

## Skyline Extraction

Not Finished... in progress

Skylines are being extracted separately to help create “points of interest” useful as additional points for correspondence (point matching between images). The skylines have other uses such as gps markers (see the Yosemite half dome and peak finder notes).

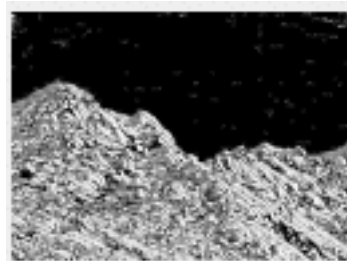
The intermediate image product while creating Canny Edge filters is a theta image created from the x and y gradients of the main color image. The theta image largest contiguous zero value pixels appears to be a good way to locate the sky. Those sky points can then be used with the color image to further grow the region to the apparent skyline.

*These are notes while implementing the skyline extraction.*

The contiguous zero values are found with a depth first traversal of image pixels. With the default stack size of the java jvm (the architecture is my laptop) the stack is small for the method frame of the dfs method when the number of pixels in the image is larger than about 870,000. Beyond that number of pixels, the runtime of the method dramatically increases so image binning is required. The image is down sized to a factor of a factor of 2 to result in nPixels < 870,000. Then the largest group of contiguous zero value pixels is found. The zero value points coordinates are then transformed back to the reference of the full size theta image and corrections for the lower resolution are made.

This appears to result in a stable location of the sky.

scaled  
theta



zero points  
from down  
scaled  
image  
upscaled  
in blue



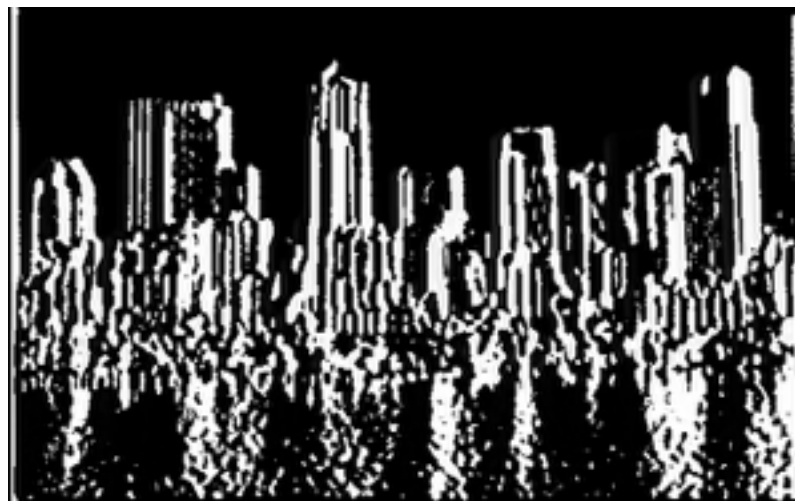
For clear skies and foreground objects with patterns and contrast, those sky points are the total sky. For other images, the sky has to be grown to larger boundaries using hue or contrast in the color image.

Note that skyscrapers with repetitive structure on the scale of combined convolution (approx the FWHM =  $2.355 * \sqrt{2^2 + 0.5^2} = 6$  pixels) or any object w/such repetition can have “blind spots” in the theta image and so they are in the sky points group and need to be removed using the color image before the sky point set is grown to larger boundaries.

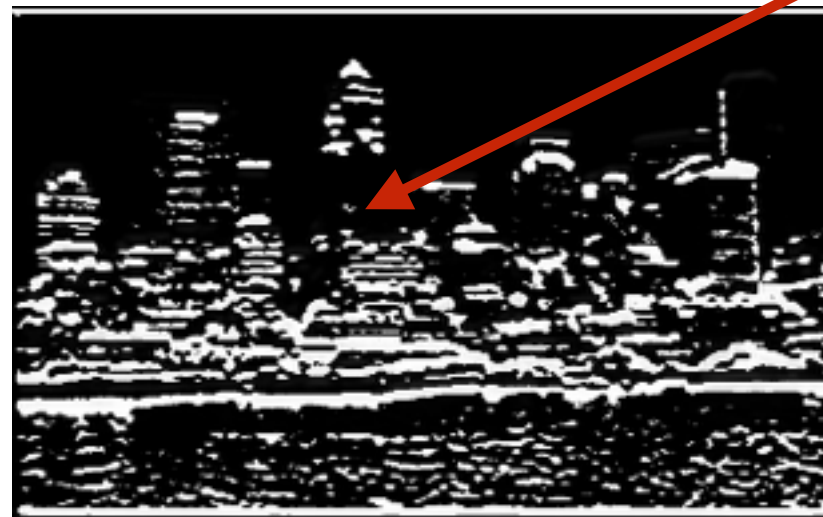
# Skyline Extraction

The repetitive structure on the scale of combined convolution (approx the FWHM =  $2.355 * \sqrt{2*2 + 0.5*0.5} = 6$  pixels) is in the y direction in the color image so is missing from the gradient Y image even though it is an object with structure.

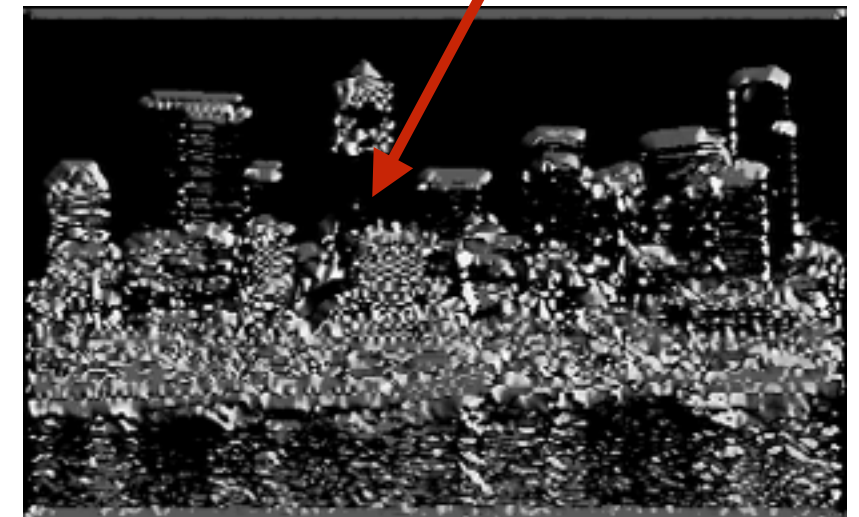
first gathering  
of sky pixels  
from theta  
before  
removing  
non-sky  
pixels and  
growing the  
set



gradient X



gradient Y



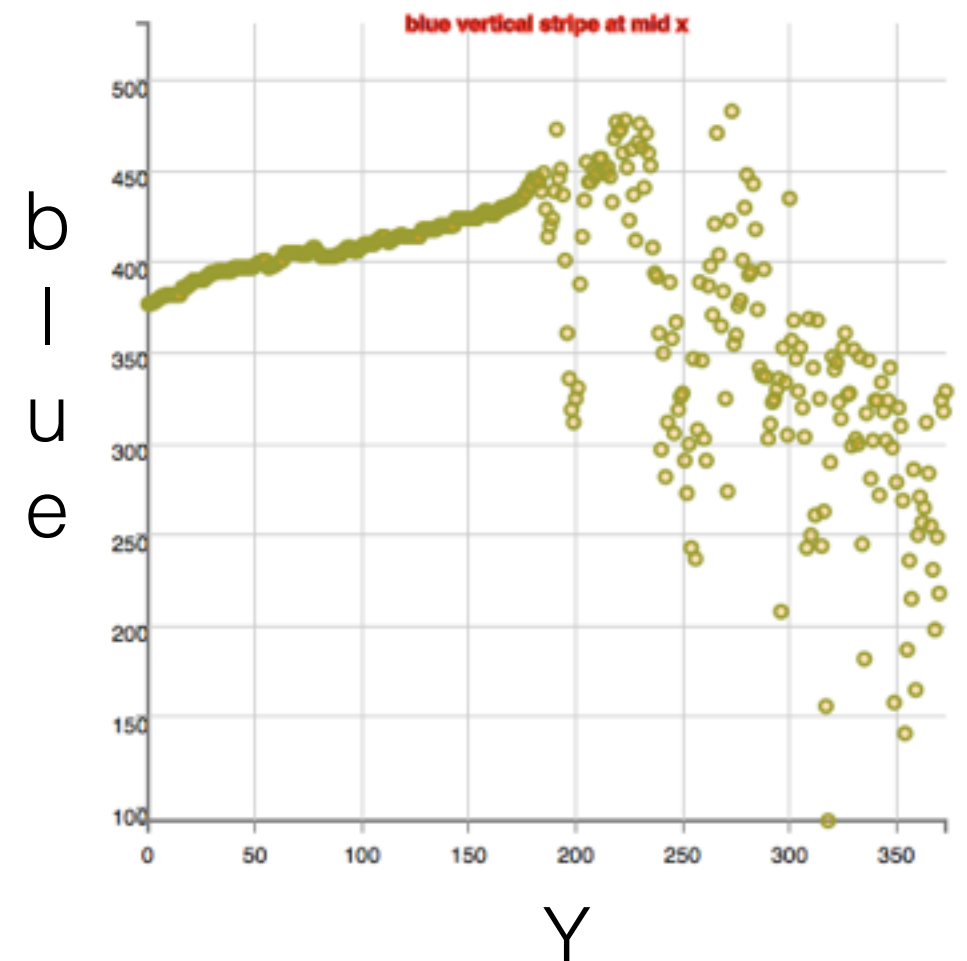
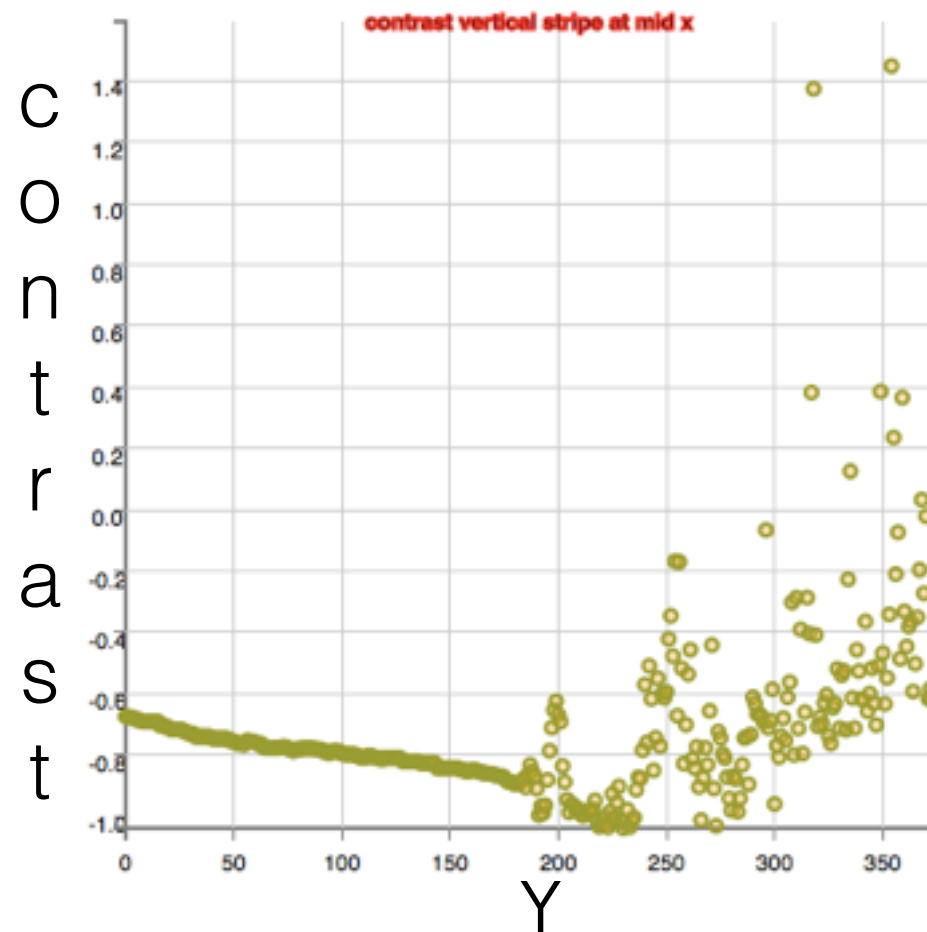
theta

# Skyline Extraction

**Brown & Lowe 2003 image:** vertical stripes through the middle of the image shows contrast and blue are good indicators for skyline boundary



**blue sky:**  
skyline is where  
contrast decr, blue  
decr.





# Skyline Extraction

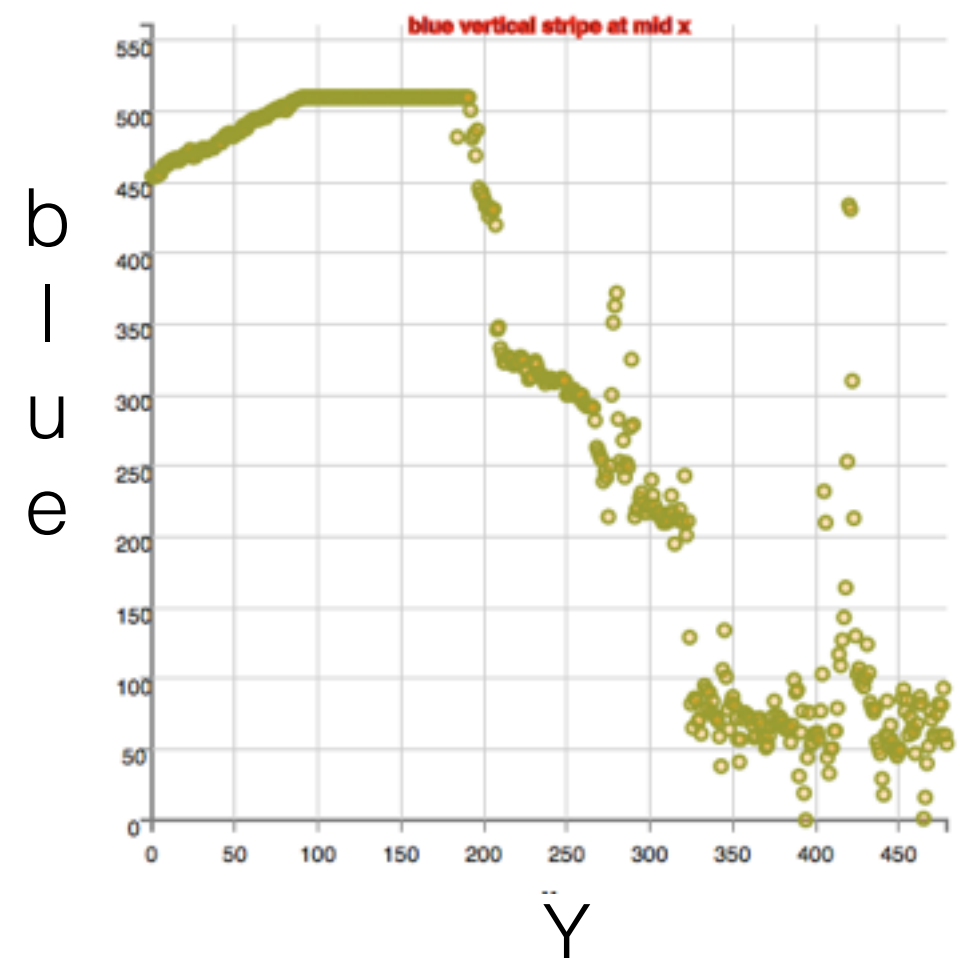
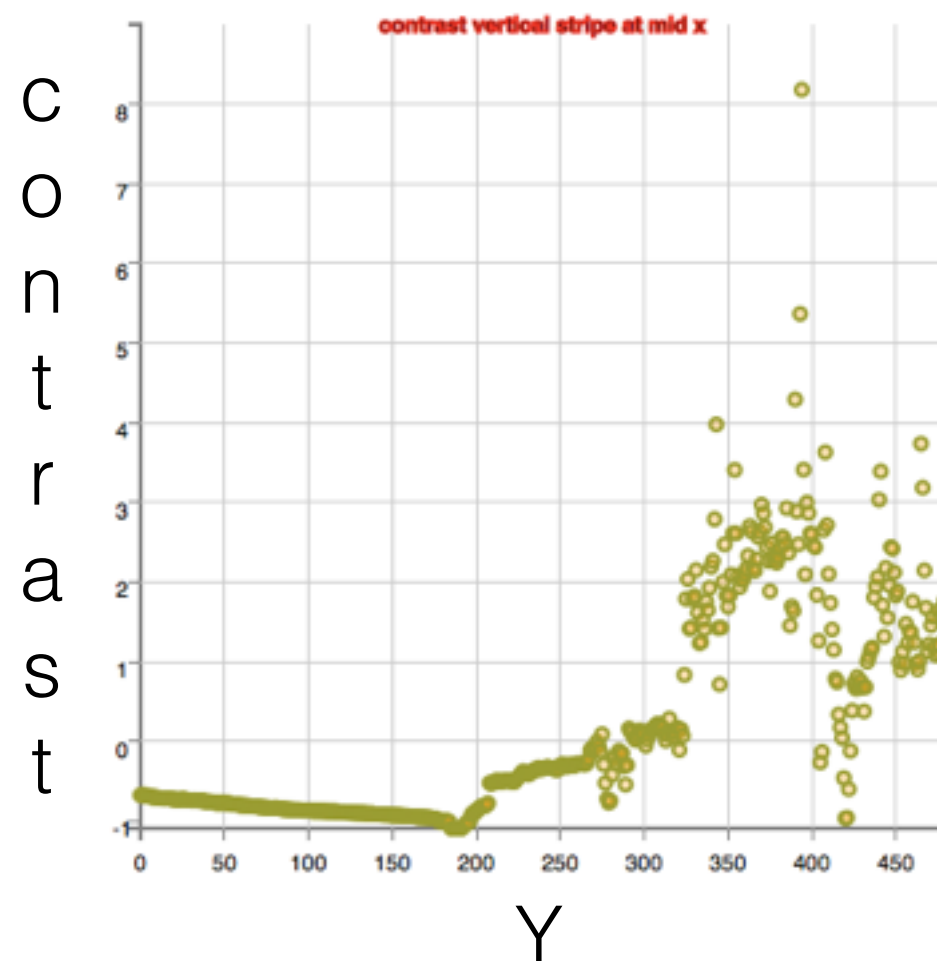
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**Venturi mountain image:** vertical stripes through the middle of the image shows contrast and blue are good skyline indicators

<https://venturi.fbk.eu/results/public-datasets/mountain-dataset/>



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skyline is where  
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# Skyline Extraction

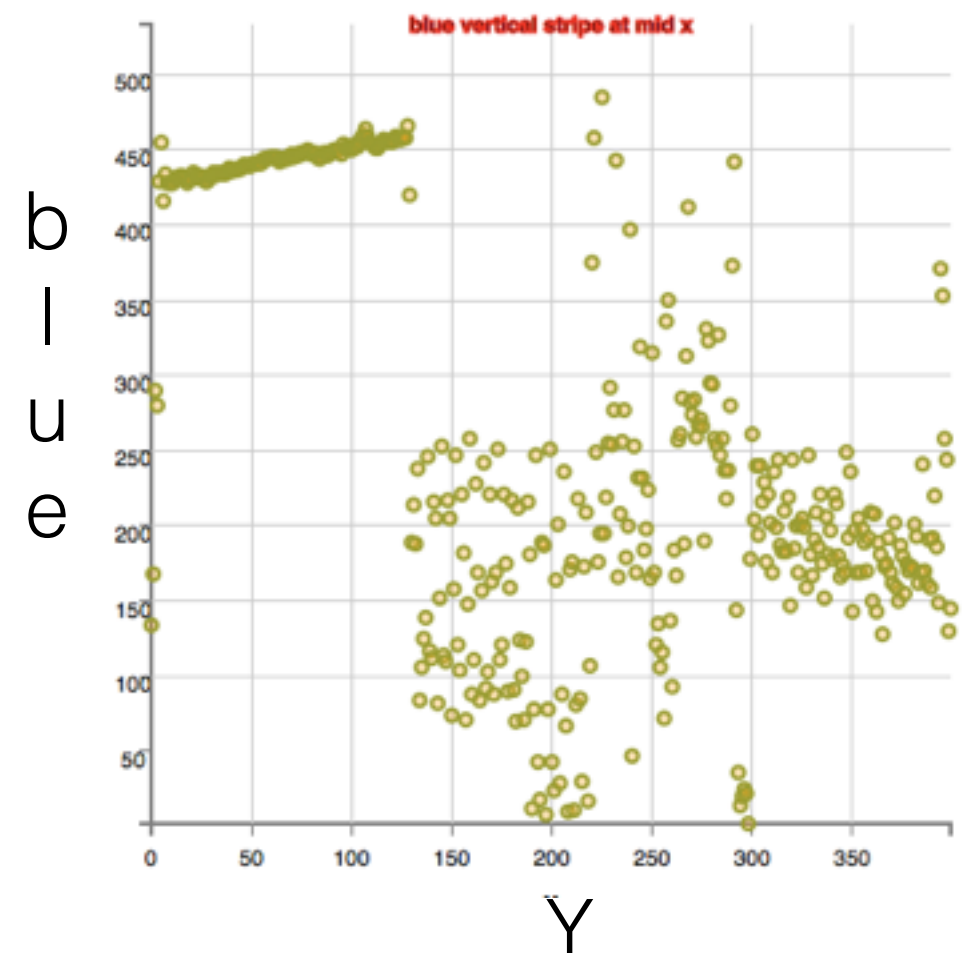
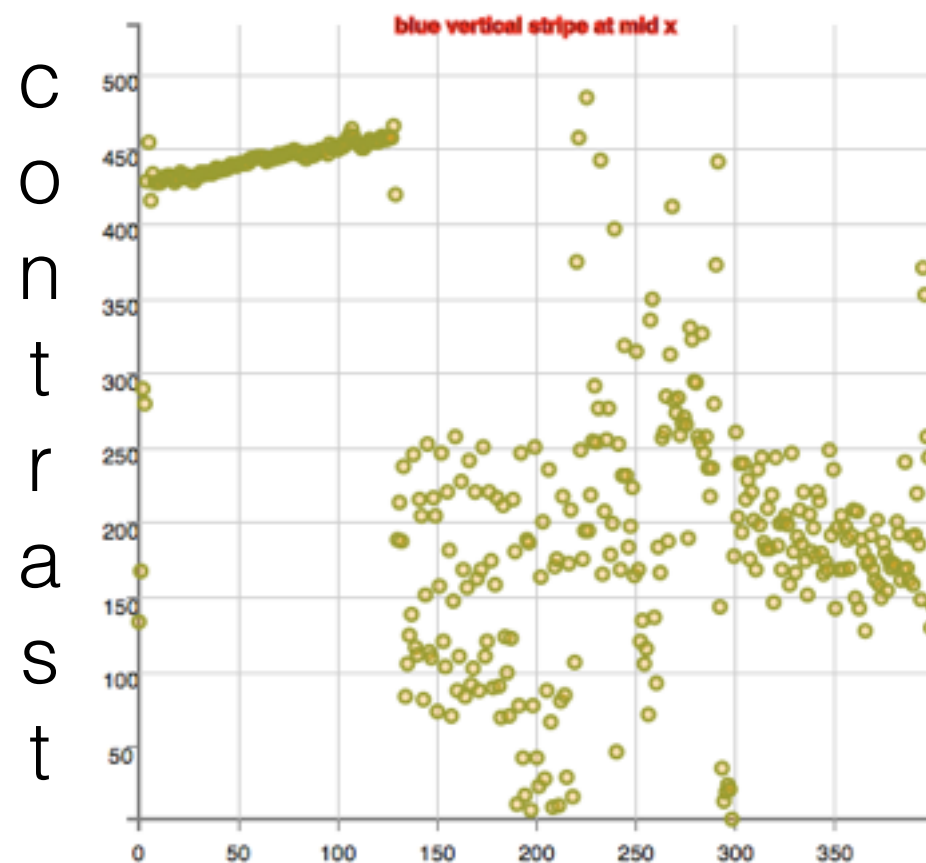
Not Finished... in progress

**Seattle image:** vertical stripes through the middle of the image show contrast and blue are good indicators for skyline boundary.

<https://www.flickr.com/photos/tdlucas5000/14177059903>



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# Skyline Extraction

Not Finished... in progress

**image:** vertical stripes through the middle of the image shows contrast and red are good indicators here for skyline boundary.

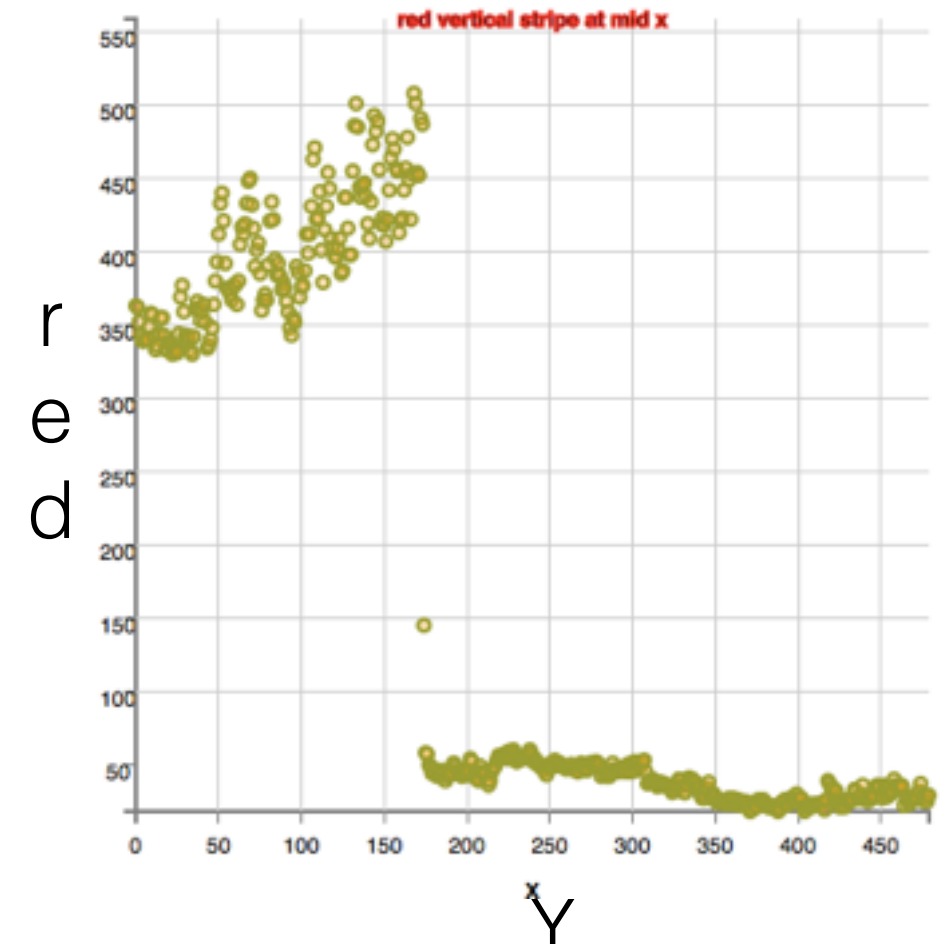
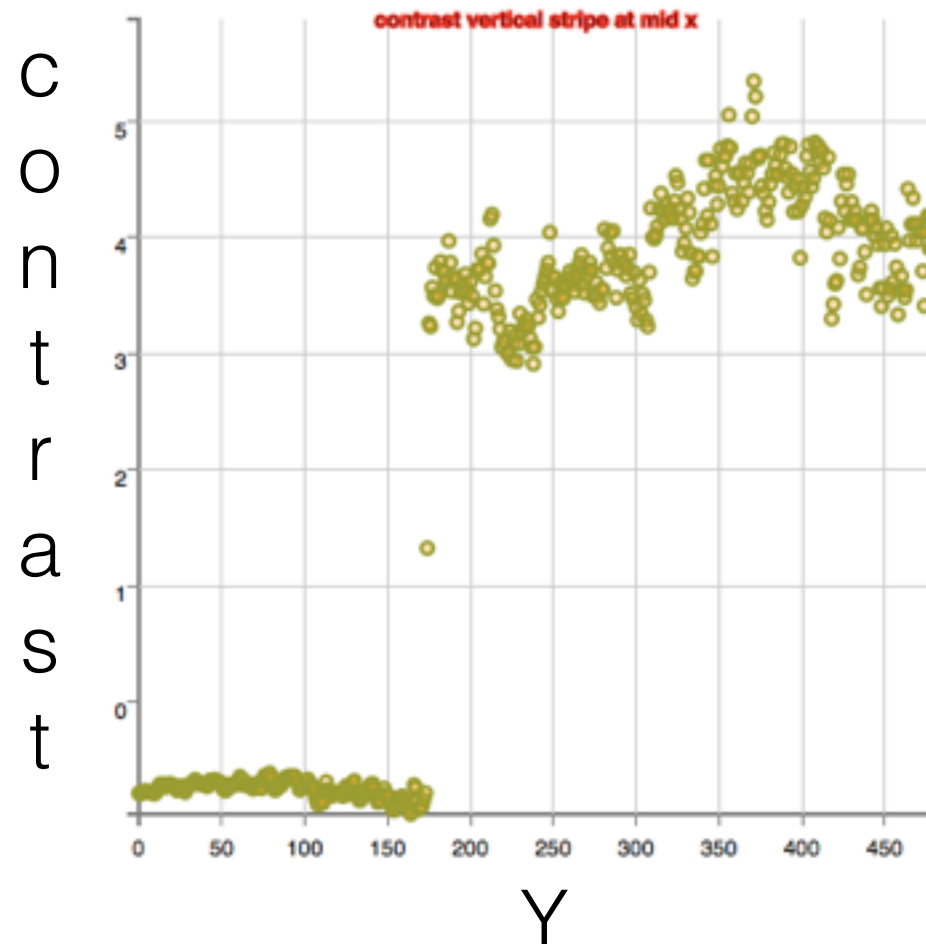
<https://www.flickr.com/photos/stonehenge-stone-circle/11774684414/>



the  
fore-  
ground  
theta '0' pixel  
sets need removal  
when color image for  
the group is nearly black.



**red sky + dark foreground:**  
skyline is where  
contrast incr, red decr.  
and reverses slope  
(plunges)



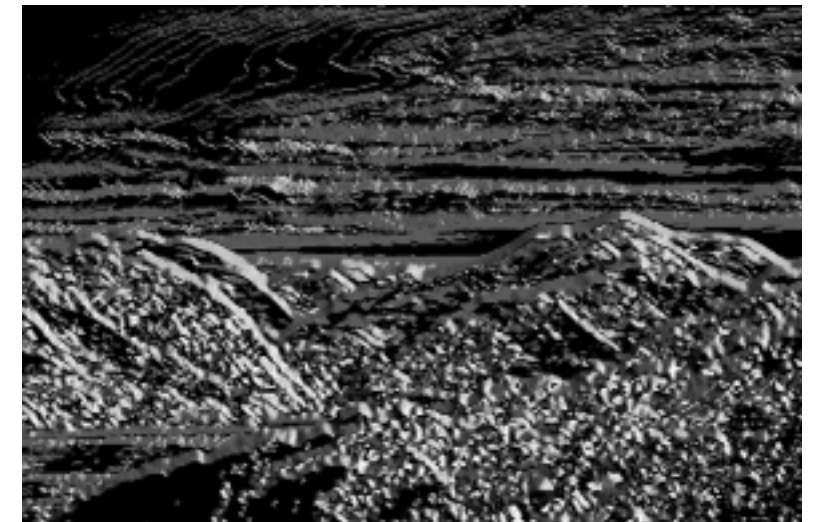
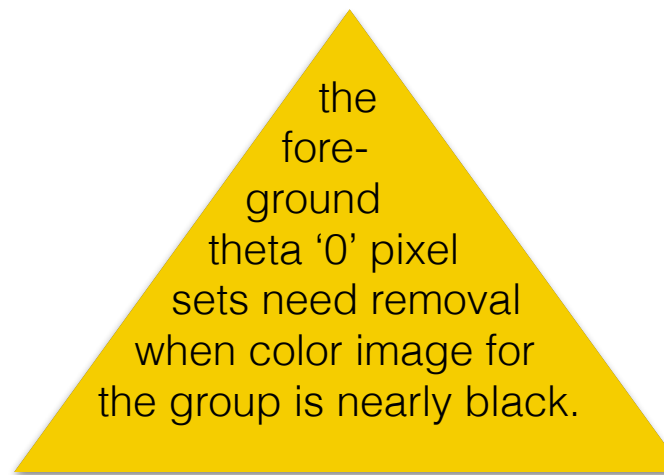
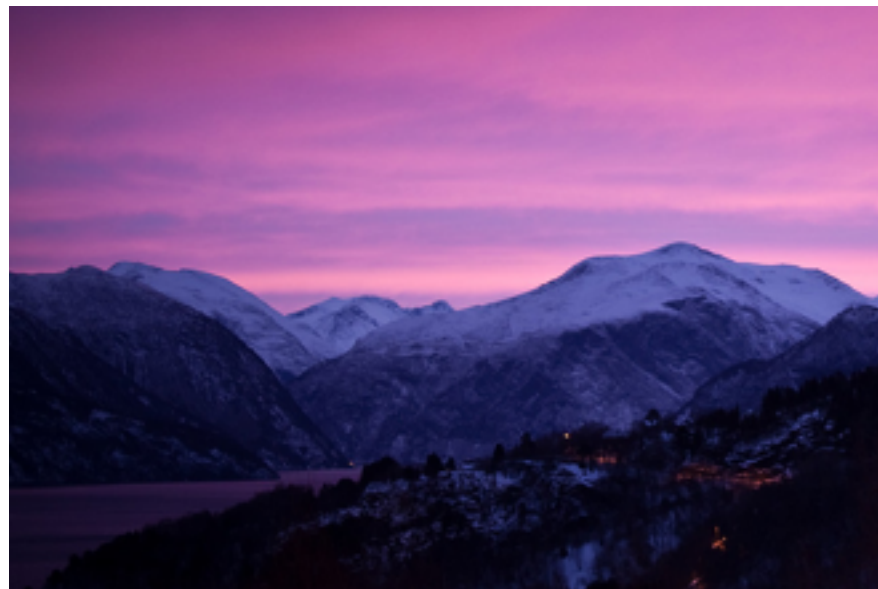


# Skyline Extraction

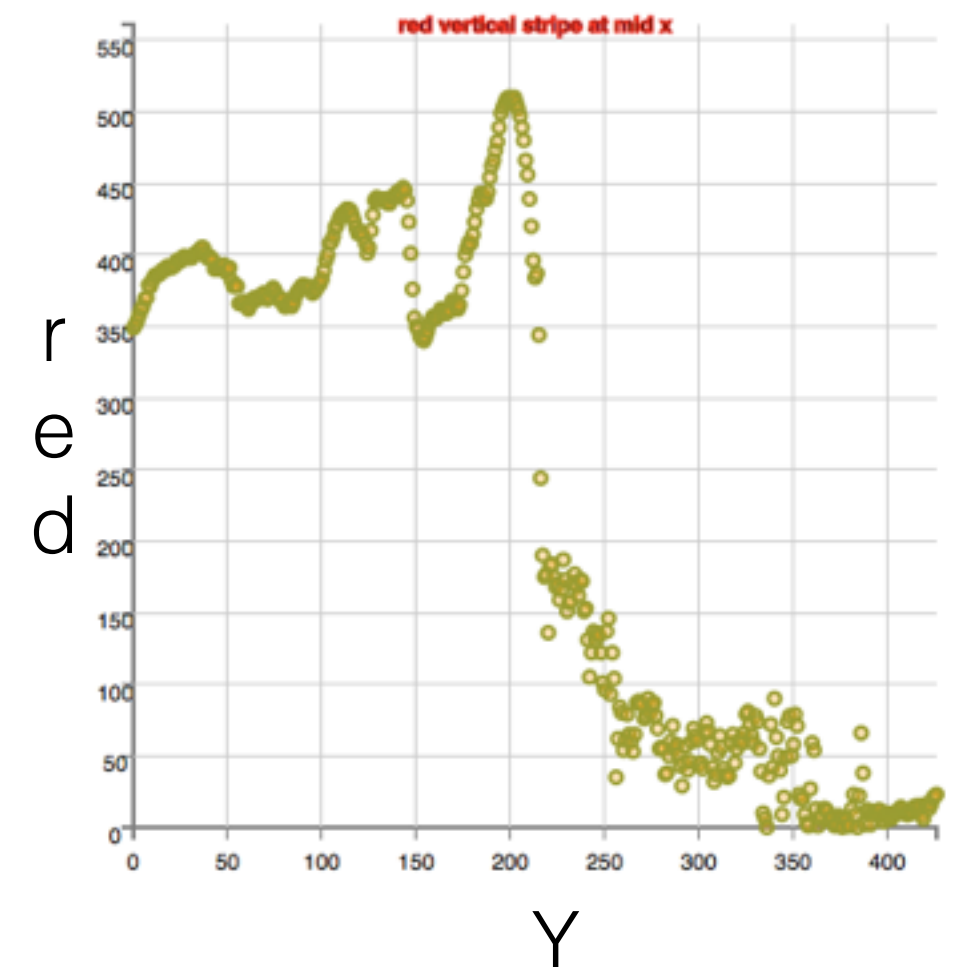
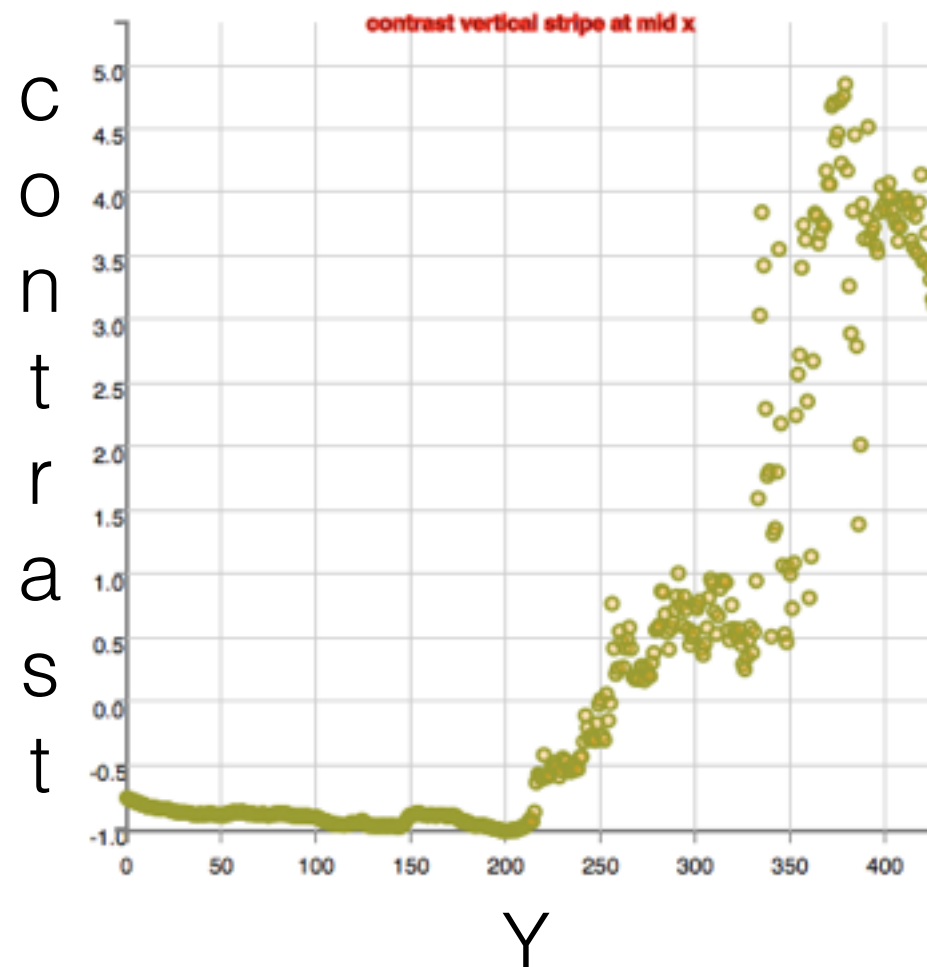
Not Finished... in progress

**image:** vertical stripes through the middle of the image shows contrast and red are good indicators here for skyline boundary.

<https://www.flickr.com/photos/jvikphoto/4305855415>



**purple sky + dark foreground:**  
skyline is where contrast incr, hue decr. and reverses slope (plunges) and so does red



# Skyline Extraction

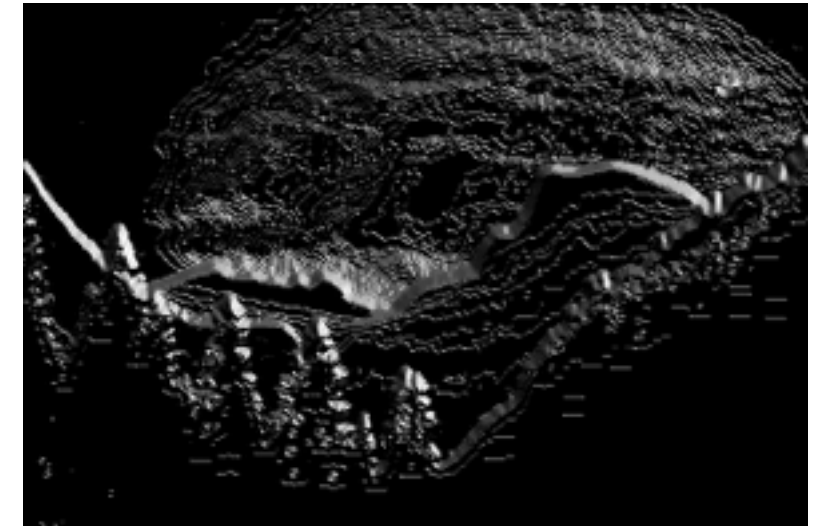
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**image:** vertical stripes through the middle of the image shows contrast and red are good indicators here for skyline boundary.

<https://www.flickr.com/photos/7147684@N03/919374354>

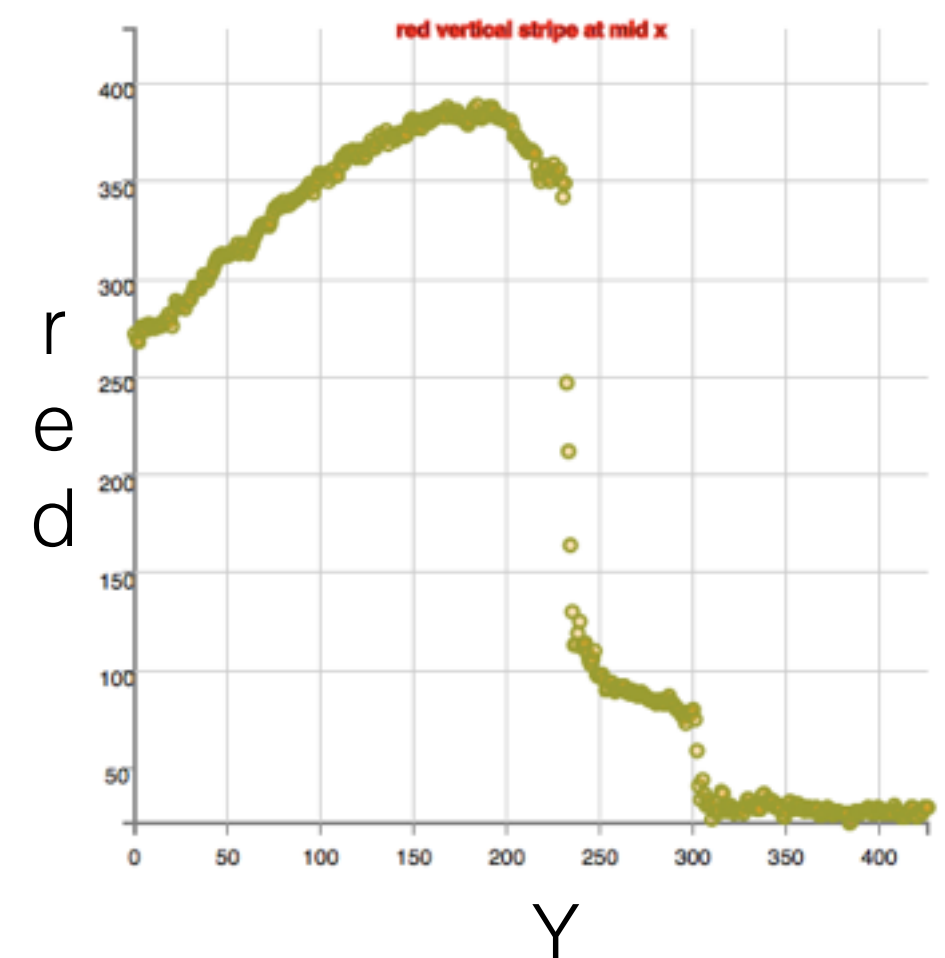
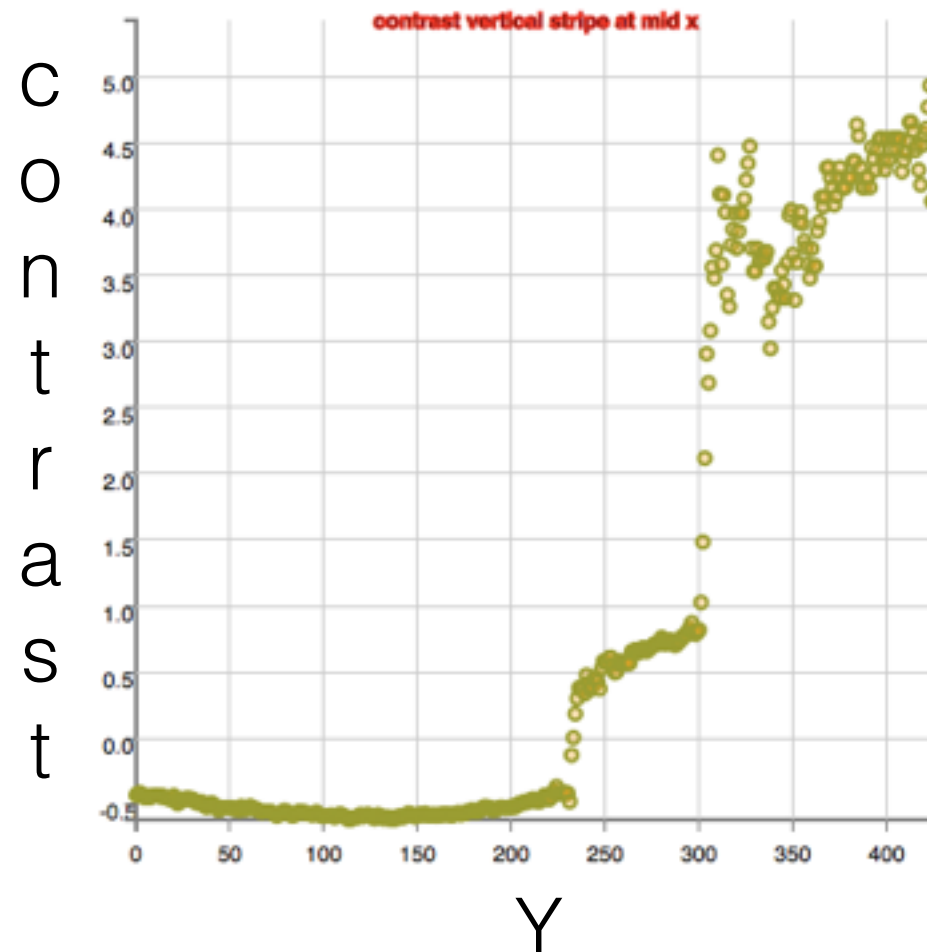


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also, see PeakFinder <http://www.peakfinder.org/?lat=37.7511&lng=-119.5215&ele=2365&name=37°45'N%20119°32'W>

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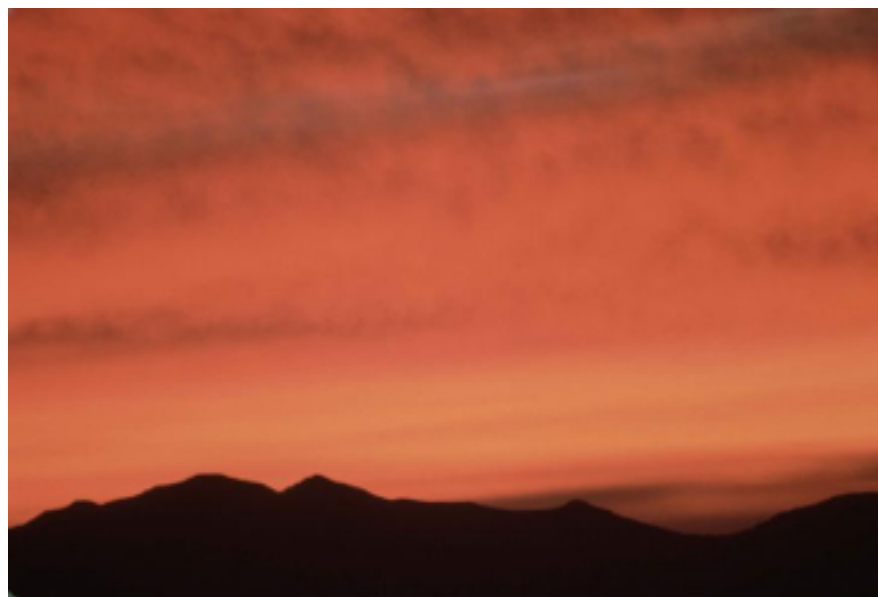




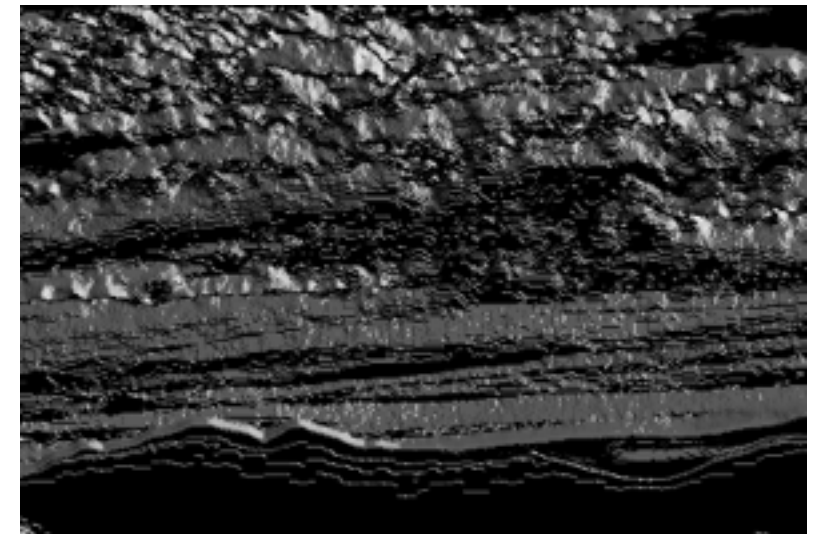
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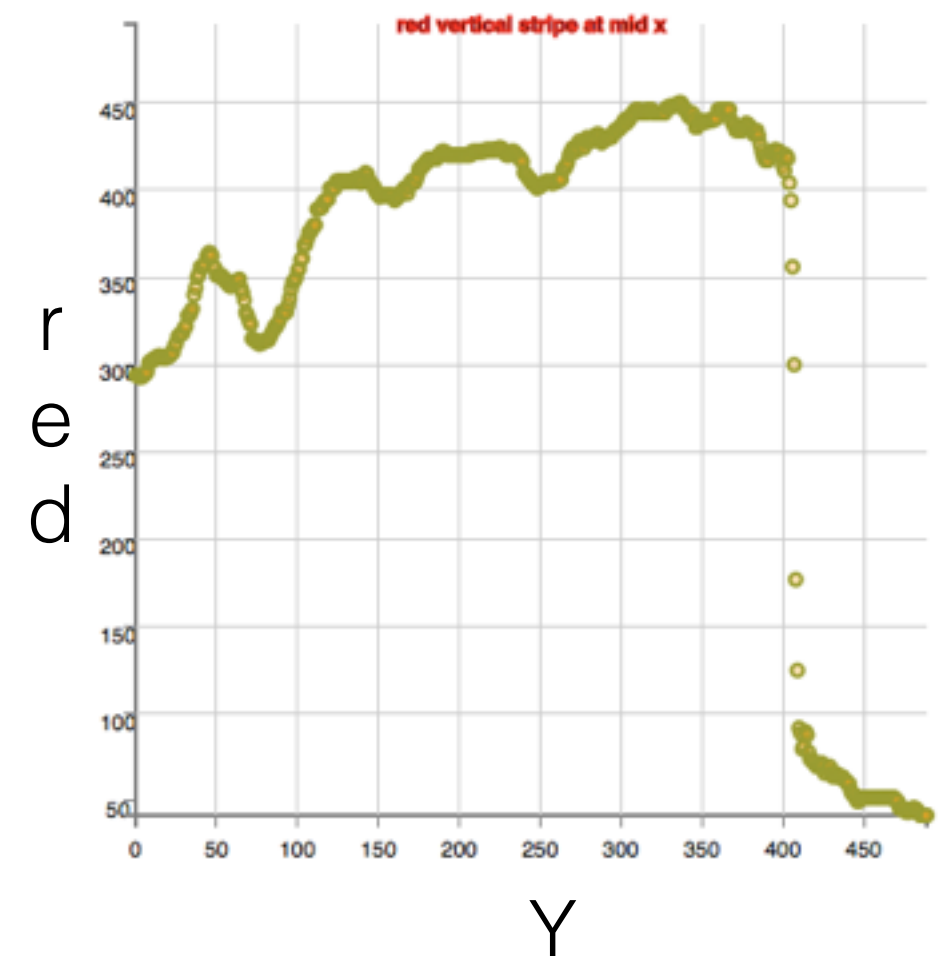
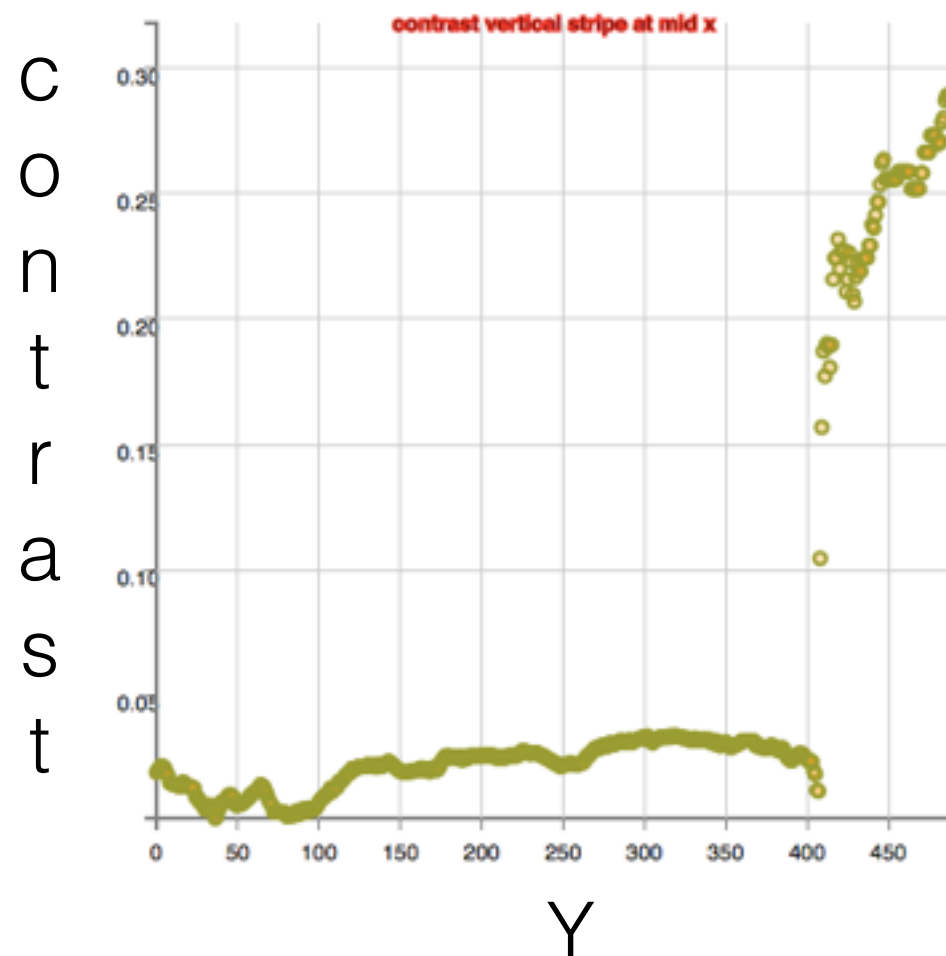
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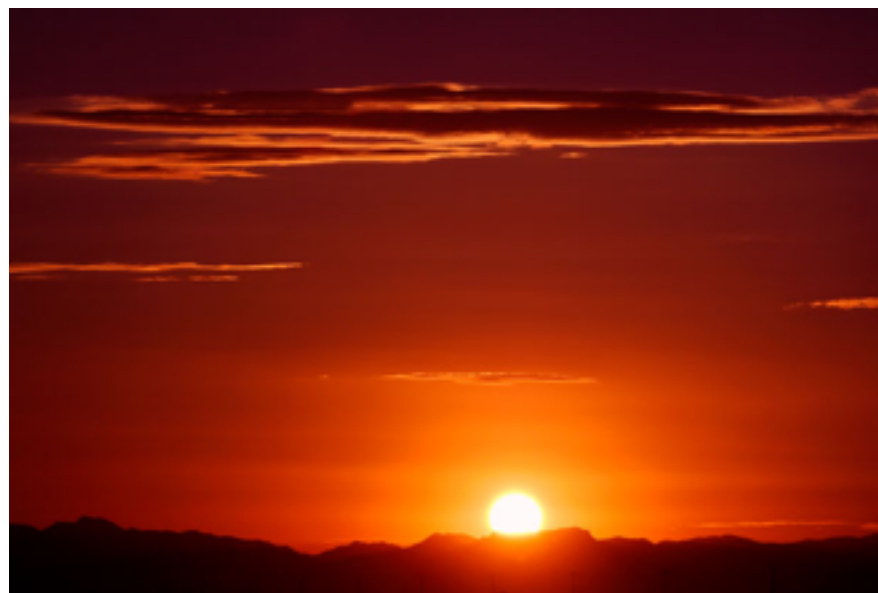
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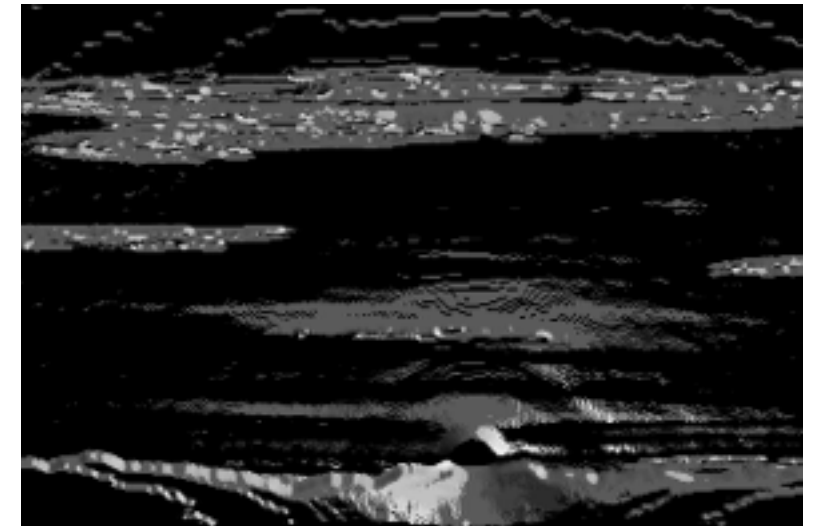
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