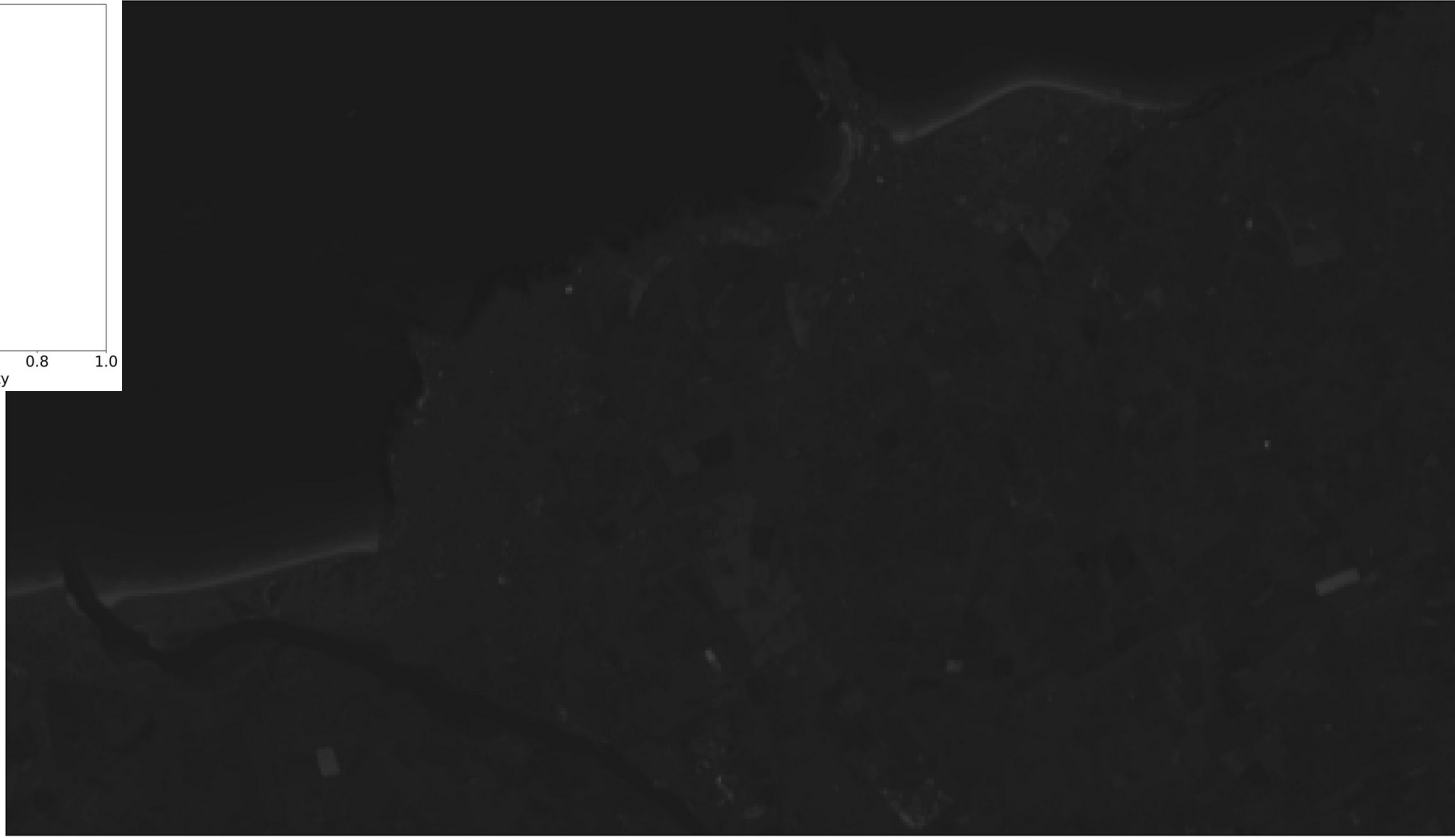
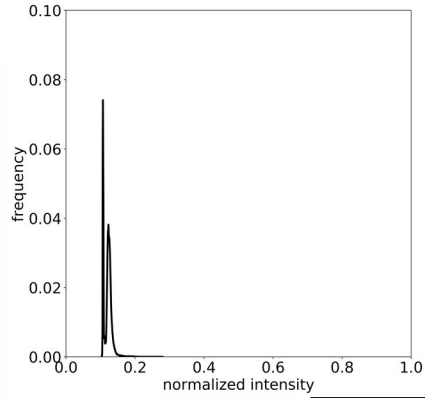


EGM310: GIS and Remote Sensing

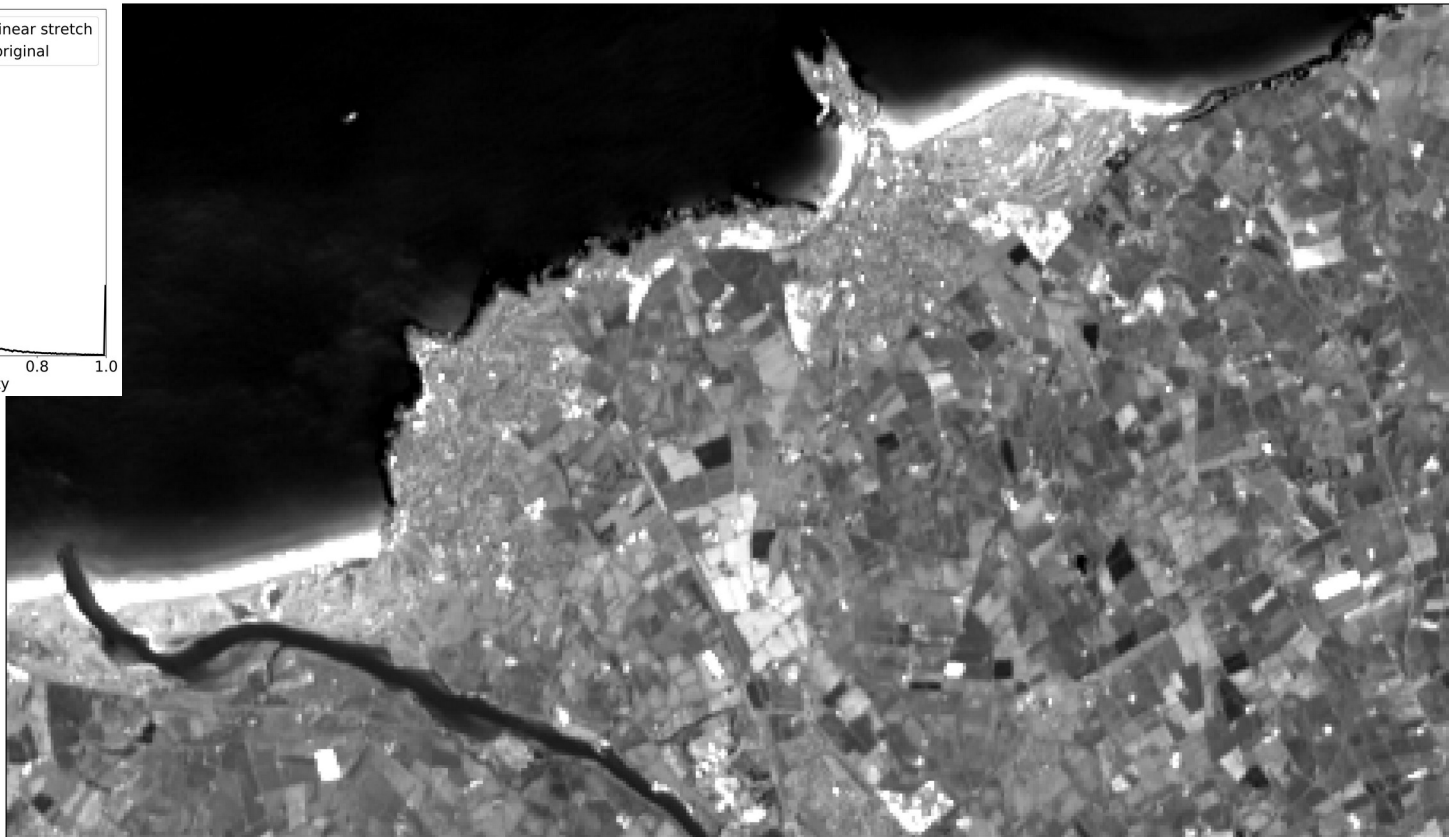
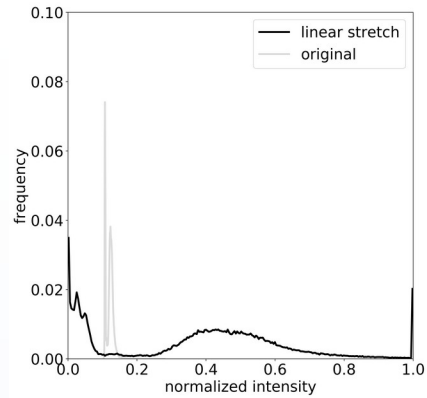
Week 11, Part 2: Image Enhancements

- Sometimes, we want to improve the appearance of an image:
 - Aid visual interpretation
 - Aid other analysis
 - Presentation
- Broad classes we will discuss:
 - Contrast stretching
 - Histogram manipulation
 - Filtering

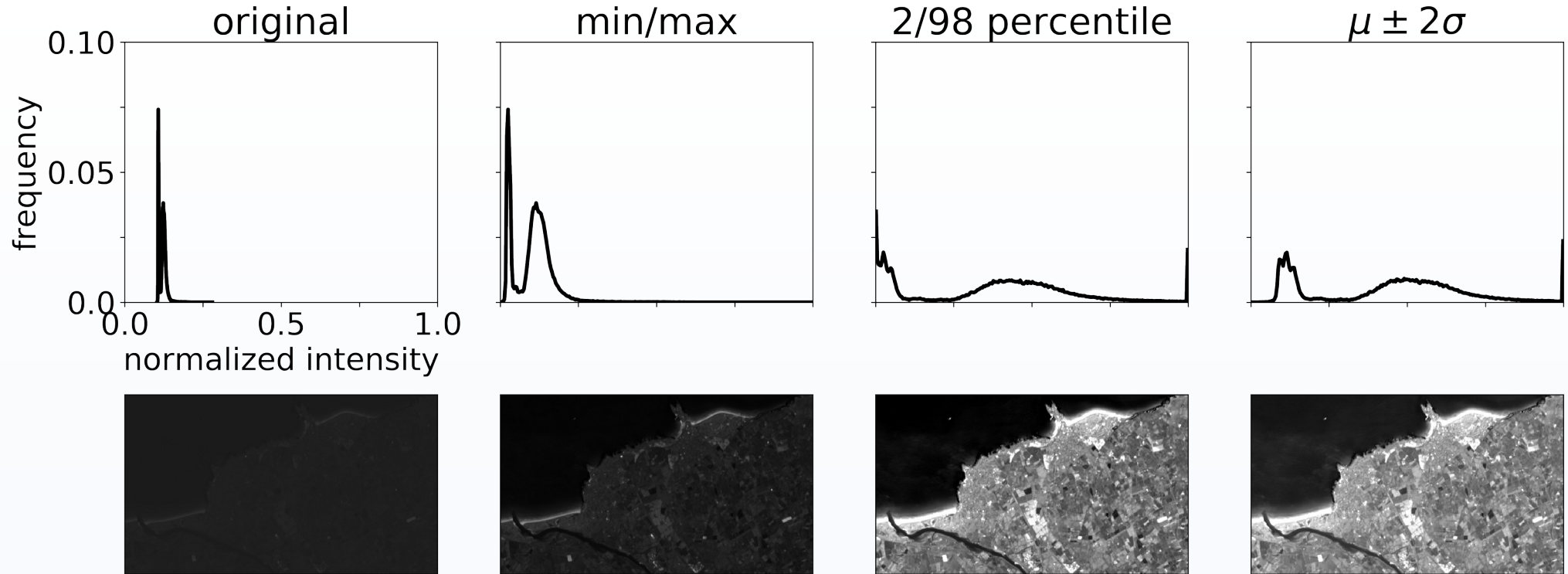
Low-contrast images

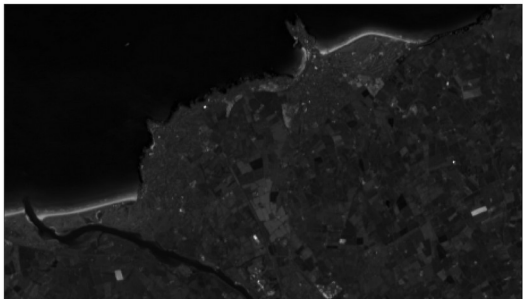
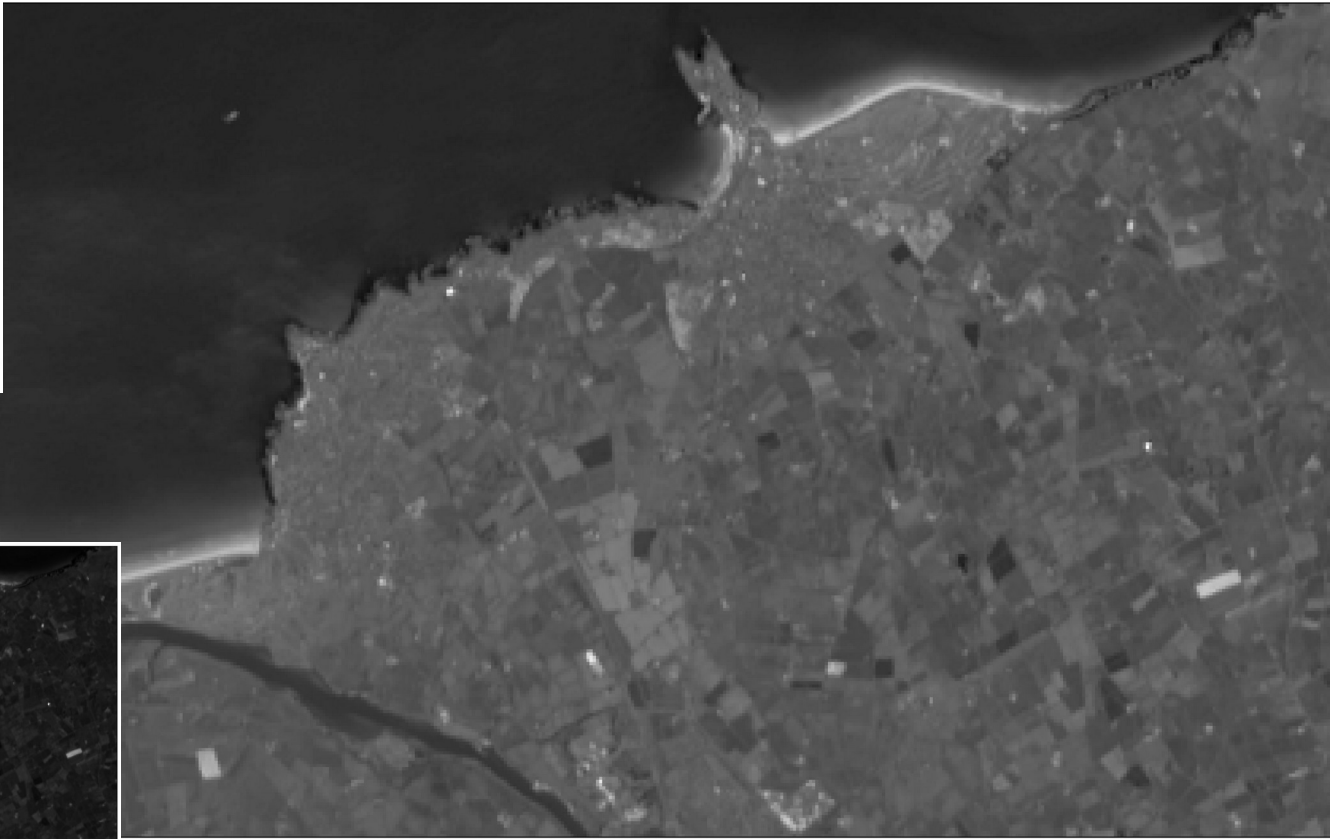
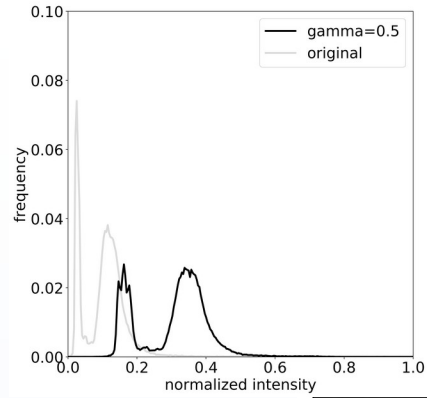


Linear contrast stretch

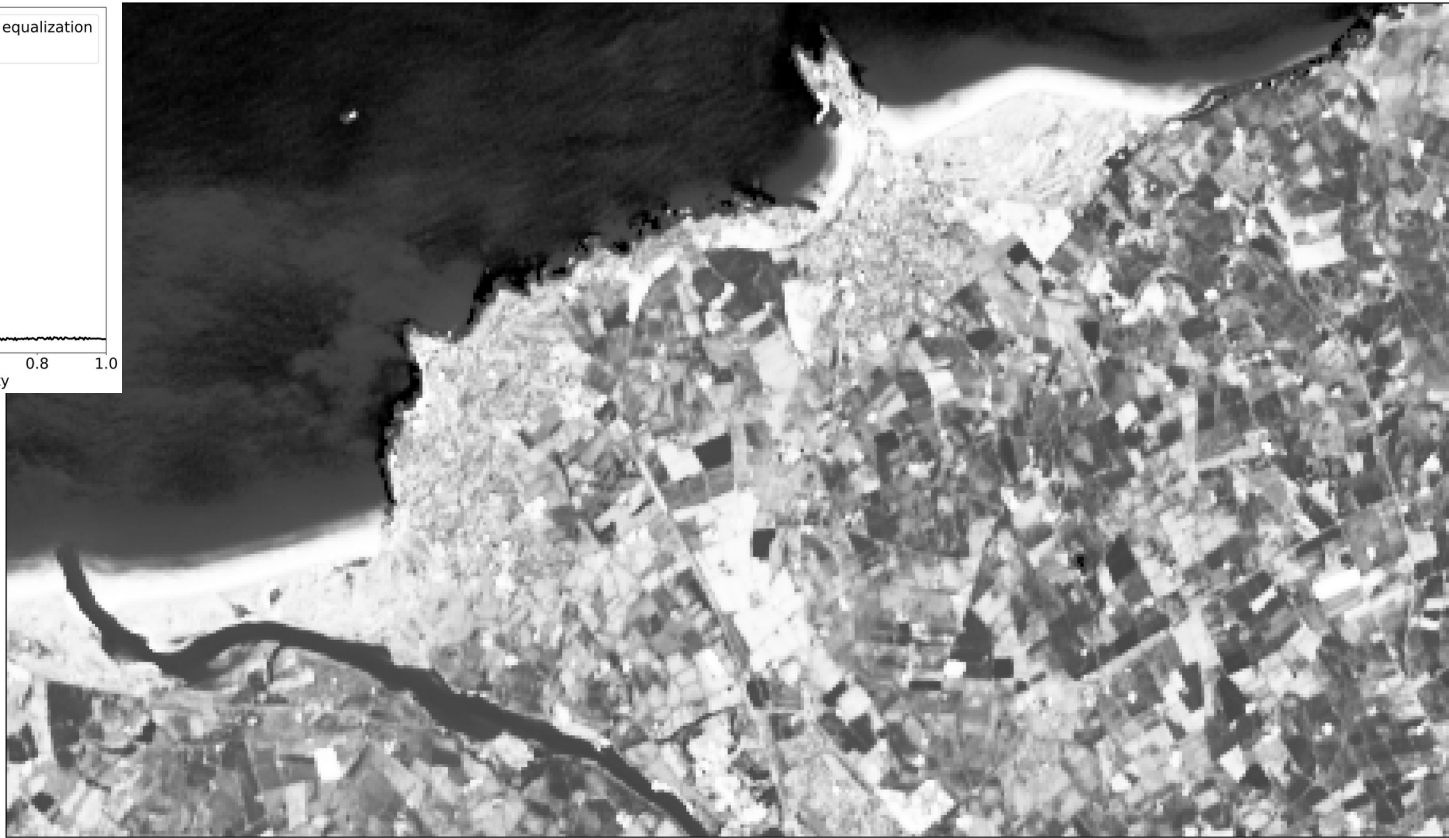
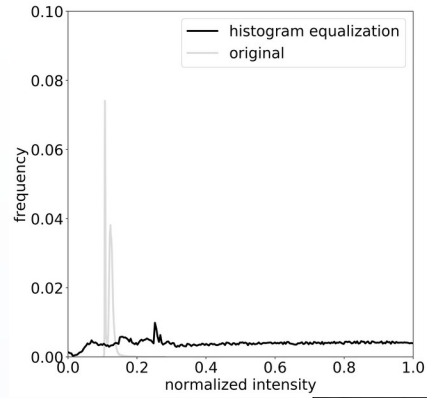


Linear contrast stretch

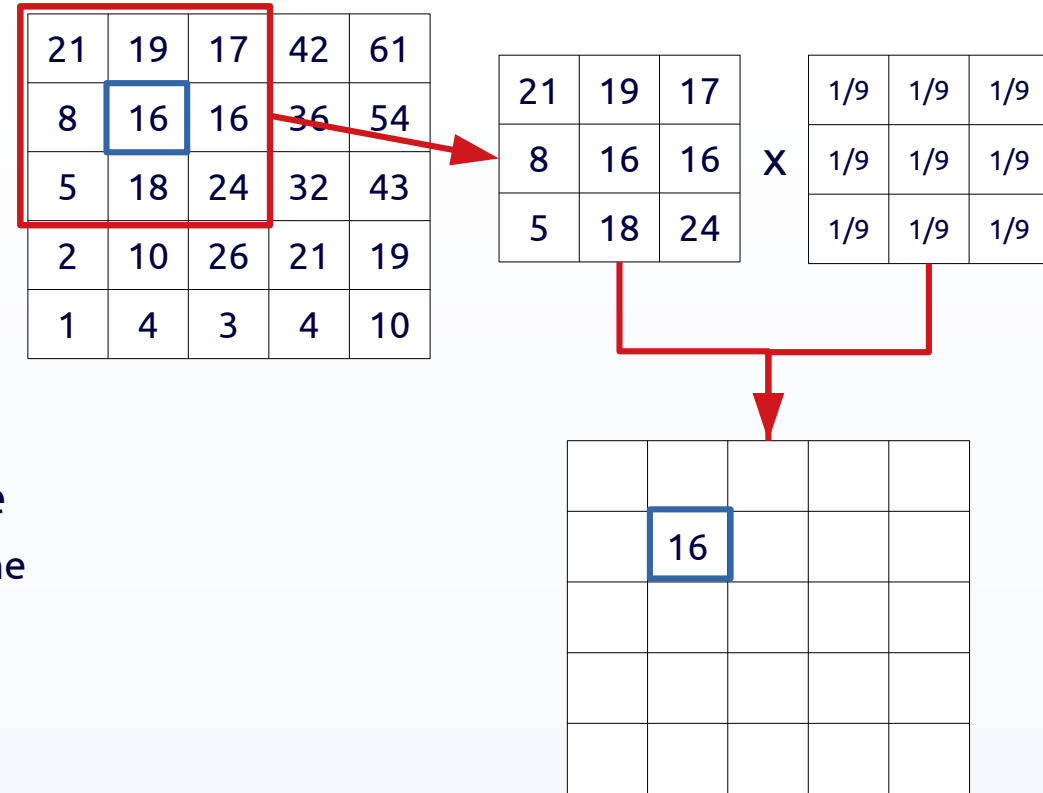




Histogram equalization



- Filters enhance or smooth image data
- Can highlight certain features, suppress other ones
- Uses:
 - Edge detection
 - Sharpening
 - Noise reduction
- Convolve a kernel (window) with the image
 - For each pixel, calculate the new value using the values that fall within the window
 - Example: 3x3 mean filter



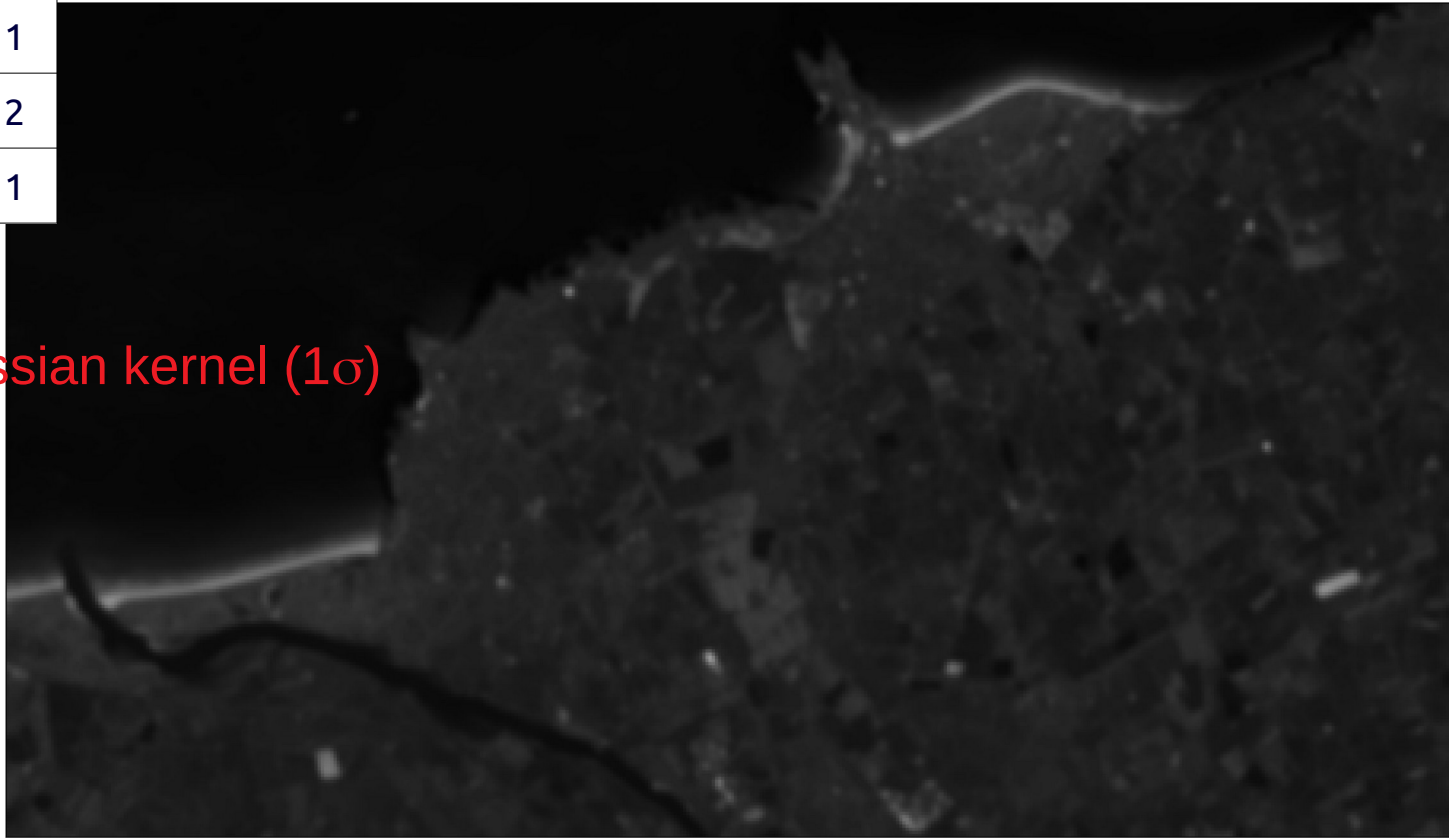
Low-pass (smoothing) filter

$$\frac{1}{16}$$

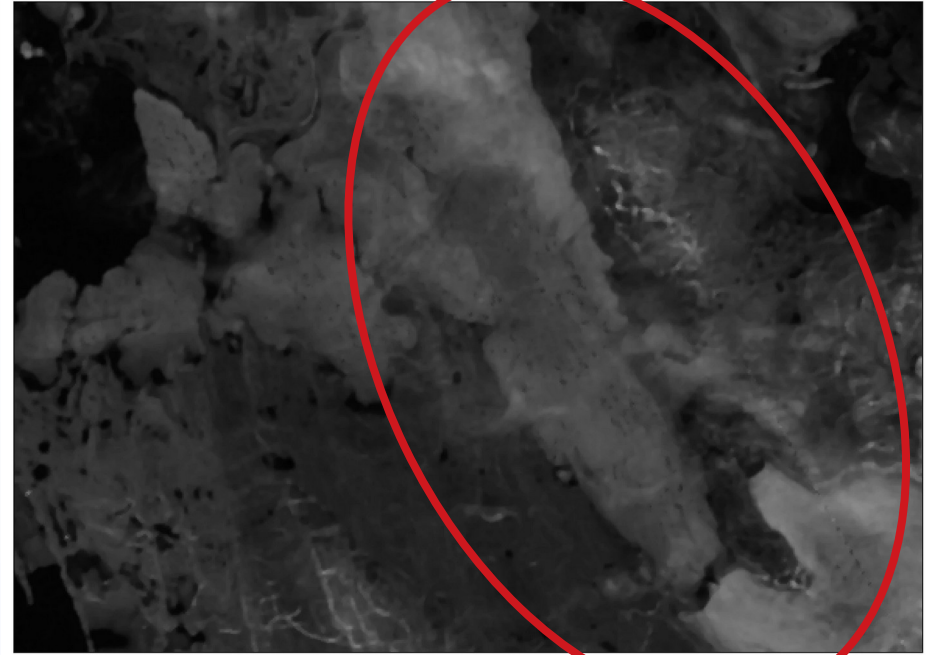
1	2	1
2	4	2
1	2	1



3x3 Gaussian kernel (1σ)

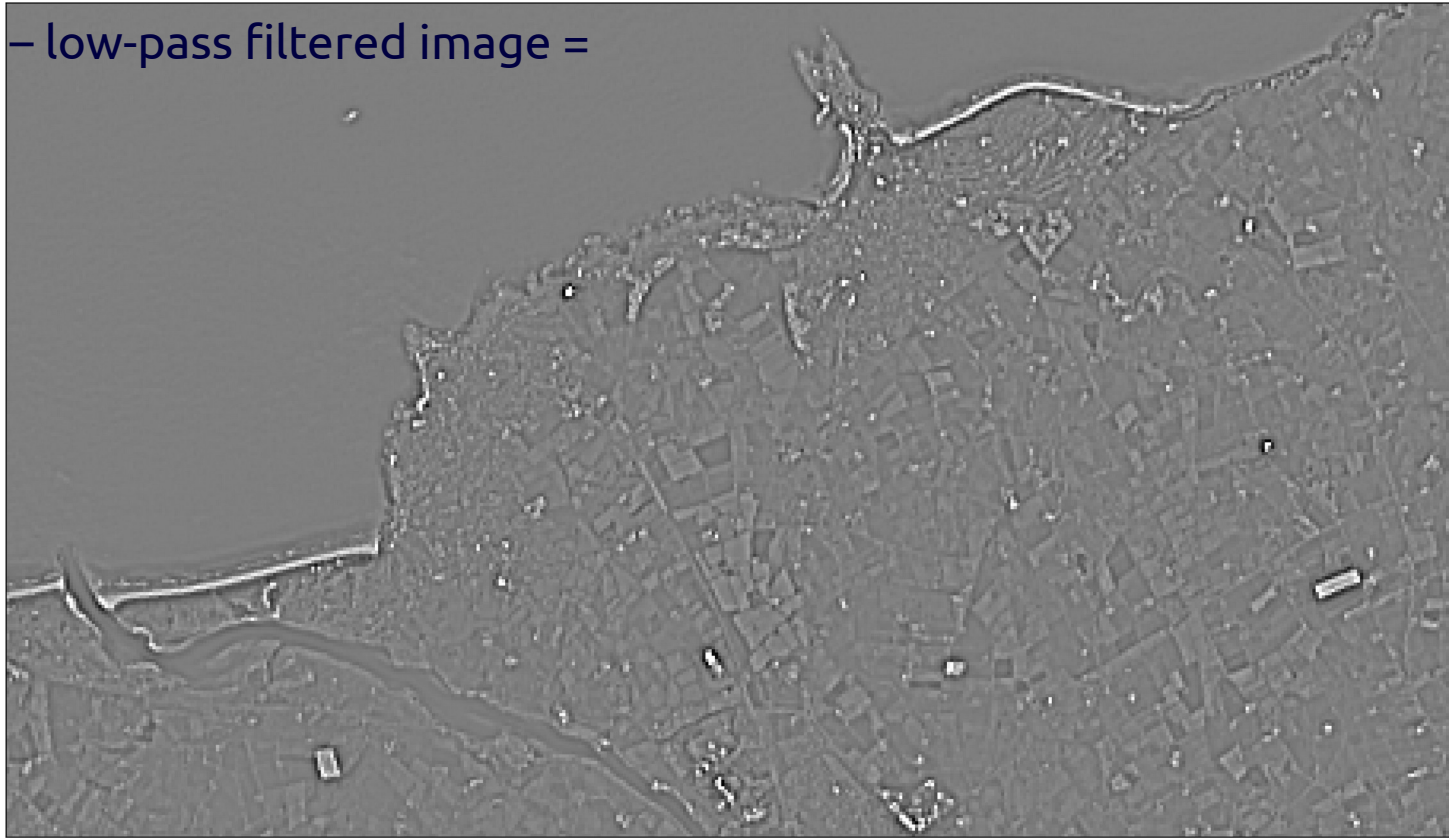


Example: noise reduction



High-pass (sharpening) filter

original image – low-pass filtered image =



Edge filters

-1	0	1
-2	0	2
-1	0	1

← horizontal (x)

vertical (y) →

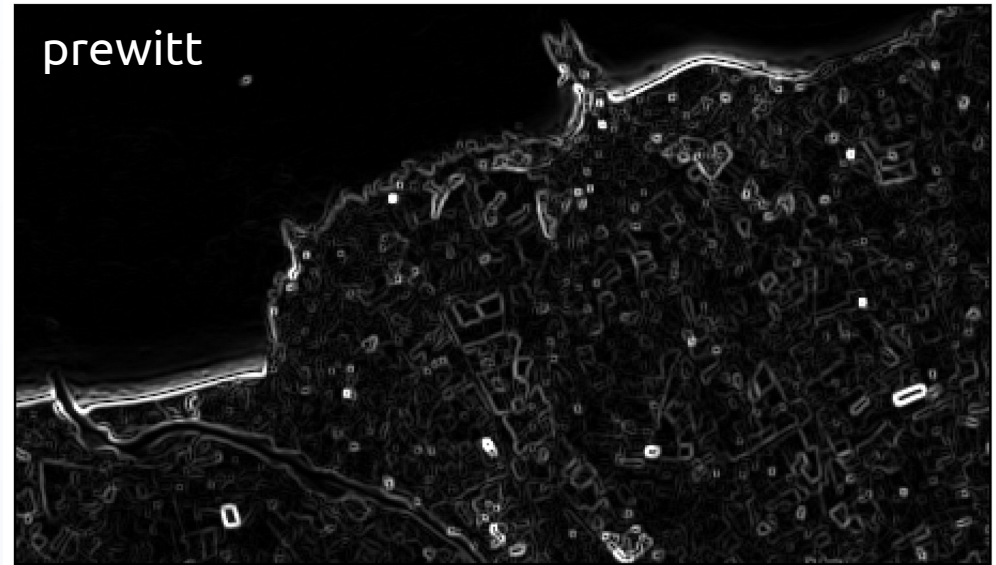
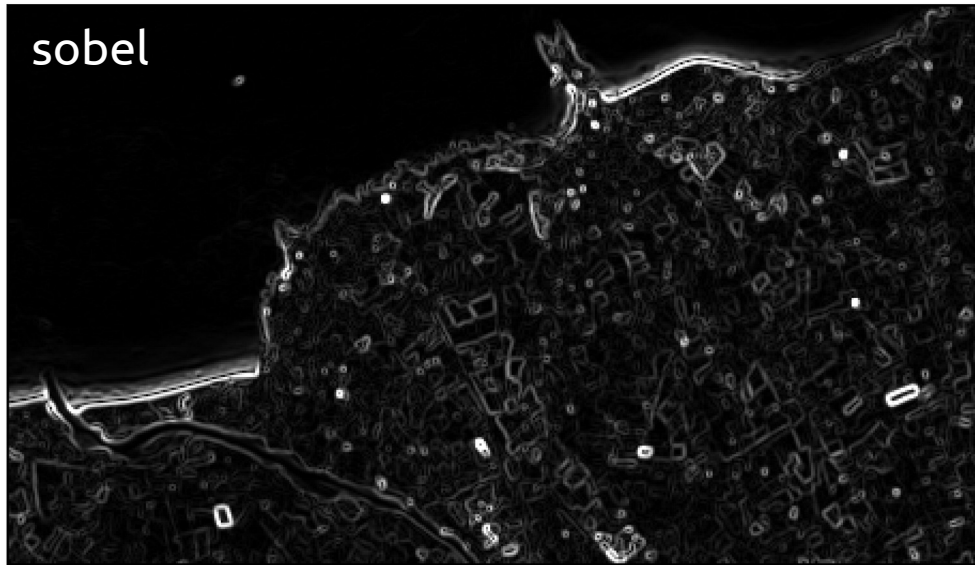
-1	-2	-1
0	0	0
1	2	1

-1	0	1
-1	0	1
-1	0	1

← horizontal

vertical →

-1	-1	-1
0	0	0
1	1	1



- Enhancements help us visually interpret images
- Can also help reduce noise in images
- Contrast stretching:
 - Increase contrast to utilize more of the range of values
- Filtering:
 - Reduce (or enhance) small-scale variation in image
 - Can be used to find edges

- Lillesand, Kiefer & Chipman – Chapter 7
- Campbell & Wynne – Chapter 4
- Natural Resources Canada [Remote Sensing Tutorials](#)
- How Blurs & Filters Work [[computerphile](#)]
- Finding the Edges (Sobel Operator) [[computerphile](#)]
- Contrast Stretching in ArcGIS [[Karen Joyce](#)]