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
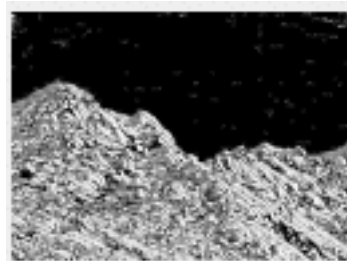
zero points from down scaled image upscaled in blue

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*0.5) = 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.
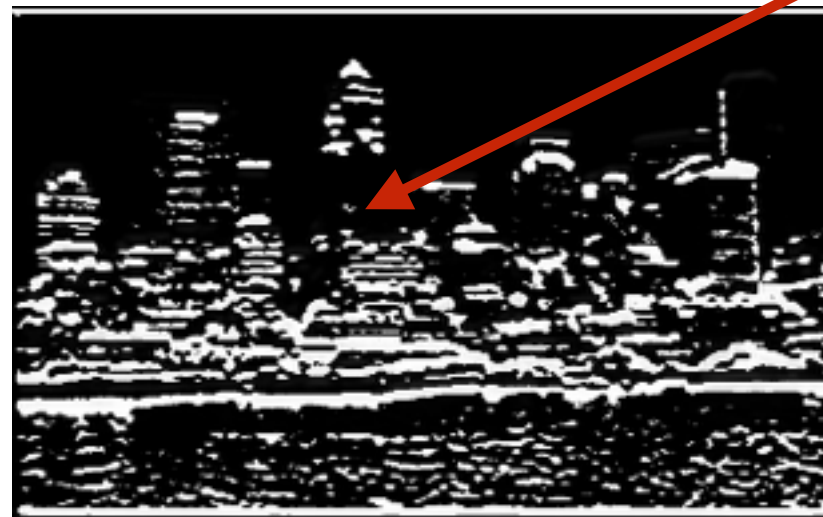
Skyline Extraction

The repetitive structure on the scale of combined convolution (approx the FWHM = 2.355 * sqrt(2*2 + 0.5*0.5) = 6 pixels) is not seen in the gradient Y image, so is missing from the gradient image too even though it is an object with structure.
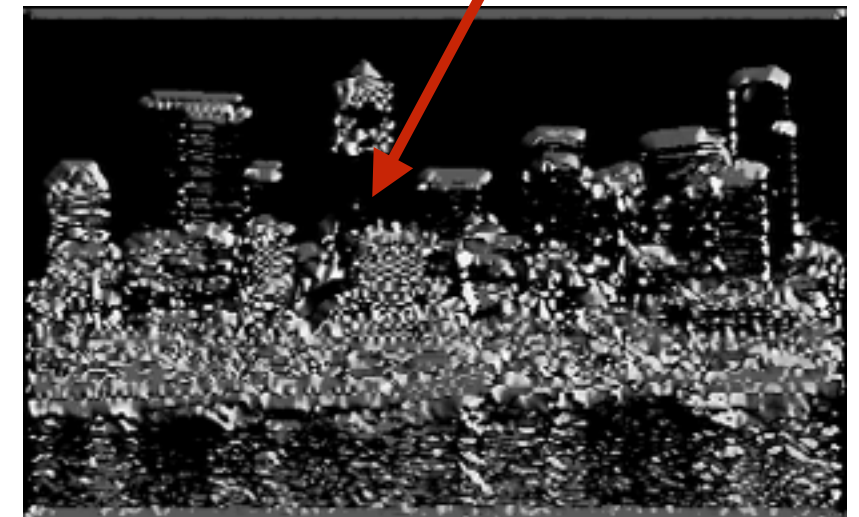
first gathering of sky pixels from theta before removing non-sky pixels and growing the set
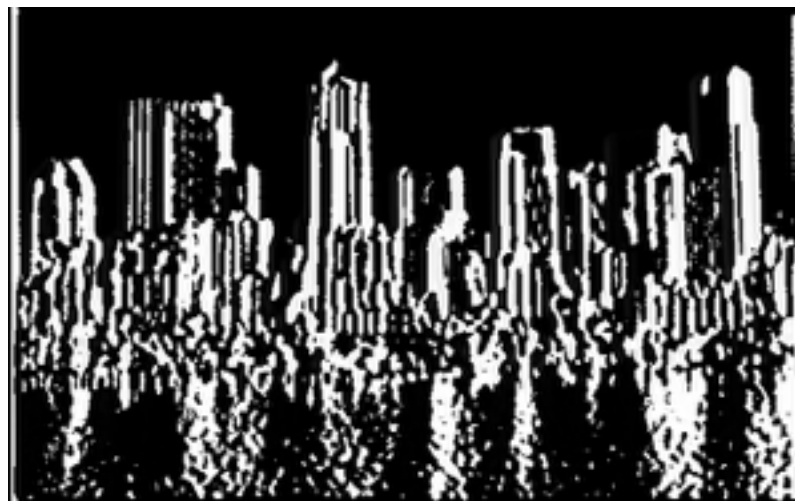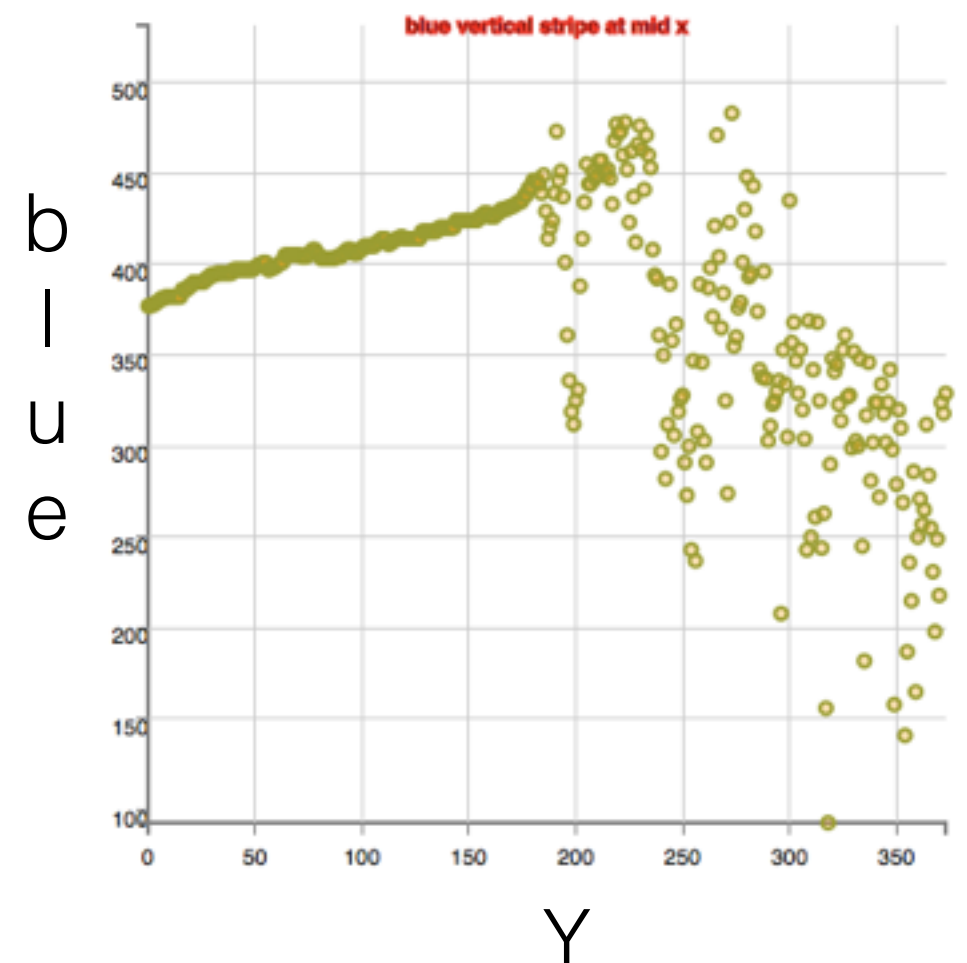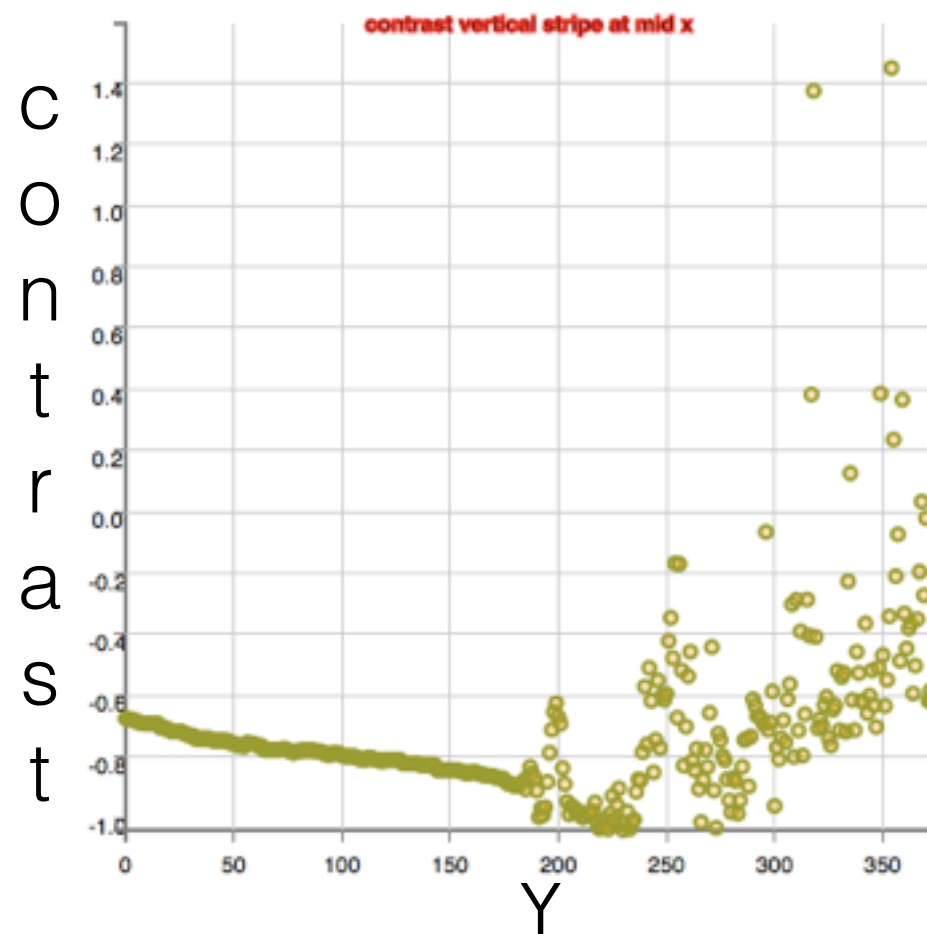
gradient X

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

Y

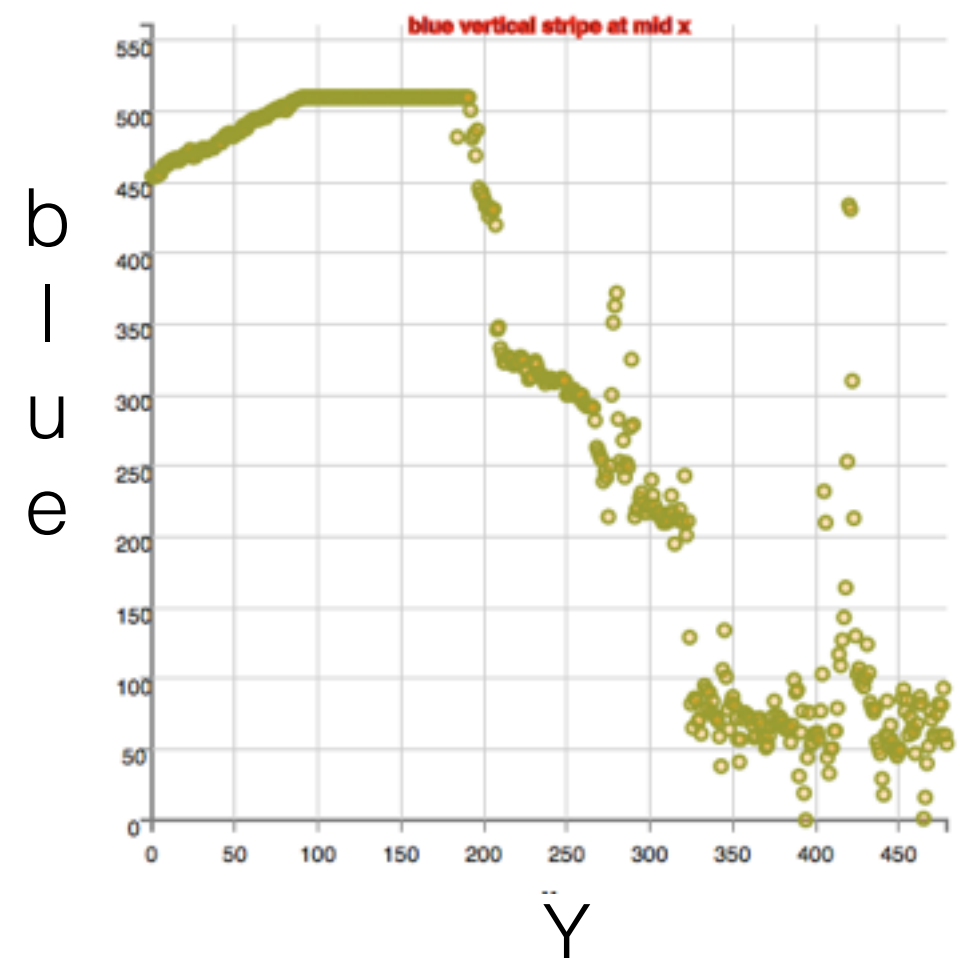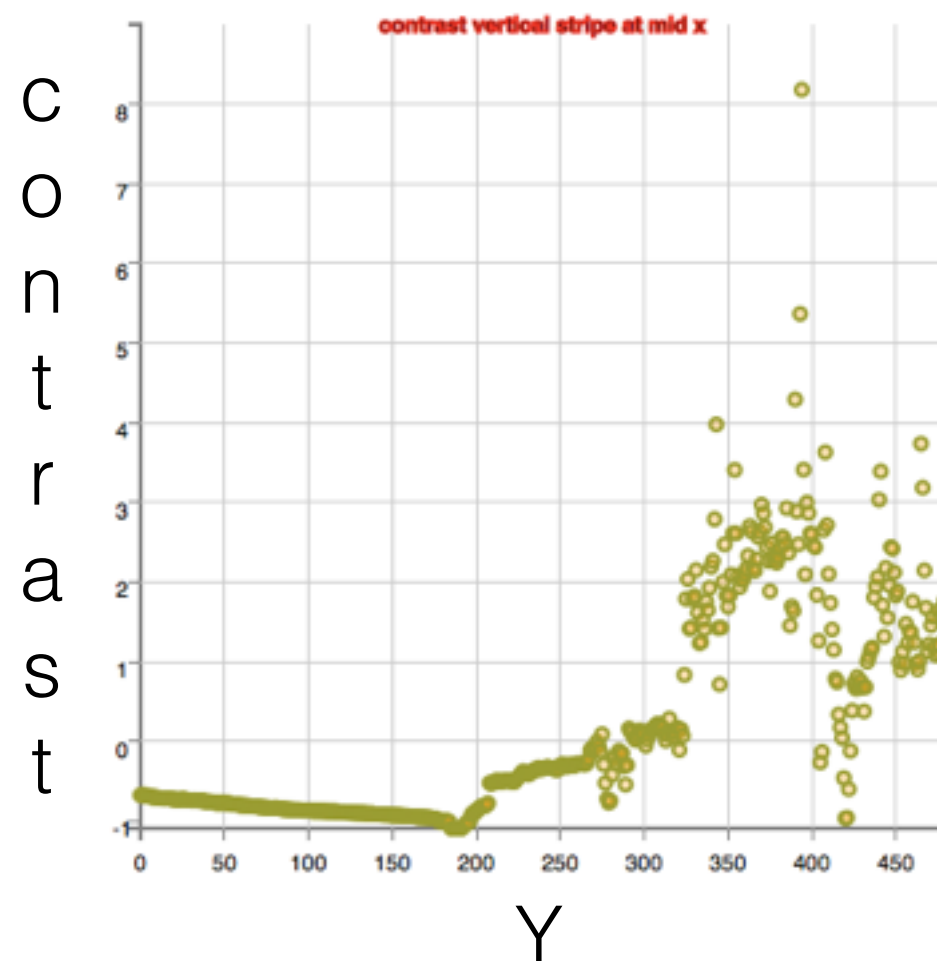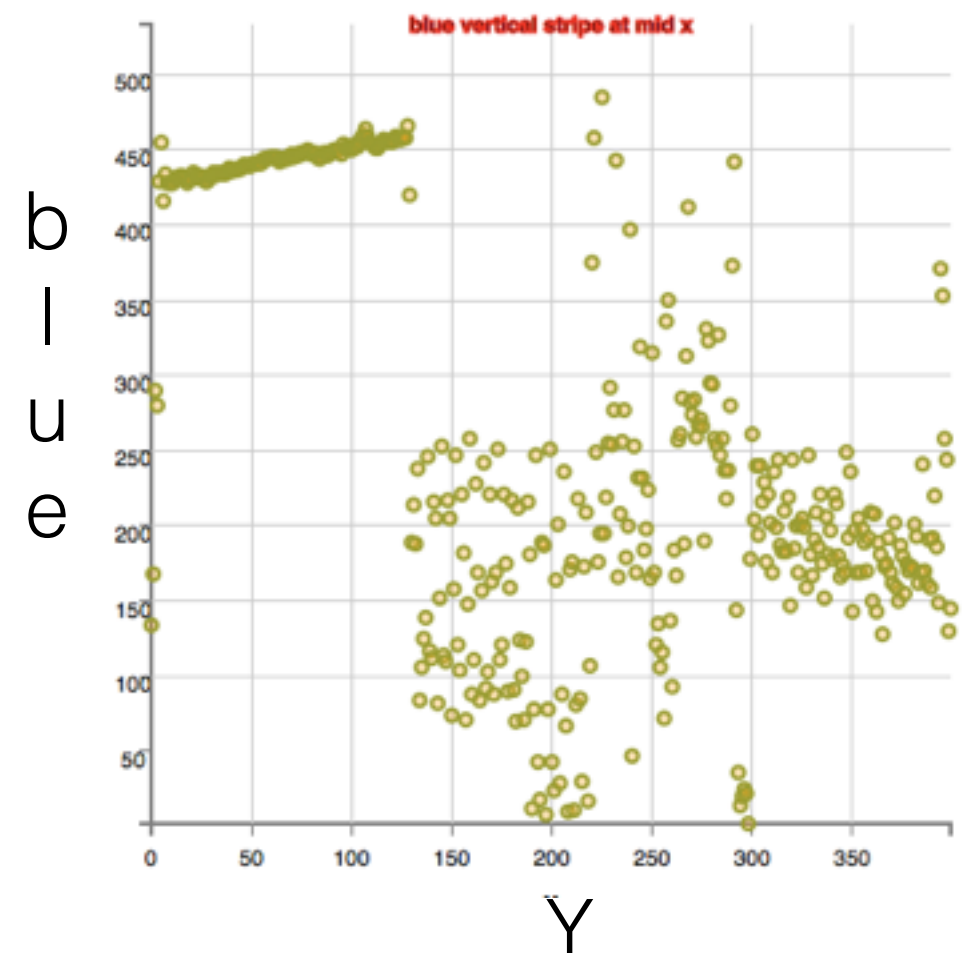**blue sky:**
skyline is where contrast decr, blue decr.

contrast vertical stripe at mid x

c o n t r a s t

Y

blue vertical stripe at mid x

b l u e

Y

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/
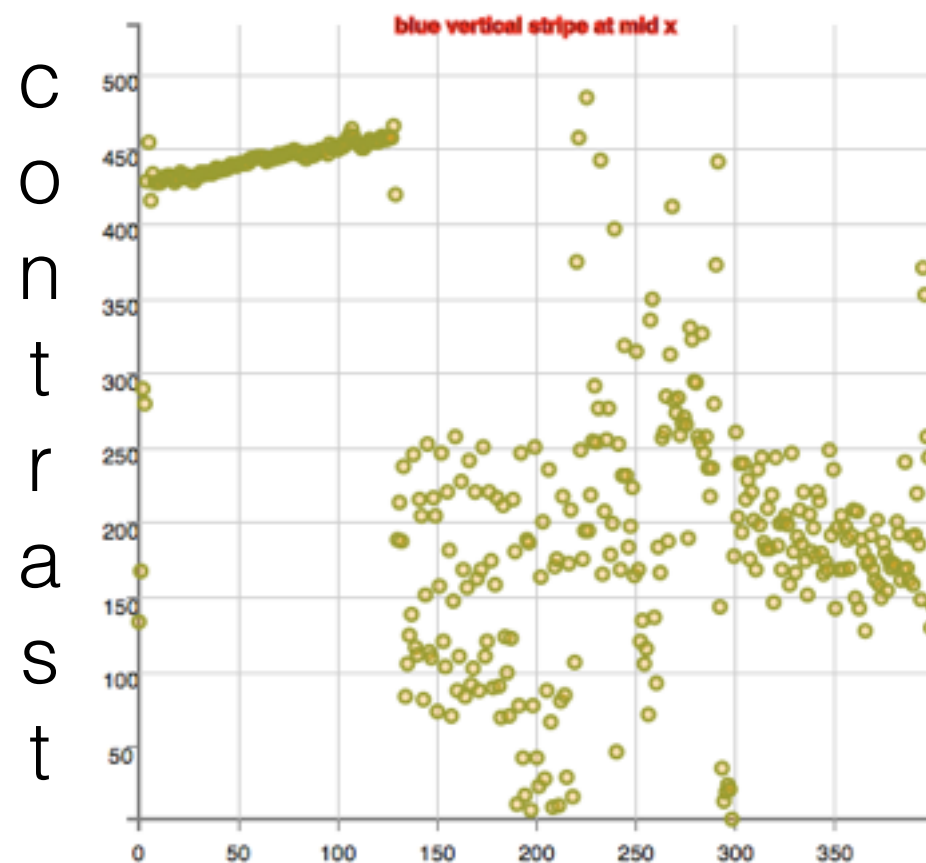

blue sky:
skyline is where contrast decr, blue decr.

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

Y

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

contrast

blue vertical stripe at mid x

blue

blue vertical stripe at mid x

Y

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

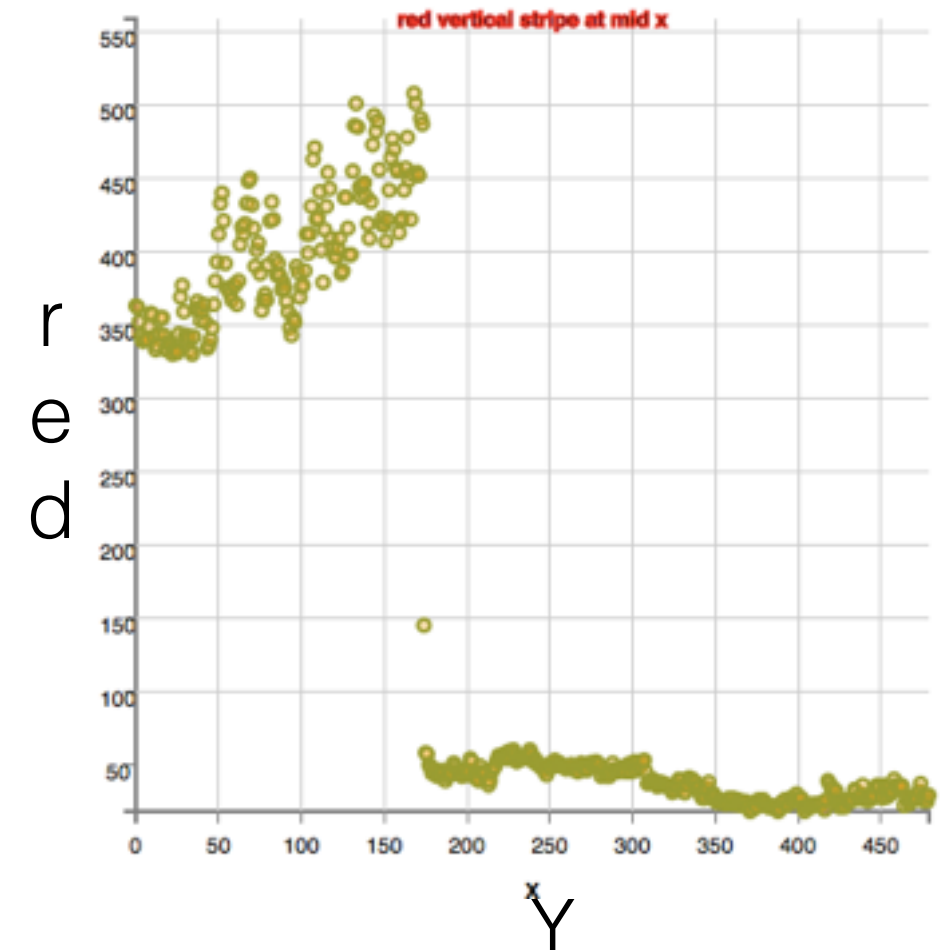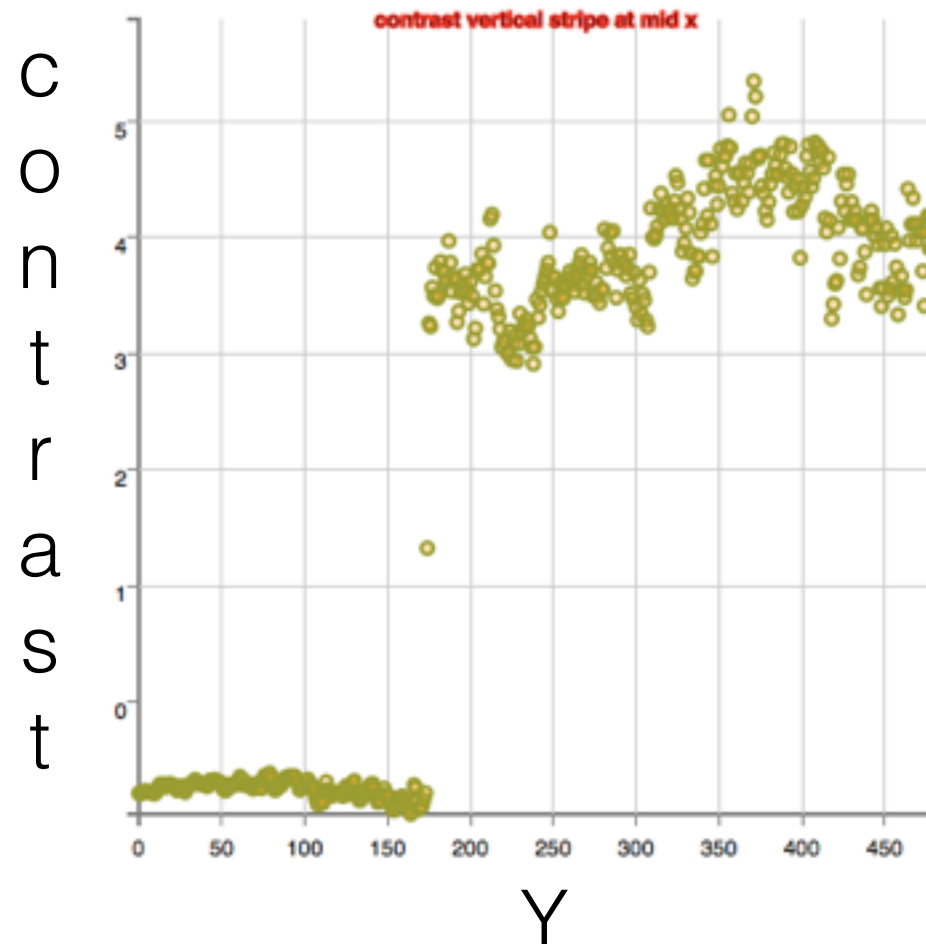`https://www.flickr.com/photos/stonehenge-stone-circle/11774684414/`

Y

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

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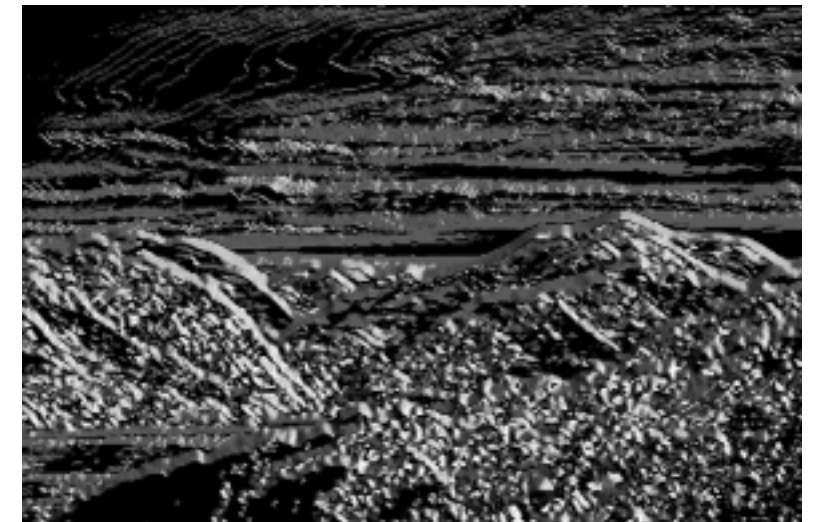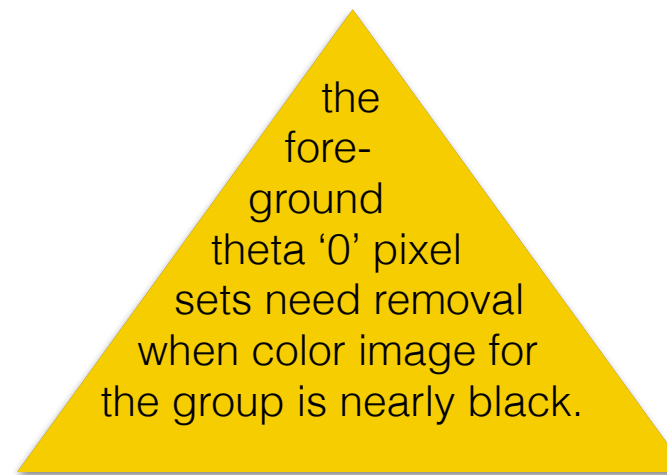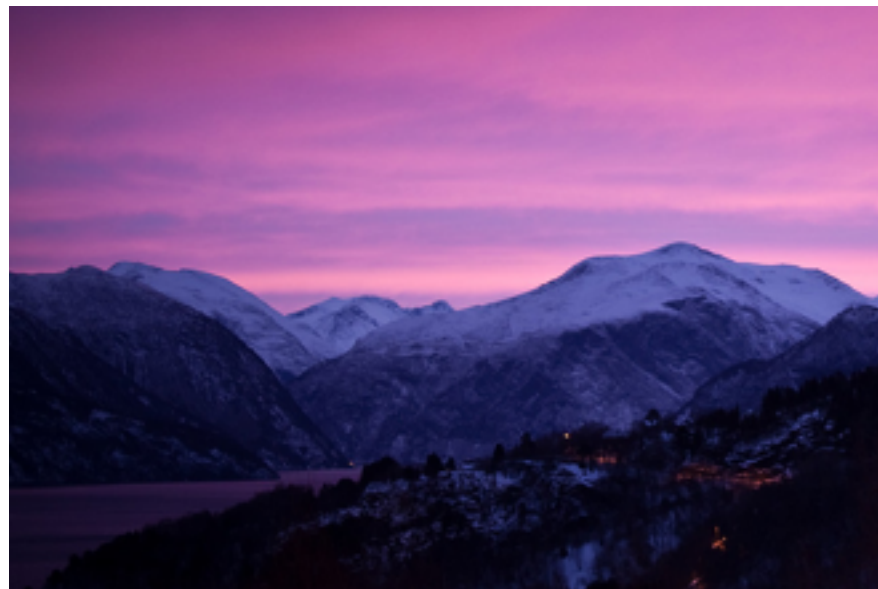skyline is where contrast incr, red decr. and reverses slope (plunges)

contrast vertical stripe at mid x

c o n t r a s t

Y

red vertical stripe at mid x
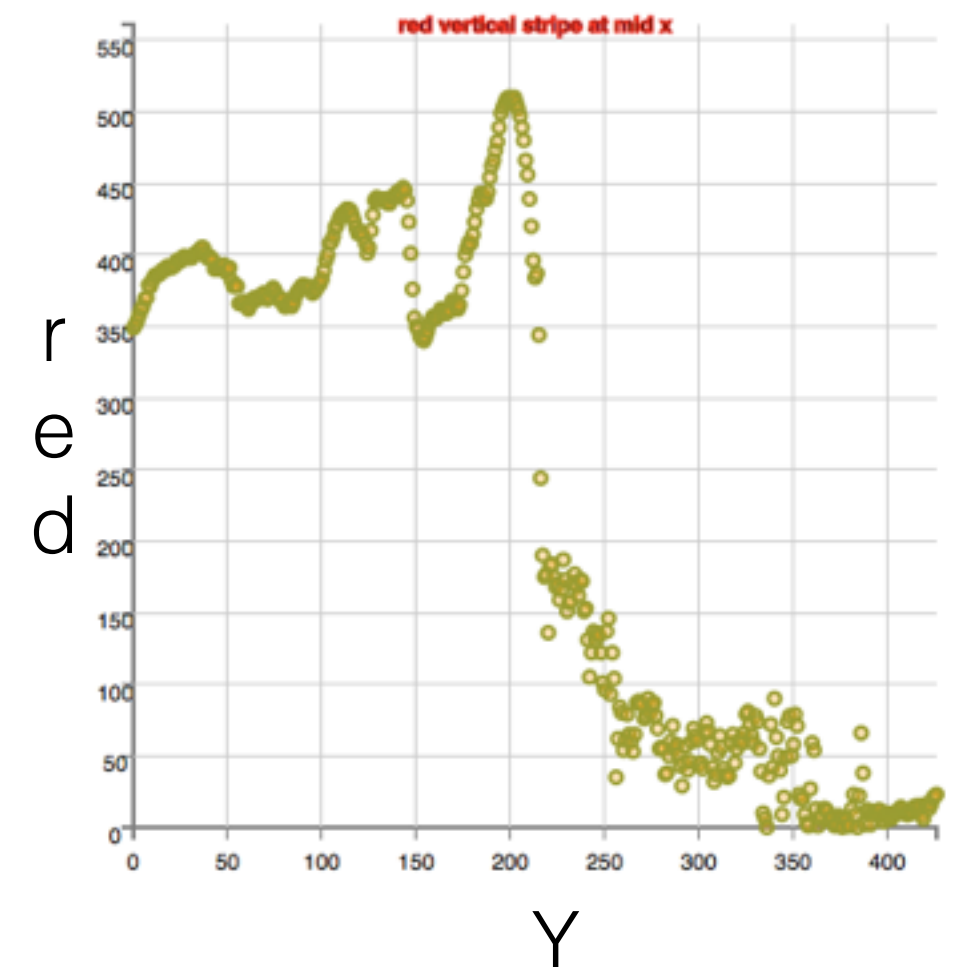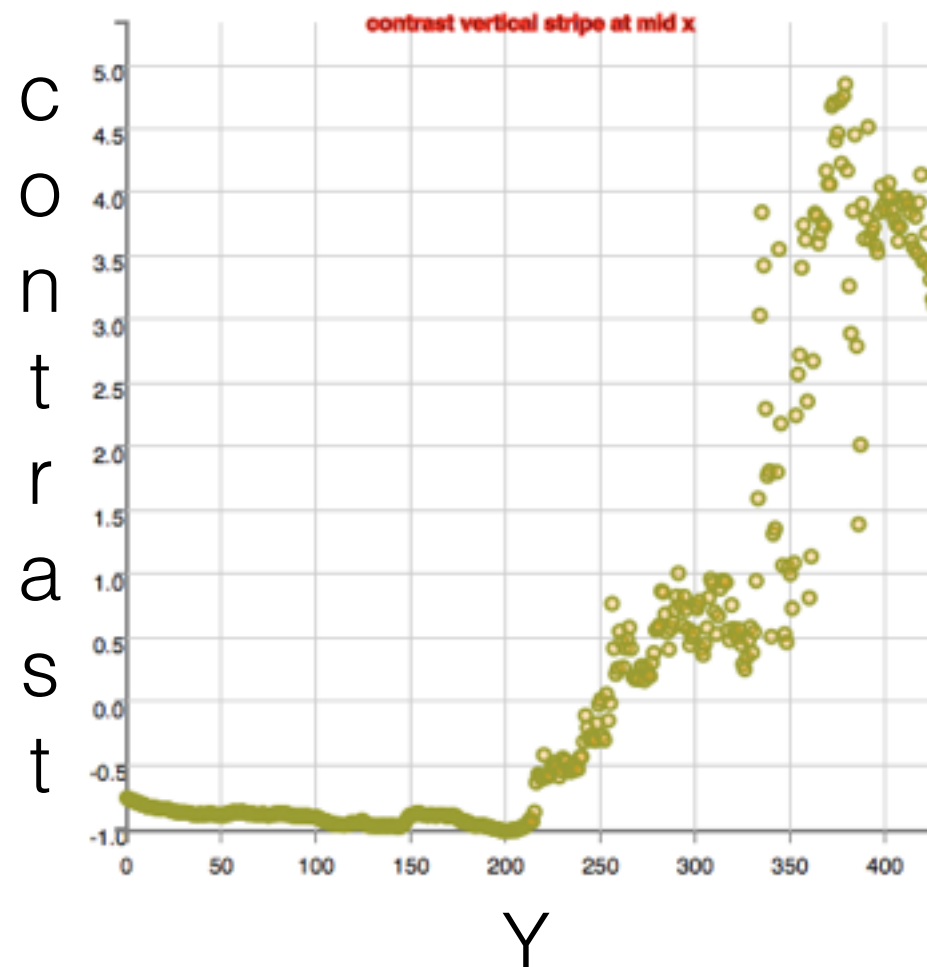
r e d

Y

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`

Y

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

purple sky + dark foreground:

skyline is where contrast incr, hue decr. and reverses slope (plunges) and so does red

contrast vertical stripe at mid x
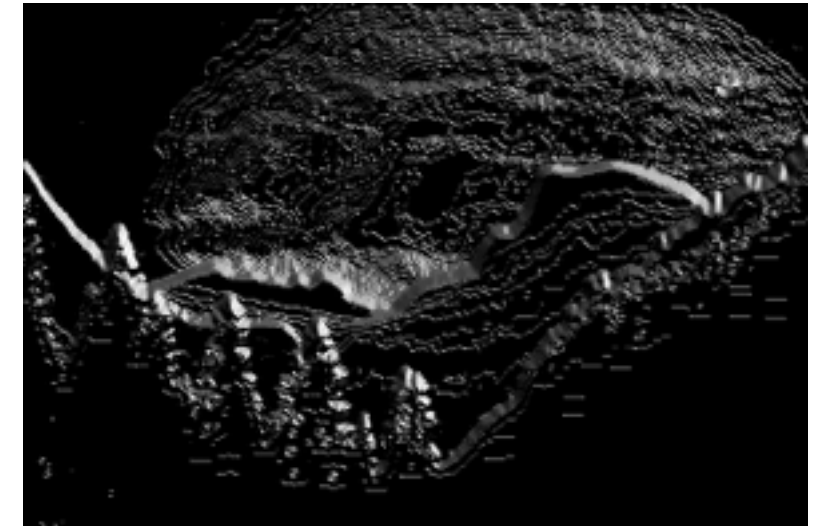

c
o
n
t
r
a
s
t

Y

red vertical stripe at mid x

r
e
d

Y

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

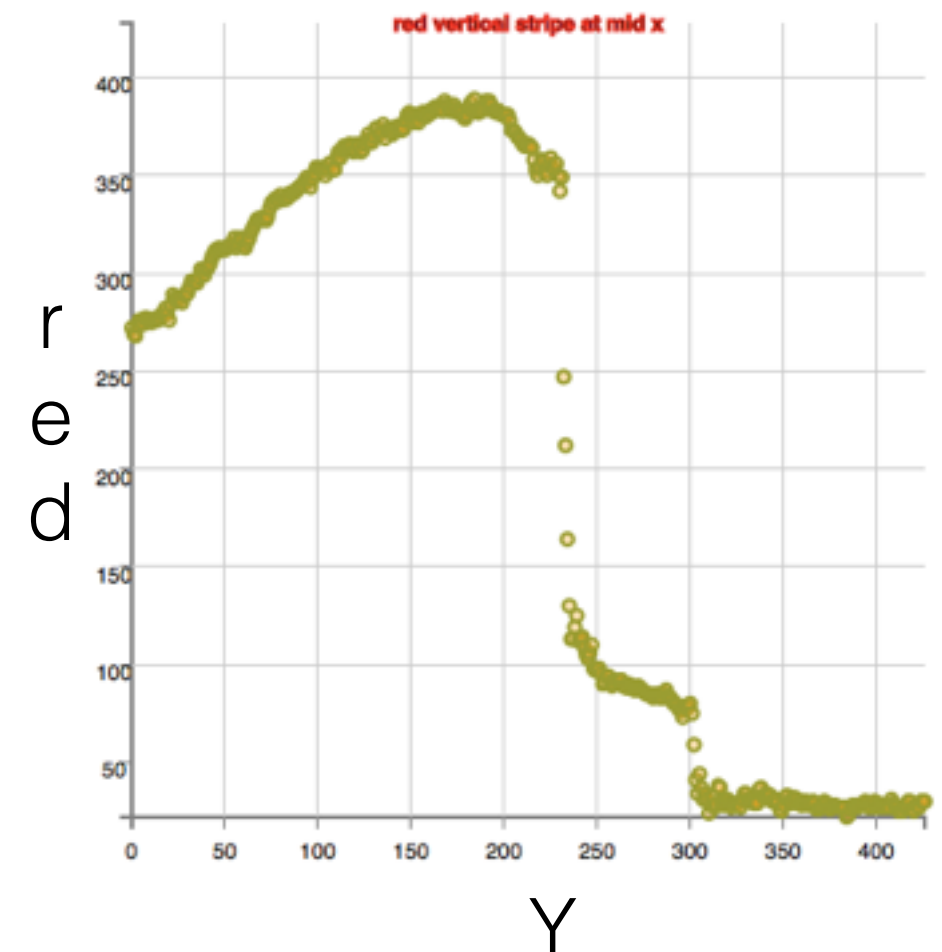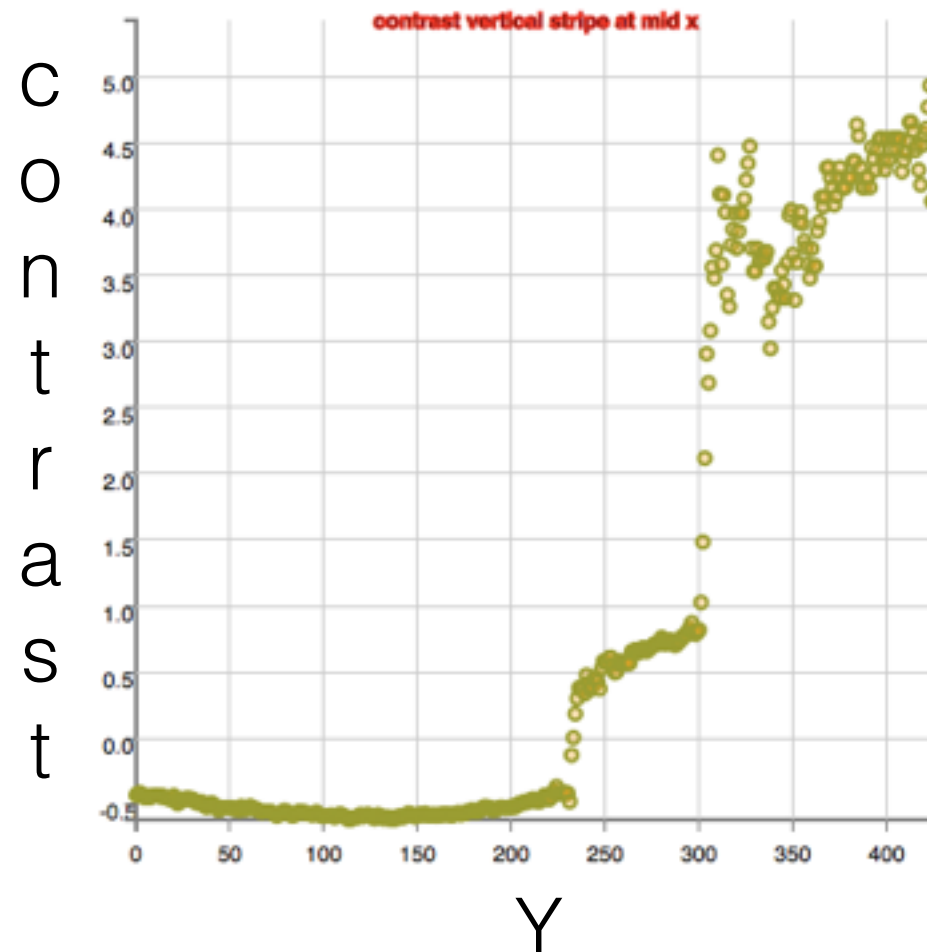`https://www.flickr.com/photos/7147684@N03/919374354`

Y

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

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

purple sky + dark foreground:

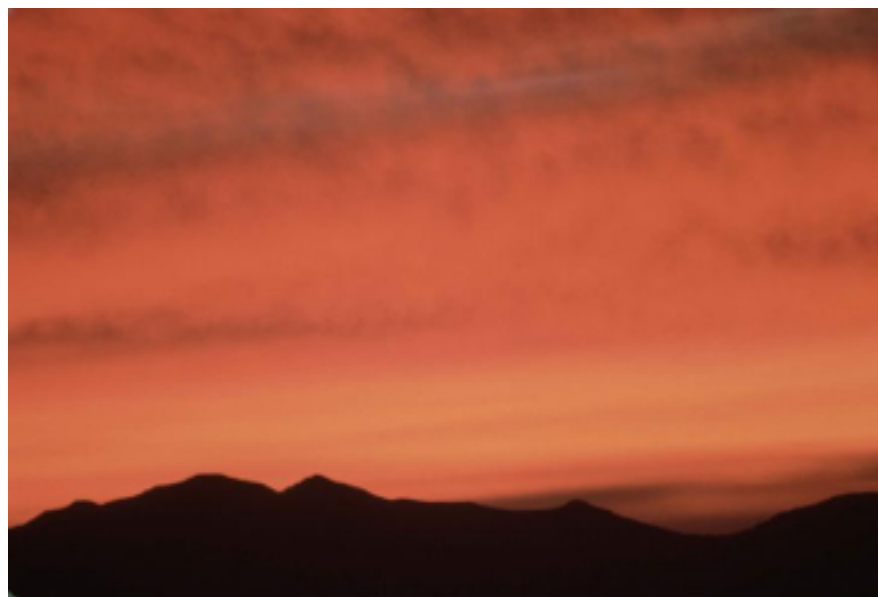skyline is where contrast incr, hue decr. and reverses slope (plunges) and so does red
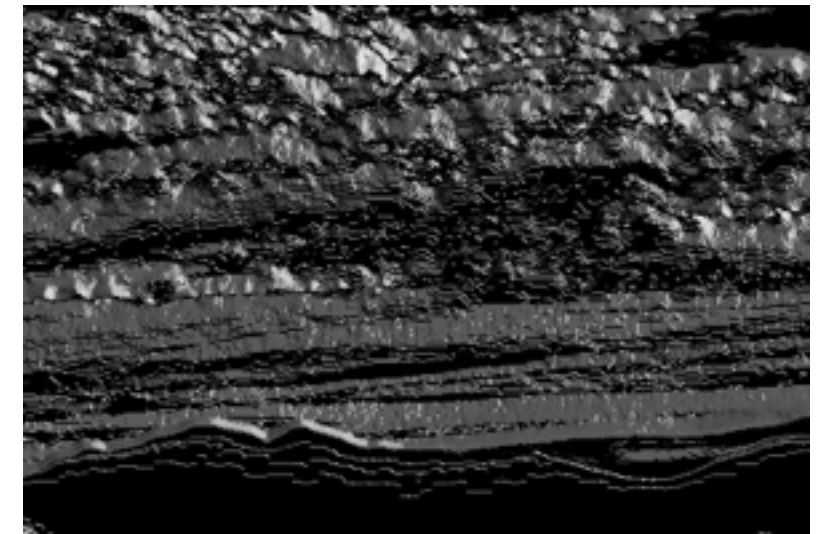

contrast vertical stripe at mid x

contrast

Y

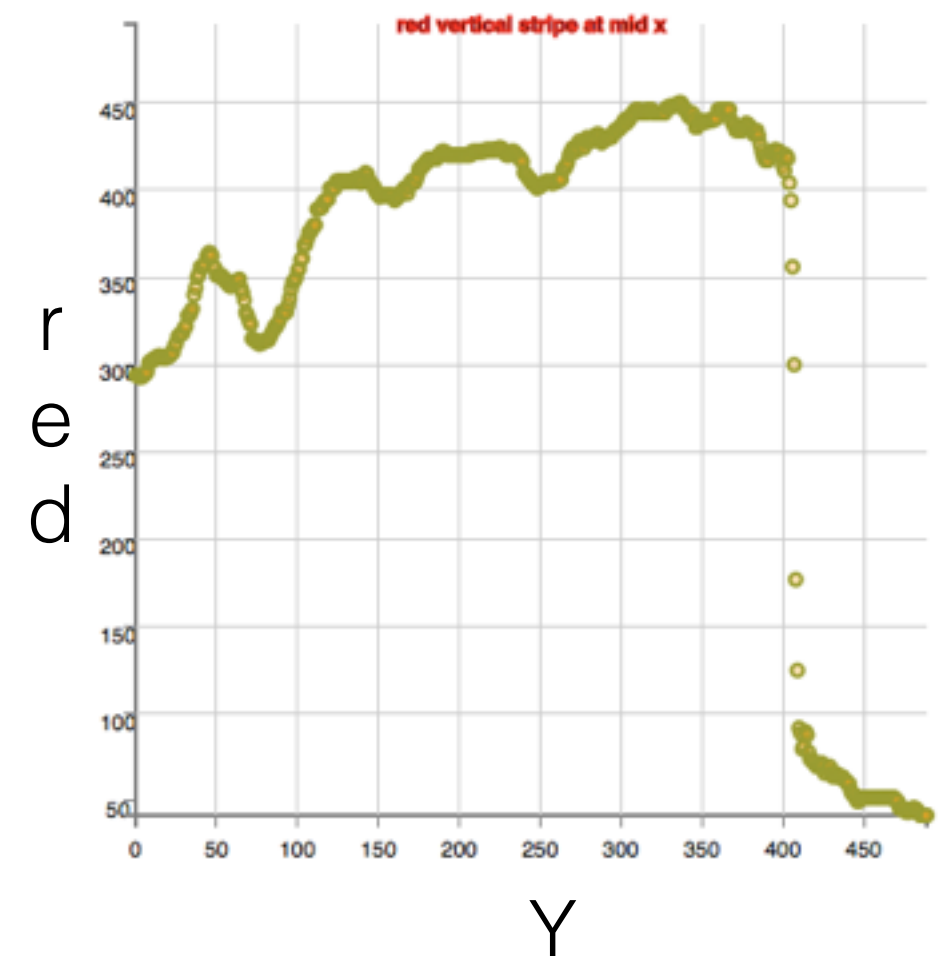
red vertical stripe at mid x

red

Y

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

Y

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, hue decr. and reverses slope (plunges) and so does red

c o n t r a s t

contrast vertical stripe at mid x

0.30
0.25
0.20
0.15
0.10
0.05

0   50   100 150 200 250 300 350 400 450

Y

r e d

red vertical stripe at mid x

450
400
350
300
250
200
150
100
50
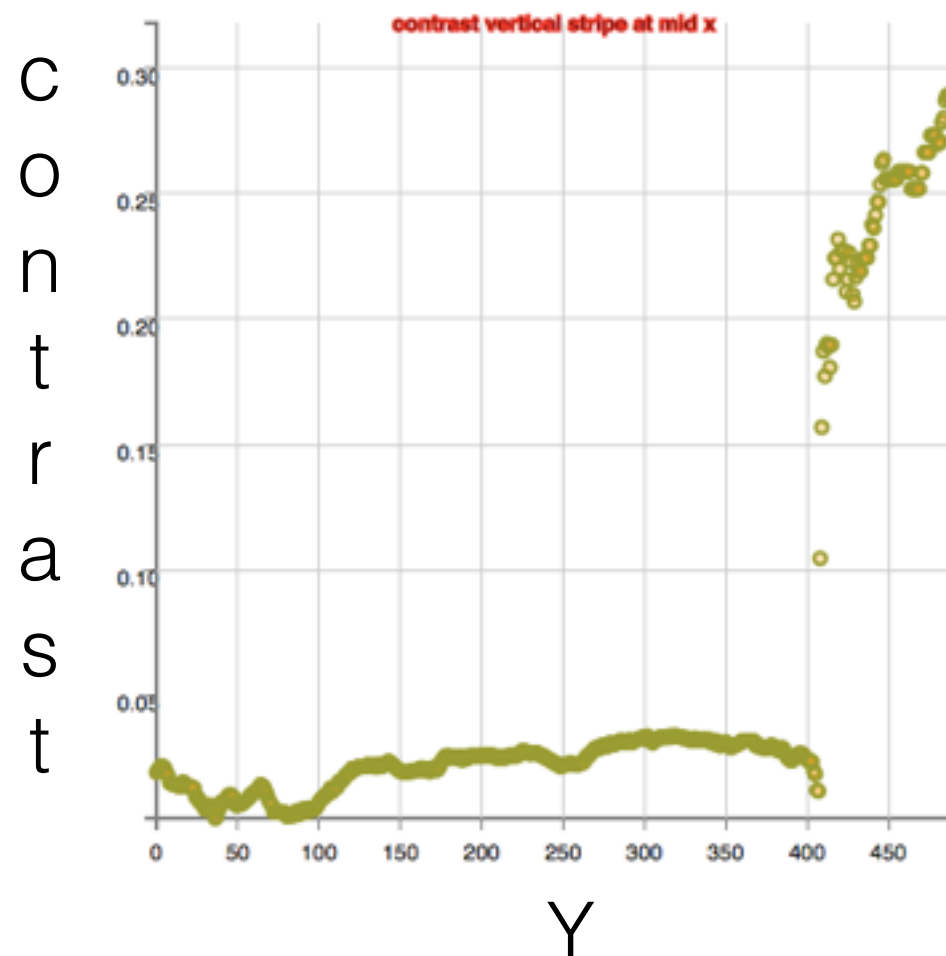
0   50   100 150 200 250 300 350 400 450

Y

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

Y

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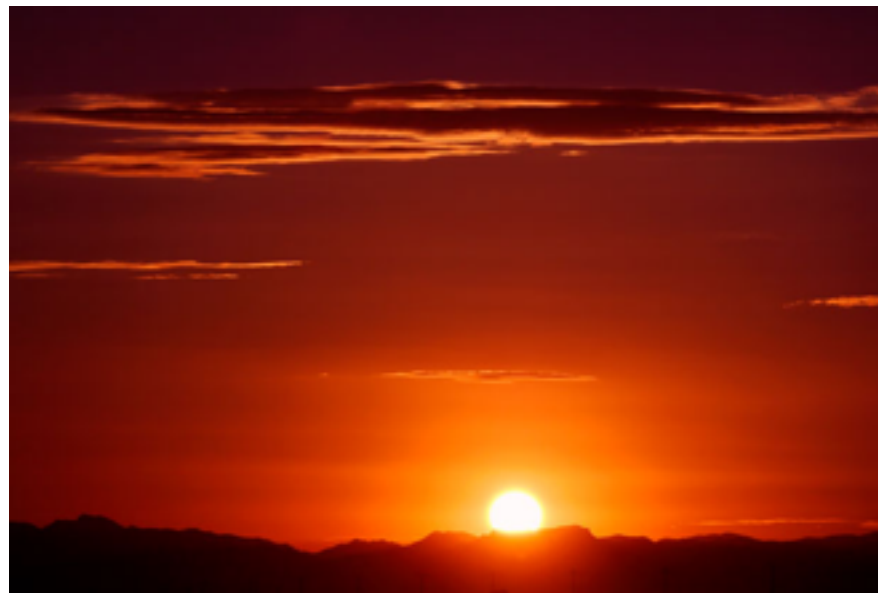

red sky + dark foreground:

skyline is where contrast incr, hue decr, and reverses slope (plunges) and so does red
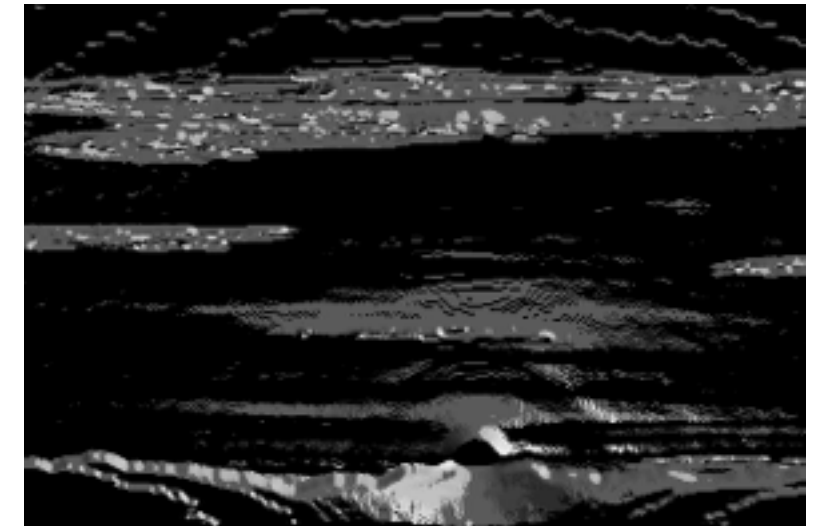
contrast vertical stripe at mid x

c o n t r a s t

Y

red vertical stripe at mid x

r e d

Y