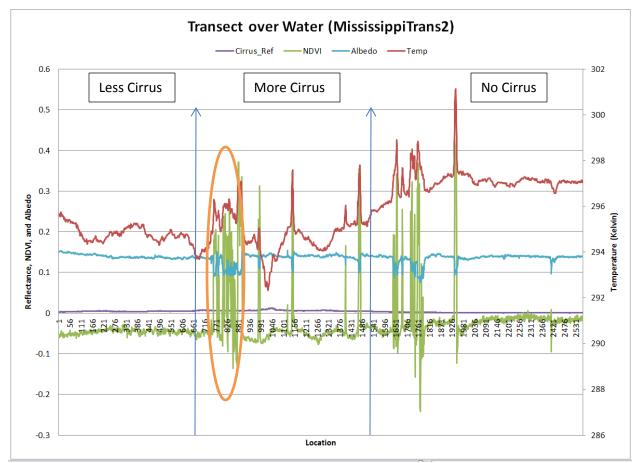


## MississippiTrans2: Reflectance vs. Temperature

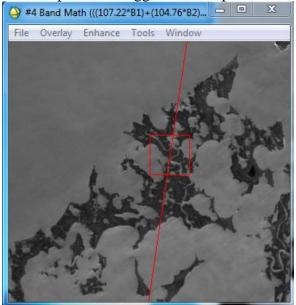
#### Summary Table: Mississippi Transect over Water (MississippiTrans2)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.006	0.001	0.012
NDVI	0.000	-0.225	0.450
Albedo	0.000	0.078	0.152
Temperature (Degrees)	-3.0	293	301

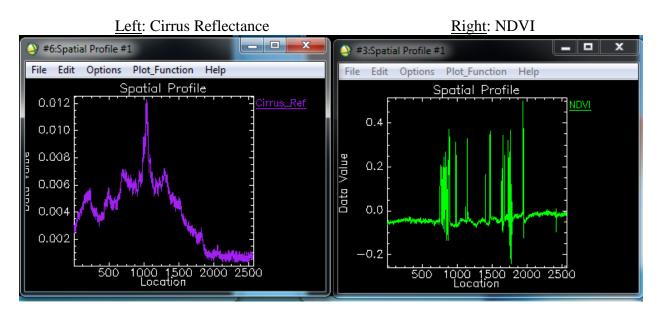
<u>Note</u>: For average difference, note that the positive values indicate higher values in the cirrus cloud regions than in the areas with no cirrus clouds. Negative values, lower values in the cirrus cloud regions.



<u>Note</u>: Any disruption in NDVI is due to land patches in the water (Ex. Islands, etc.). The bigger the disruption, the bigger the land patches. See below for an example.

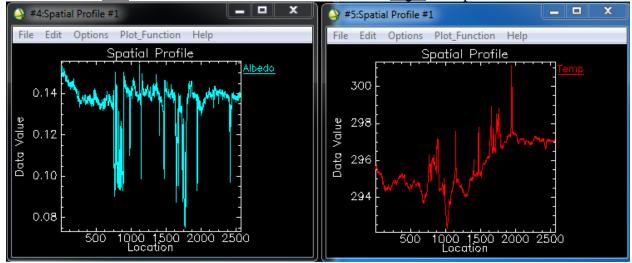


## Spatial Profiles for MississippiTrans2

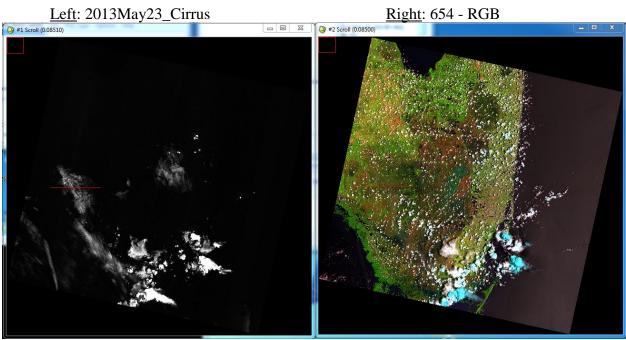


## Left: Albedo

#### **<u>Right</u>**: Temperature



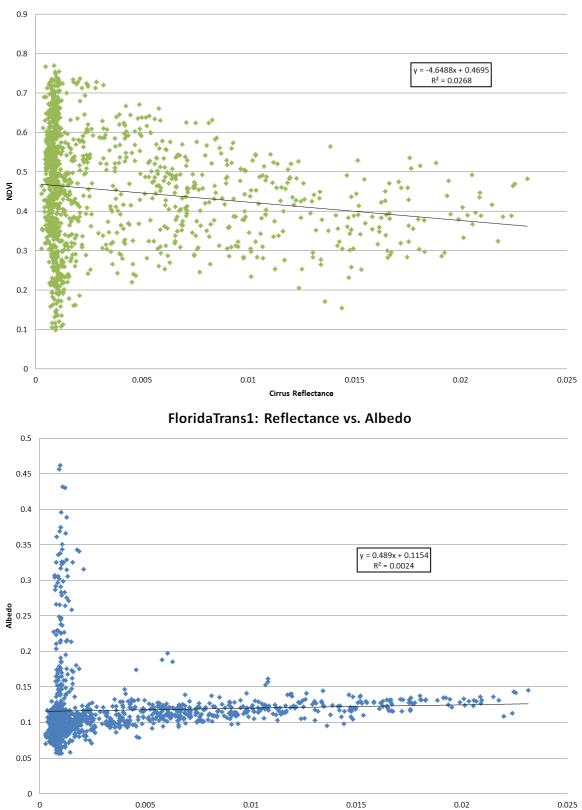
FloridaTransect1: Transect over Land



Note: The red line indicates the transect line used for analysis.

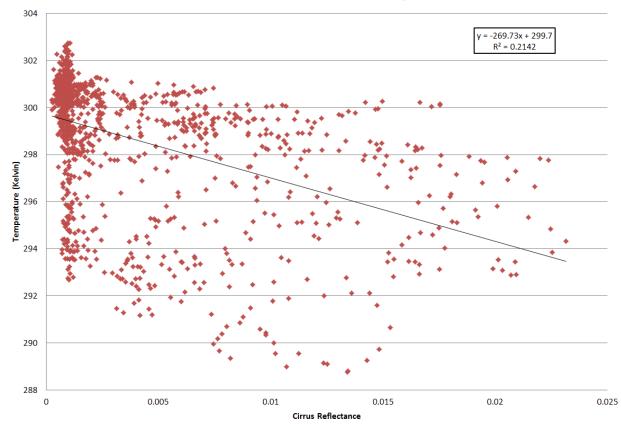
Trend Lines: Florida Transect over Land (Florida Transf)					
	NDVI Albedo Temperature				
FloridaTrans1	y = -4.6488x + 0.4695	y = 0.489x + 0.1154	y = -269.73x + 299.7		
	$R^2 = 0.0268$	$R^2 = 0.0024$	$R^2 = 0.2142$		

## Trend Lines: Florida Transect over Land (FloridaTrans1)



**Cirrus Reflectance** 

FloridaTrans1: Reflectance vs. NDVI

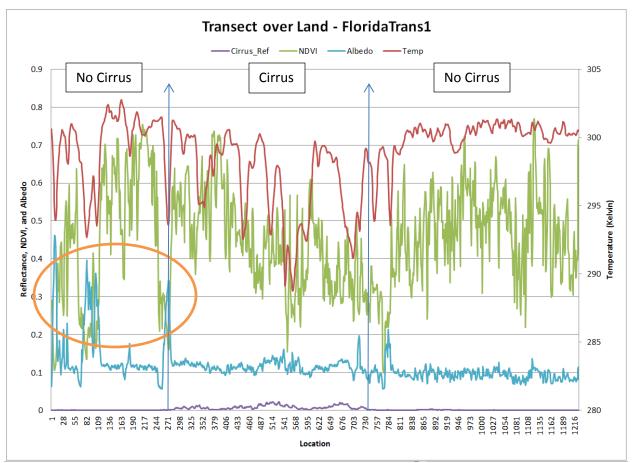


## FloridaTrans1: Reflectance vs. Temperature

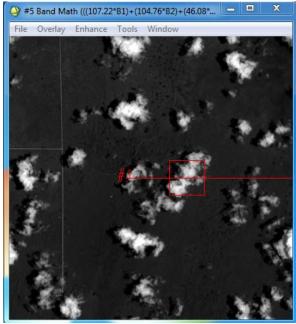
Summary Table: Florida Transect over Land (FloridaTrans1)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.001	0.023
NDVI	-0.070	0.116	0.754
Albedo	0.025	0.068	0.462
Temperature (Degrees)	-5.0	289	303

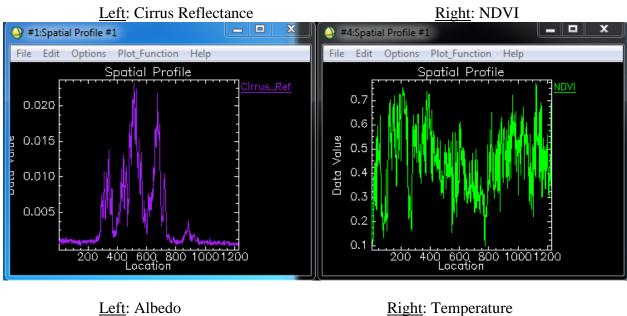
<u>Note</u>: For average difference, note that the positive values indicate higher values in the cirrus cloud regions than in the areas with no cirrus clouds. Negative values, lower values in the cirrus cloud regions.

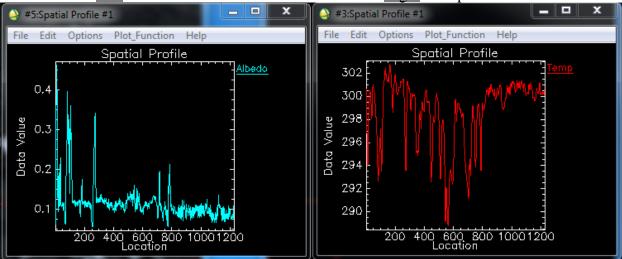


<u>Note</u>: Florida terrain is strewn with small cumulous clouds. Any disruption – notably in albedo – is due to these warm clouds. See below for an example.

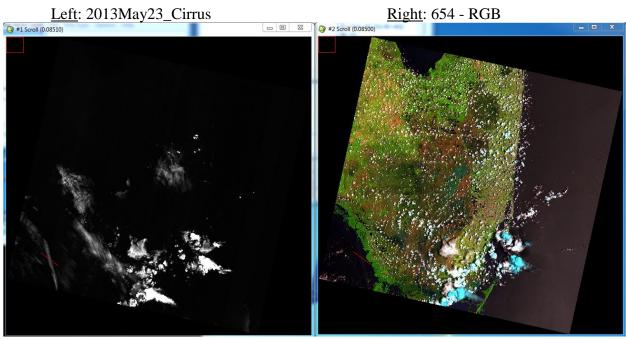


## Spatial Profiles for FloridaTrans1





FloridaTransect2: Transect over Water

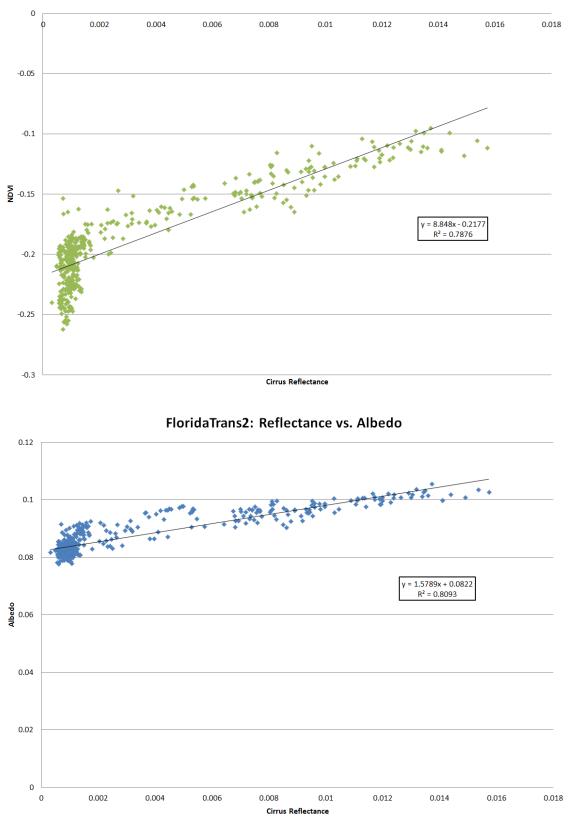


Note: The red line indicates the transect line used for analysis.

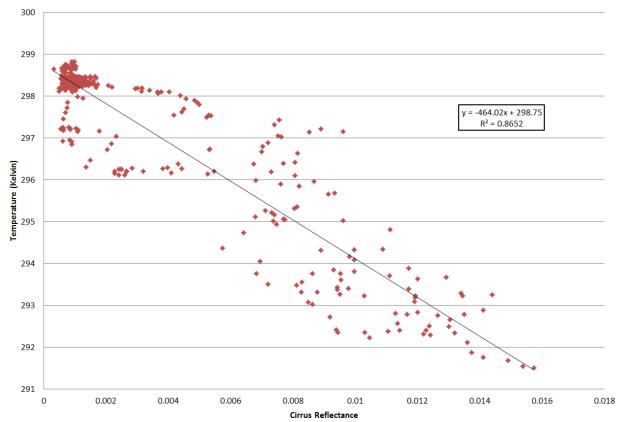
Trend Lines: Florida	<b>Fransect</b> over Water	· (FloridaTrans2)

	NDVI	Albedo	Temperature
FloridaTrans2*	y = 8.848x - 0.2177	y = 1.5789x + 0.0822	y = -464.02x + 298.75
	$R^2 = 0.7876$	$R^2 = 0.8093$	$R^2 = 0.8652$

<u>Note</u>: The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data.



#### FloridaTrans2: Reflectance vs. NDVI

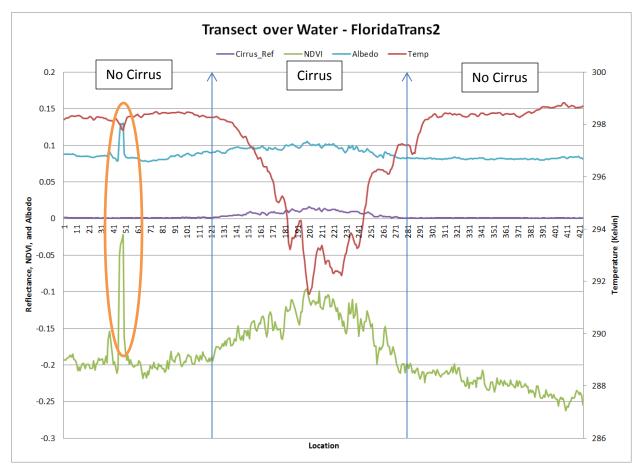


## FloridaTrans2: Reflectance vs. Temperature

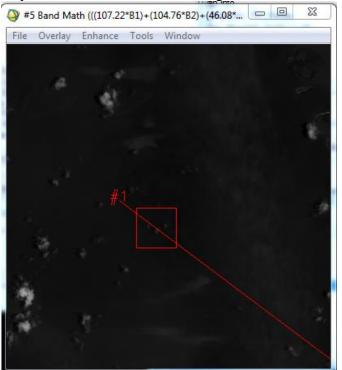
Summary Table: Florida Transect over Water (FloridaTrans2)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.001	0.016
NDVI	0.100	-0.262	-0.021
Albedo	0.015	0.078	0.129
Temperature (Degrees)	-5.0	292	299

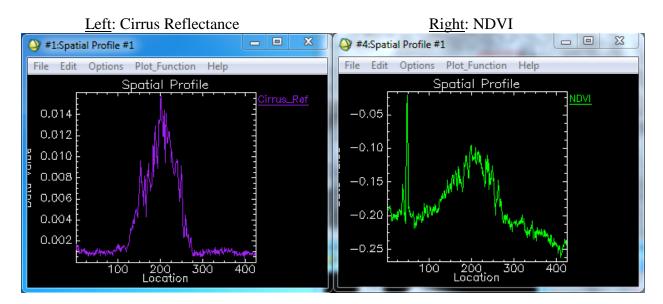
<u>Note</u>: For average difference, note that the positive values indicate higher values in the cirrus cloud regions than in the areas with no cirrus clouds. Negative values, lower values in the cirrus cloud regions.

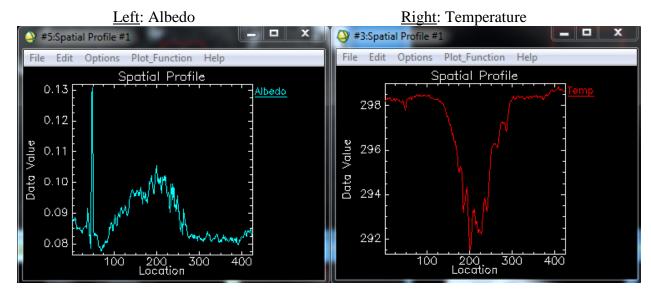


<u>Note</u>: The orange circle indicates one major disruption in this scene. This is due to some small stray cloud. See below for the image of the said cloud.

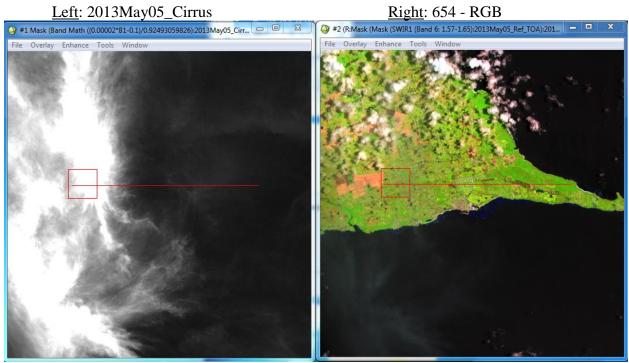


## Spatial Profiles for FloridaTrans1





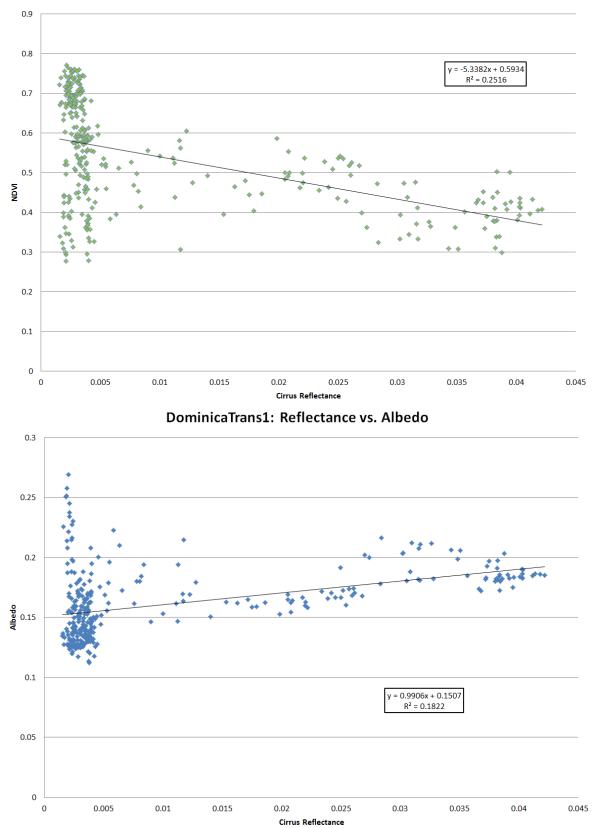
DominicaTransect1: Transect over Land



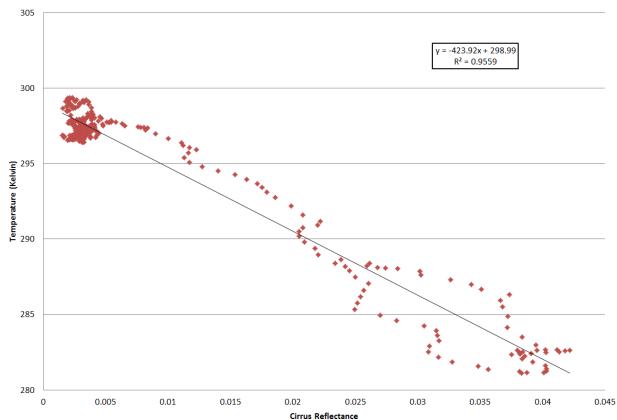
Note: The red line indicates the transect line used for analysis.

Trend Emes. Dominica Transect over Land (Dominica Transf)				
	NDVI Albedo Temperatur			
DominicaTrans1	y = -5.3382x + 0.5934	y = 0.9906x + 0.1507	y = -423.92x + 298.99	
	$R^2 = 0.2516$	$R^2 = 0.1822$	$R^2 = 0.9559$	

## Trend Lines: Dominica Transect over Land (DominicaTrans1)



#### DominicaTrans1: Reflectance vs. NDVI

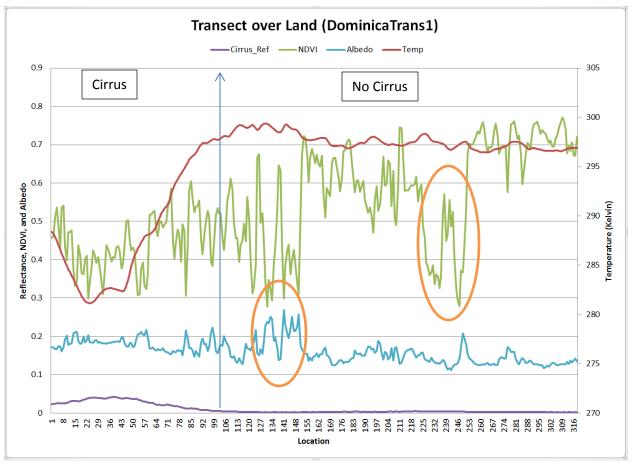


## Summary Table: Dominica Transect over Land (DominicaTrans1)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.030	0.002	0.042
NDVI	-0.250	0.278	0.771
Albedo	0.150	0.112	0.269
Temperature (Degrees)	-15.0	281	299

<u>Note</u>: For average difference, note that the positive values indicate higher values in the cirrus cloud regions than in the areas with no cirrus clouds. Negative values, lower values in the cirrus cloud regions.

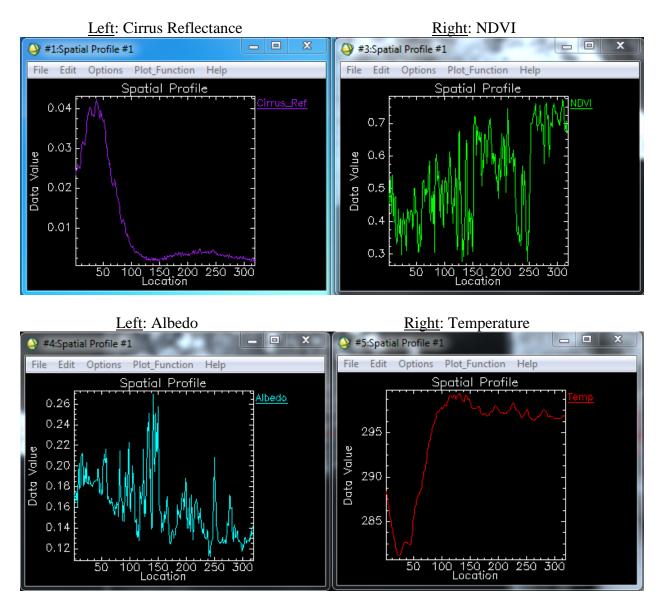
## DominicaTrans1: Reflectance vs. Temperature



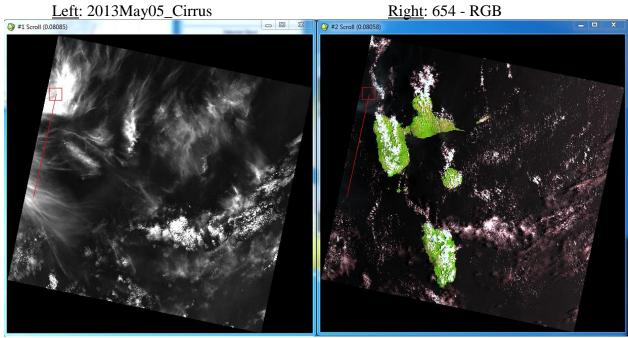
<u>Note</u>: While the previous transects over land consisted of mainly vegetation, this transect over land in Dominica consists of both vegetation and urban areas. The left orange circle indicates the spike in albedo due to crossing through urban areas (See left image below - Albedo). The right circle indicates the drop in NDVI as it passes through some bare soil on a ridge (See right image below – 654RGB).



## Spatial Profiles for FloridaTrans1



DominicaTransect2: Transect over Water

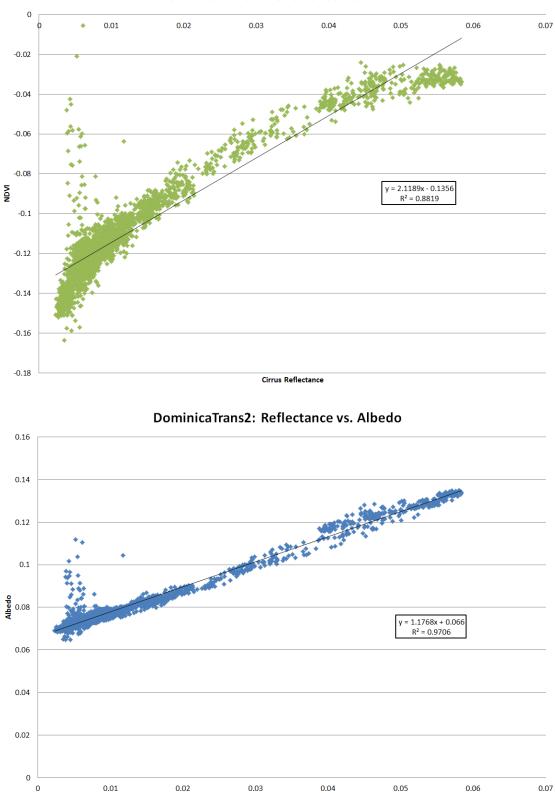


Note: The red line indicates the transect line used for analysis.

#### Trend Lines: Dominica Transect over Water (DominicaTrans2)

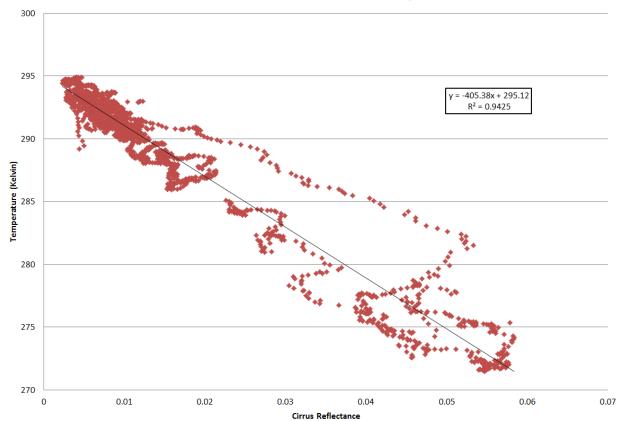
	NDVI	Albedo	Temperature
DominicaTrans2*	y = 2.1189x - 0.1356	y = 1.1768x + 0.066	y = -405.38x + 295.12
	$R^2 = 0.8819$	$R^2 = 0.9706$	$R^2 = 0.9425$

<u>Note</u>: The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data.



DominicaTrans2: Reflectance vs. NDVI

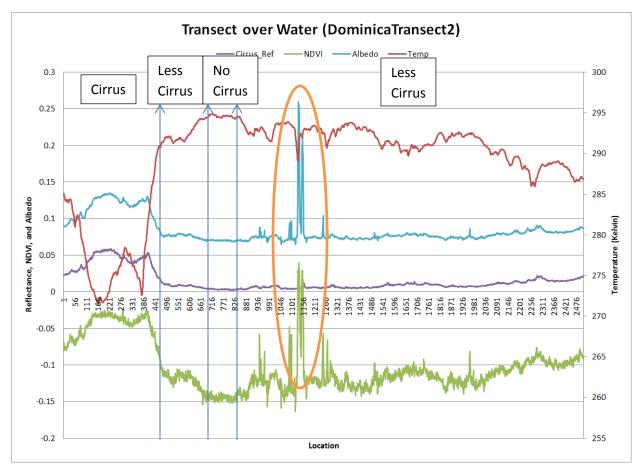
Cirrus Reflectance



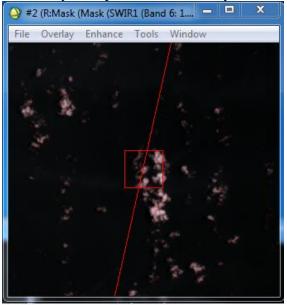
#### DominicaTrans2: Reflectance vs. Temperature

### Summary Table: Dominica Transect over Water (DominicaTrans2)

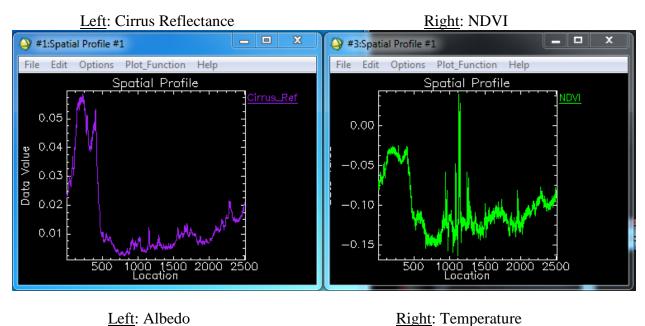
	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.050	0.002	0.058
NDVI	0.100	-0.164	0.035
Albedo	0.050	0.065	0.260
Temperature (Degrees)	-17.0	272	295

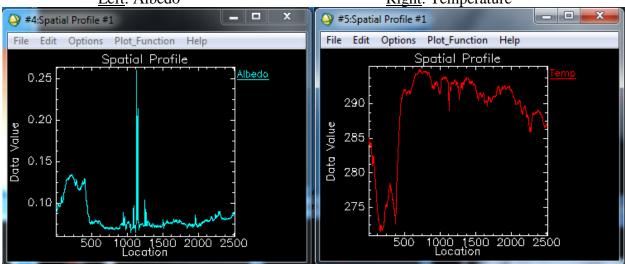


Note: Any disruption is due to stray cumulous clouds. See below for an example.

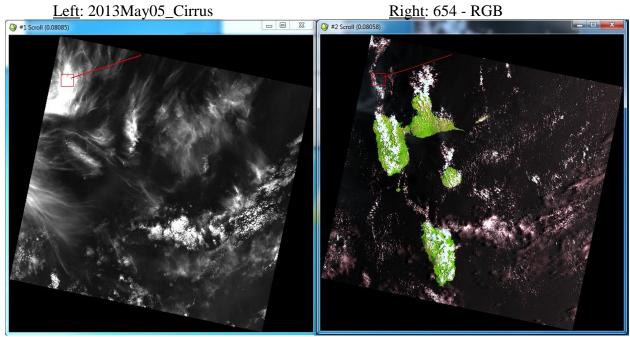


## Spatial Profiles for DominicaTrans2





DominicaTransect22: Transect over Water

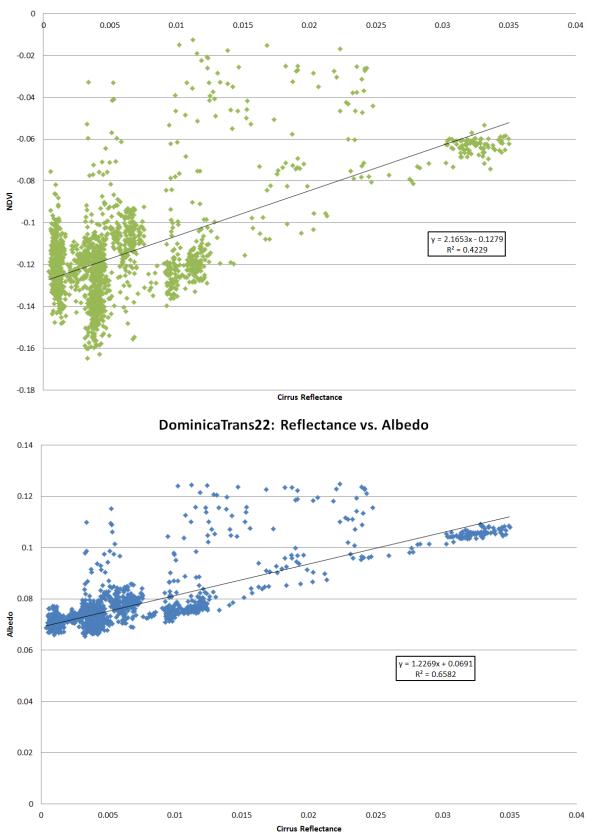


Note: The red line indicates the transect line used for the analysis.

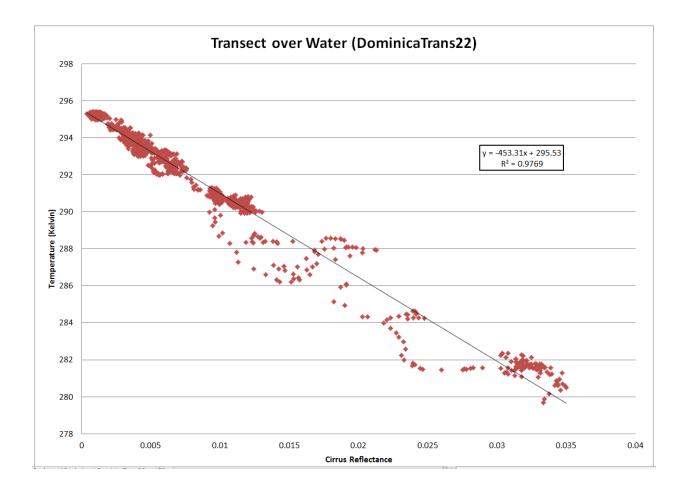
### Trend Lines: Dominica Transect over Water (DominicaTrans22)

	NDVI	Albedo	Temperature
DominicaTrans22*	y = 2.1653x - 0.1279	y = 1.2269x + 0.0691	y = -453.31x + 295.53
	$R^2 = 0.4229$	$R^2 = 0.6582$	$R^2 = 0.9769$

<u>Note</u>: The asterisk (\*) indicates that any obvious outliers due to isolated disturbances such as small cumulous clouds or land patches were removed from the data.

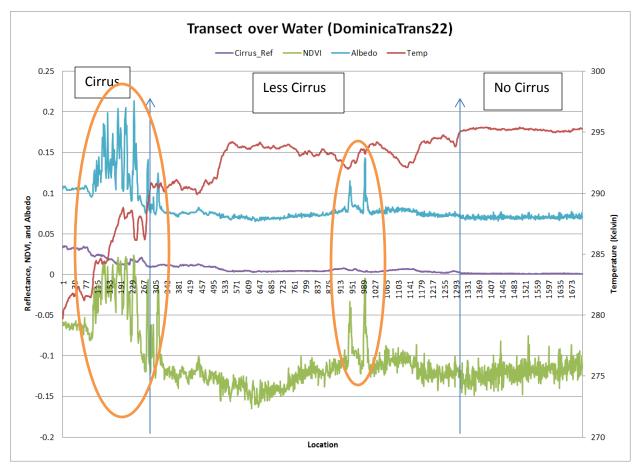


#### DominicaTrans22: Reflectance vs. NDVI

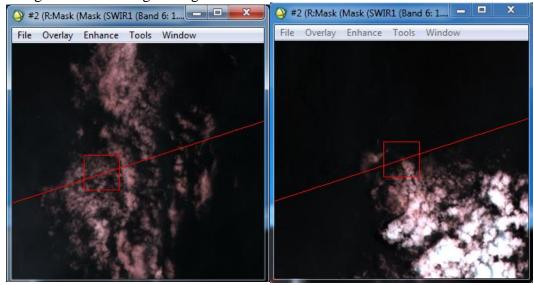


#### Summary Table: Dominica Transect over Water (DominicaTrans22)

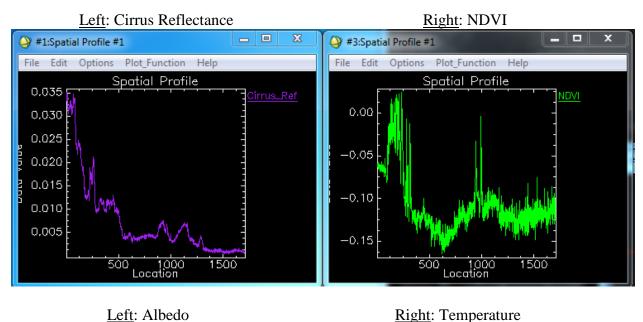
	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.030	0.001	0.035
NDVI	0.050	-0.165	0.022
Albedo	0.035	0.065	0.213
Temperature (Degrees)	-15.0	280	295

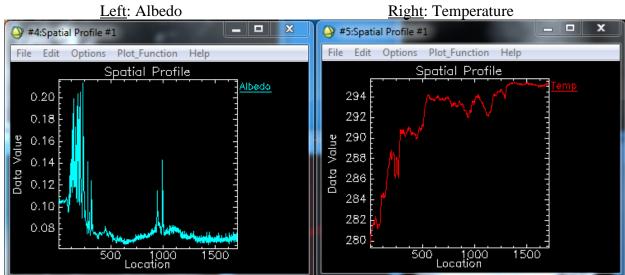


<u>Note</u>: The big spikes, notably in albedo and NDVI, are due to the overlapping cumulous clouds under the cirrus cloud. The left orange circle corresponds to the left image below; the right orange circle to the right image below.



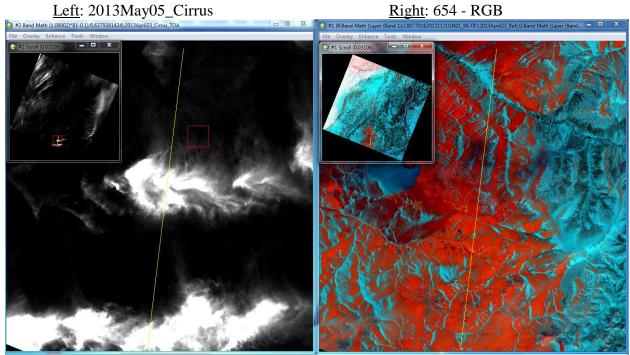
## Spatial Profiles for DominicaTrans22





Below are the analyses of few spatial subsets of the alternate Alaska scene. These yielded weak correlations compared to the previous analyses, mainly due to heterogeneous land cover.

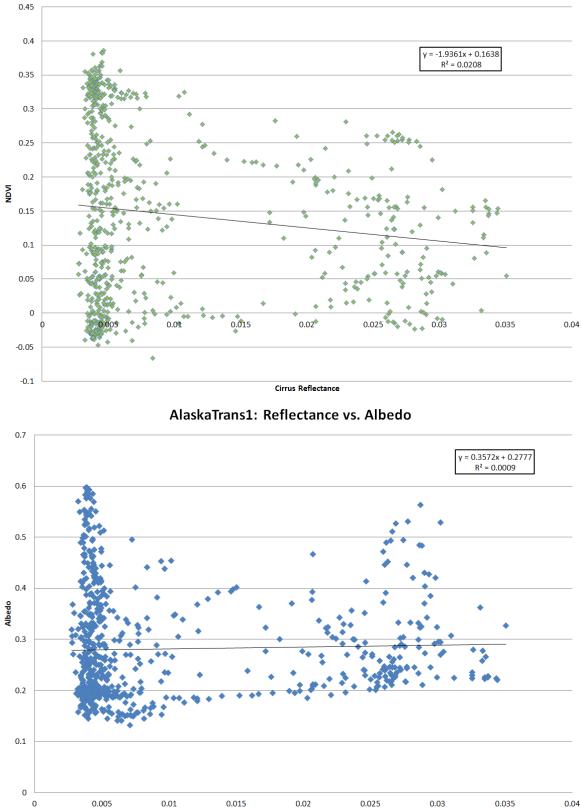
✤ AlaskaTransect1: Transect over Land (Bare Soil)



Notes: 1. The yellow line indicates the transect line used for analysis. 2. The small boxes in the left upper corners are the Scroll Windows.

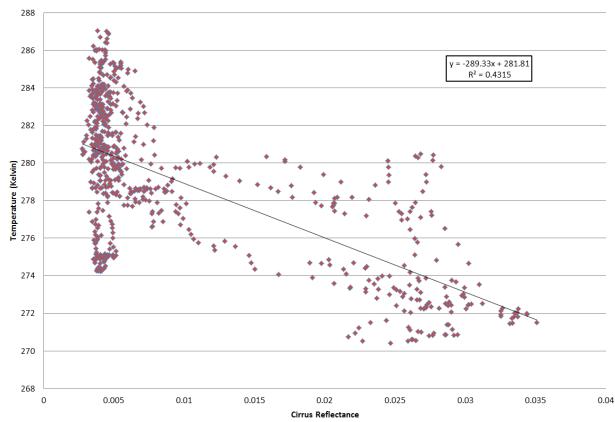
#### Trend Lines: Alaska Transect over Land (AlaskaTrans1)

	NDVI	Albedo	Temperature
AlaskaTrans1	y = -1.9361x + 0.1638	y = 0.3572x + 0.2777	y = -289.33x + 281.81
	$R^2 = 0.0208$	$R^2 = 0.0009$	$R^2 = 0.4315$



#### AlaskaTrans1: Reflectance vs. NDVI

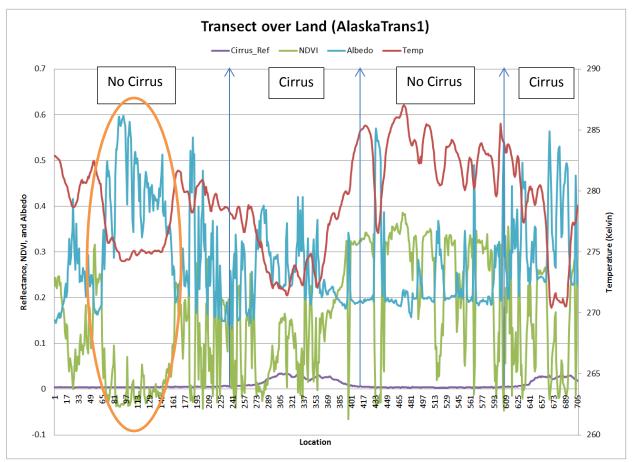
**Cirrus Reflectance** 



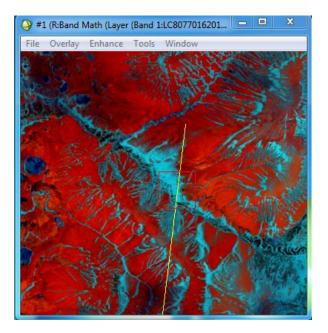
## AlaskaTrans1: Reflectance vs. Temperature

Summary Table: Alaska Transect over Land (AlaskaTrans1)

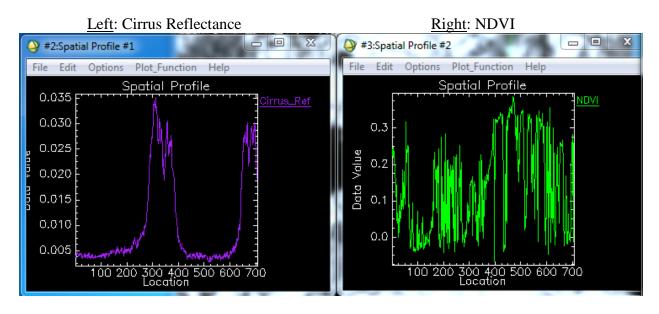
Summary Tuble. Mus	Ra Hanseet over Land (Maska Hansi)				
	Average Difference	Minimum	Maximum		
	across Cirrus Cloud				
	Boundaries				
	(Cirrus-NonCirrus)				
<b>Reflectance for</b>	0.025	0.003	0.0385		
<b>Cirrus Band</b>					
NDVI	-0.175	-0.066	0.385		
Albedo	0.150	0.132	0.598		
Temperature	-12.0	270	287		
(Degrees)					

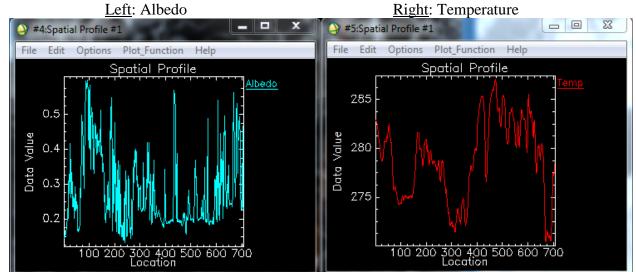


<u>Note</u>: The orange circle indicates where the transect line crosses a segment of icy river. Below is the image of that specified area.

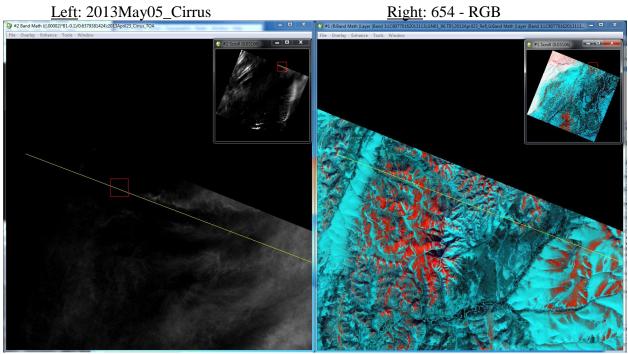


## Spatial Profiles for AlaskaTrans1





✤ AlaskaTransect11: Transect over Land (Ice/Bare Soil)



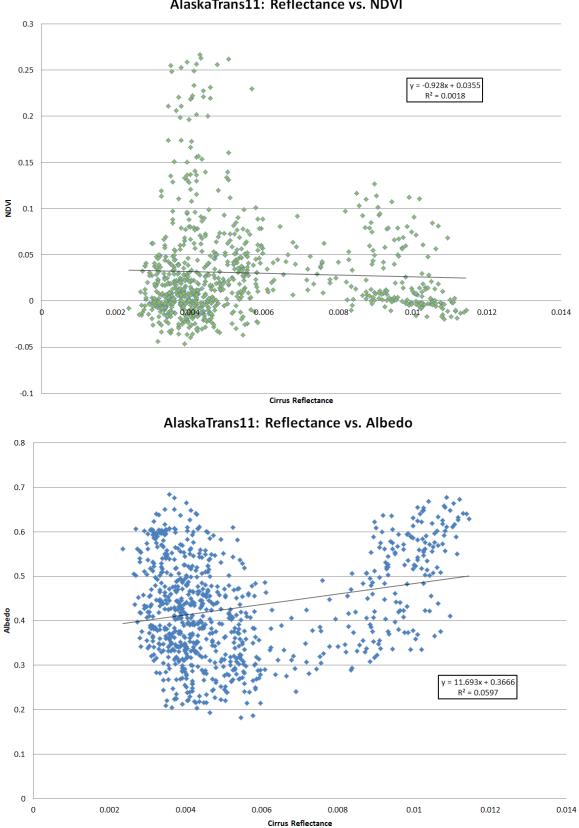
Notes: 1. The yellow line indicates the transect line used for analysis.

2. The small boxes in the right upper corners are the Scroll Windows.

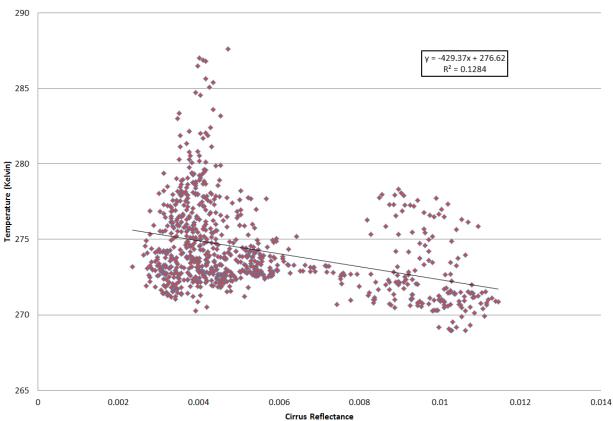
3. The mountain peaks show up on the cirrus band, which may overestimate the amount of cirrus clouds in the western part of the image above.

### Trend Lines: Alaska Transect over Land (AlaskaTrans11)

	NDVI	Albedo	Temperature
AlaskaTrans11	y = -0.928x + 0.0355	y = 11.693x + 0.3666	y = -429.37x + 276.62
	$R^2 = 0.0018$	$R^2 = 0.0597$	$R^2 = 0.1284$



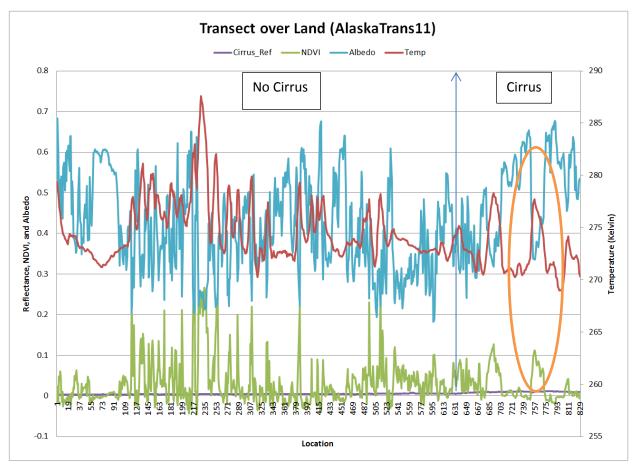
AlaskaTrans11: Reflectance vs. NDVI



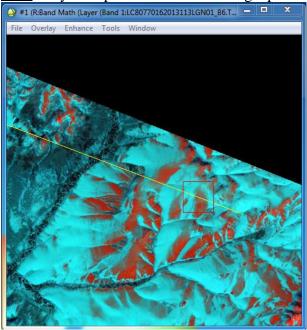
### AlaskaTrans11: Reflectance vs. Temperature

### Summary Table: Alaska Transect over Land (AlaskaTrans11)

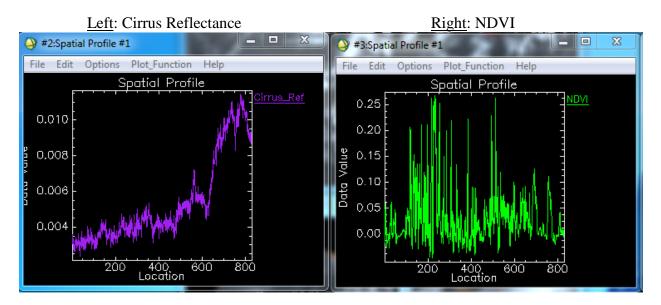
	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.010	0.002	0.011
NDVI	0.000	-0.046	0.267
Albedo	0.050	0.186	0.678
Temperature (Degrees)	-2.0	269	288

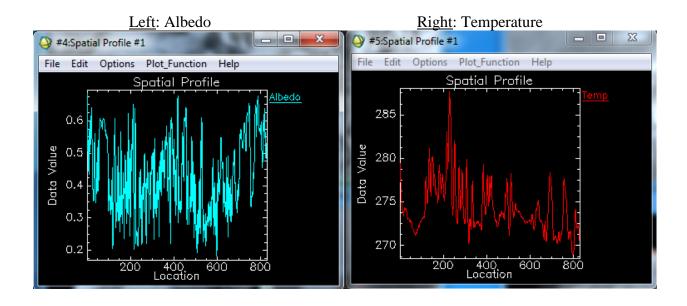


Note: Any disruption is due to crossing a path of bare soil. See blow for an example.

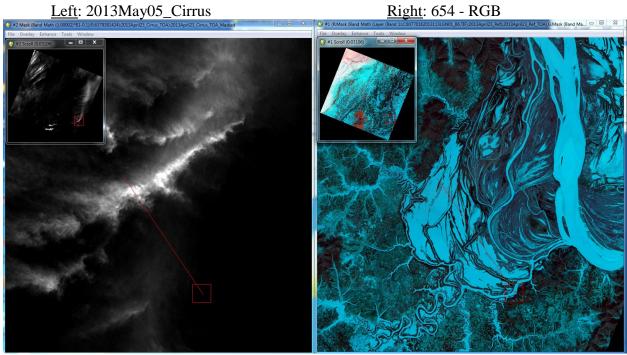


# Spatial Profiles for AlaskaTrans11





✤ AlaskaTransect2: Transect over Water (Icy River)

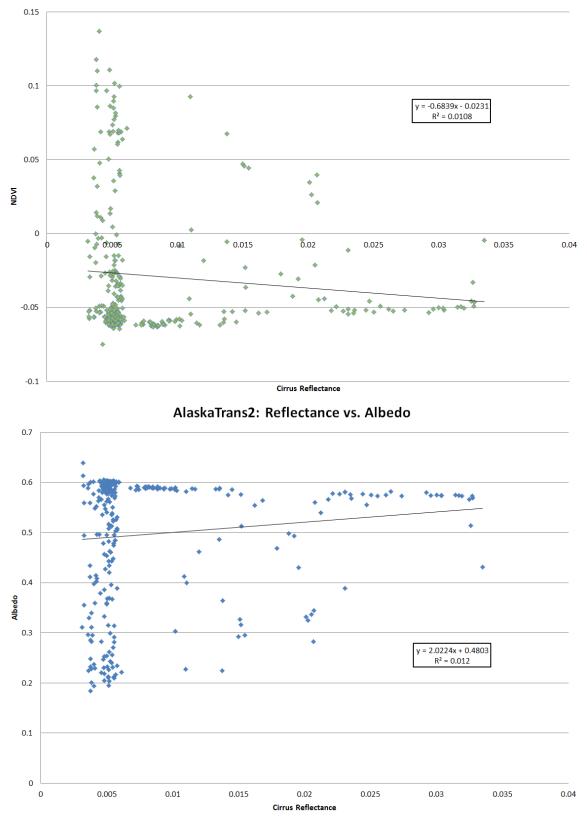


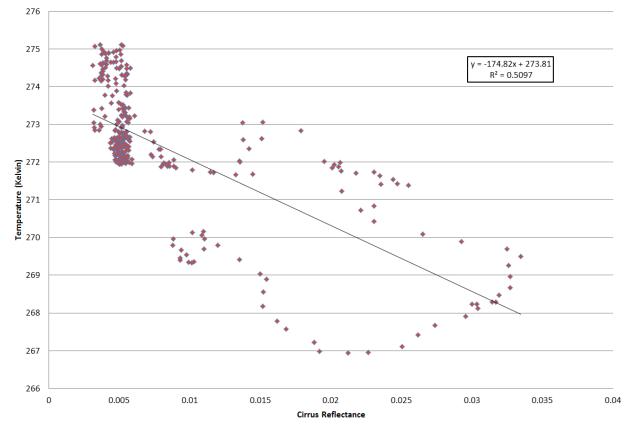
<u>Note</u>: 1. The red line indicates the transect line used for analysis. 2. The small boxes in the left upper corners are the Scroll Windows.

TTehu Lines, Alaska Transect over Water (Alaska Trans2)						
	NDVI	Albedo	Temperature			
AlaskaTrans2	y = -0.6839x - 0.0231	y = 2.0224x + 0.4803	y = -174.82x + 273.81			
	$R^2 = 0.0108$	$R^2 = 0.012$	$R^2 = 0.5097$			

	<b>Trend Lines:</b>	Alaska	Transect	over V	Water (	(AlaskaTrans2)
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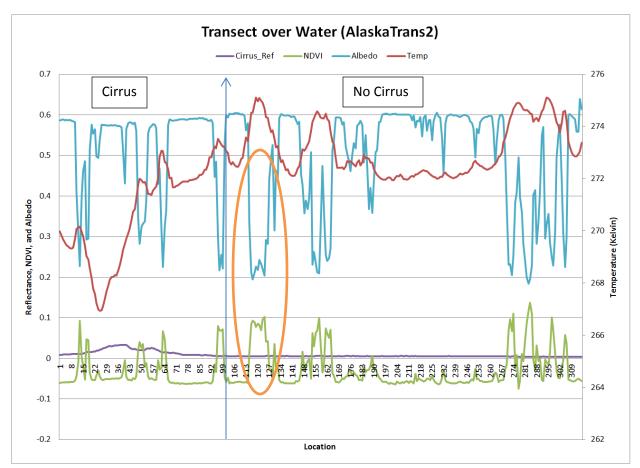




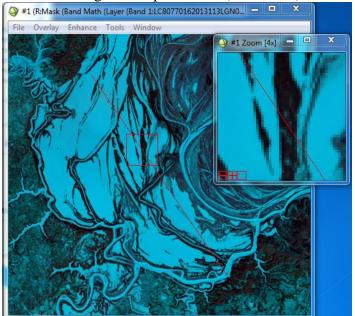
# AlaskaTrans2: Reflectance vs. Temperature

## Summary Table: Alaska Transect over Water (AlaskaTrans2)

	Average Difference across Cirrus Cloud Boundaries (Cirrus-NonCirrus)	Minimum	Maximum
Reflectance for Cirrus Band	0.020	0.003	0.003
NDVI	0.010	-0.075	0.137
Albedo	0.025	0.194	0.9639
Temperature (Degrees)	-5.0	267	275



<u>Note</u>: Every disruption (peak in NDVI, dip in Albedo, and peak in Temp) corresponds to whenever the transect comes across melting ice (dark streams with temperature of 0 degree Celsisus) in the river. See below for the image. The zoom window shows one major disruption circled in orange in the plot above (654- RGB).



## Spatial Profiles for AlaskaTrans2

