Lyell Glacier

Change between 1999 and 2016

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GIST58, Spring 2021

Mount Lyell and the Lyell Glacier August, 1901. Photo by G. K. Gilbert (courtesy USGS)

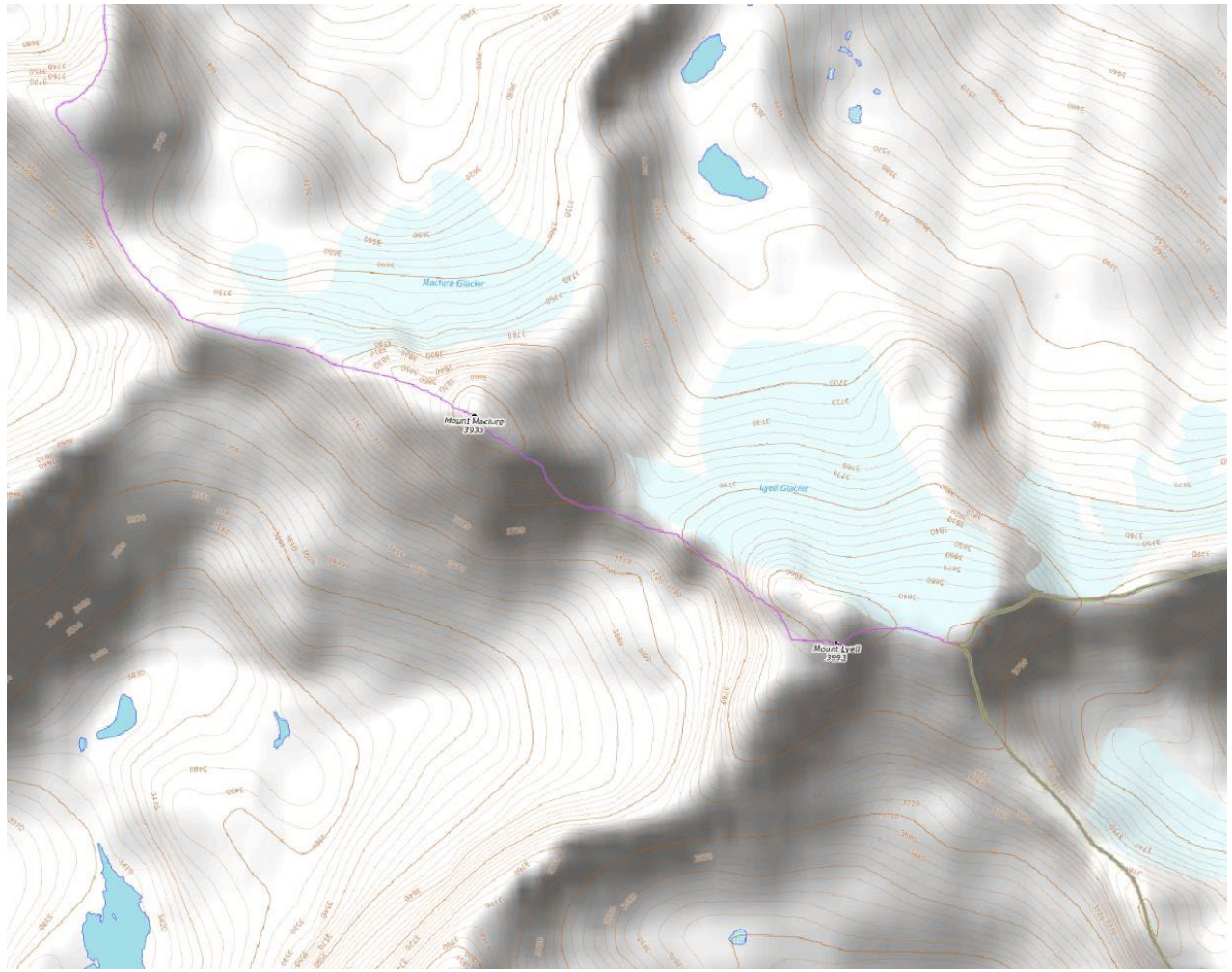
Same view in September 2011. Note that the eastern (left side of photo) lobe of the glacier is mostly gone.
Photo by Jonathan Byers

Location

- Yosemite National Park
- California, USA

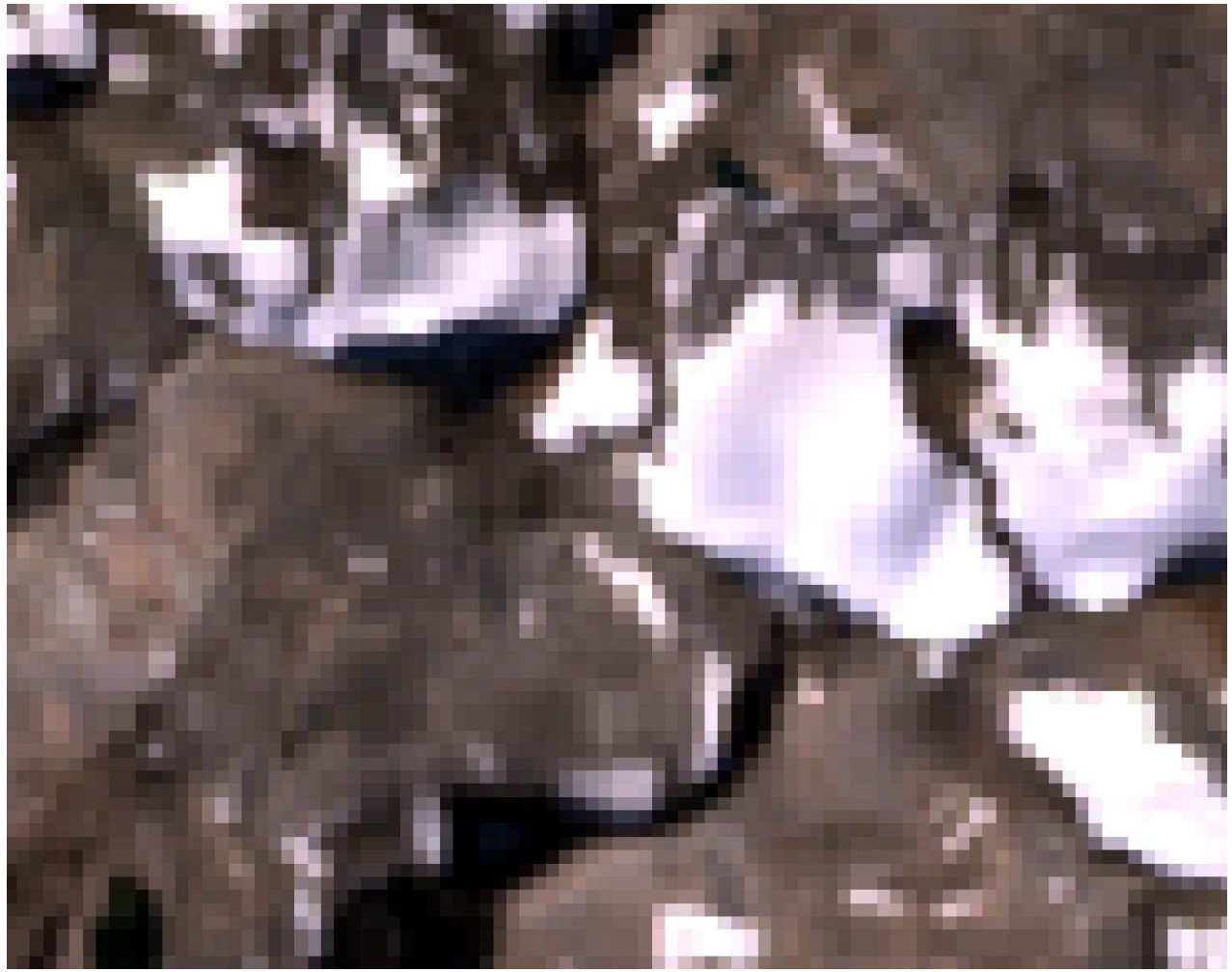
Study area

- 4.6 x 4.2 km
- 19.6 km^2
- Mt. Lyell glacier
- Mt. McClure glacier



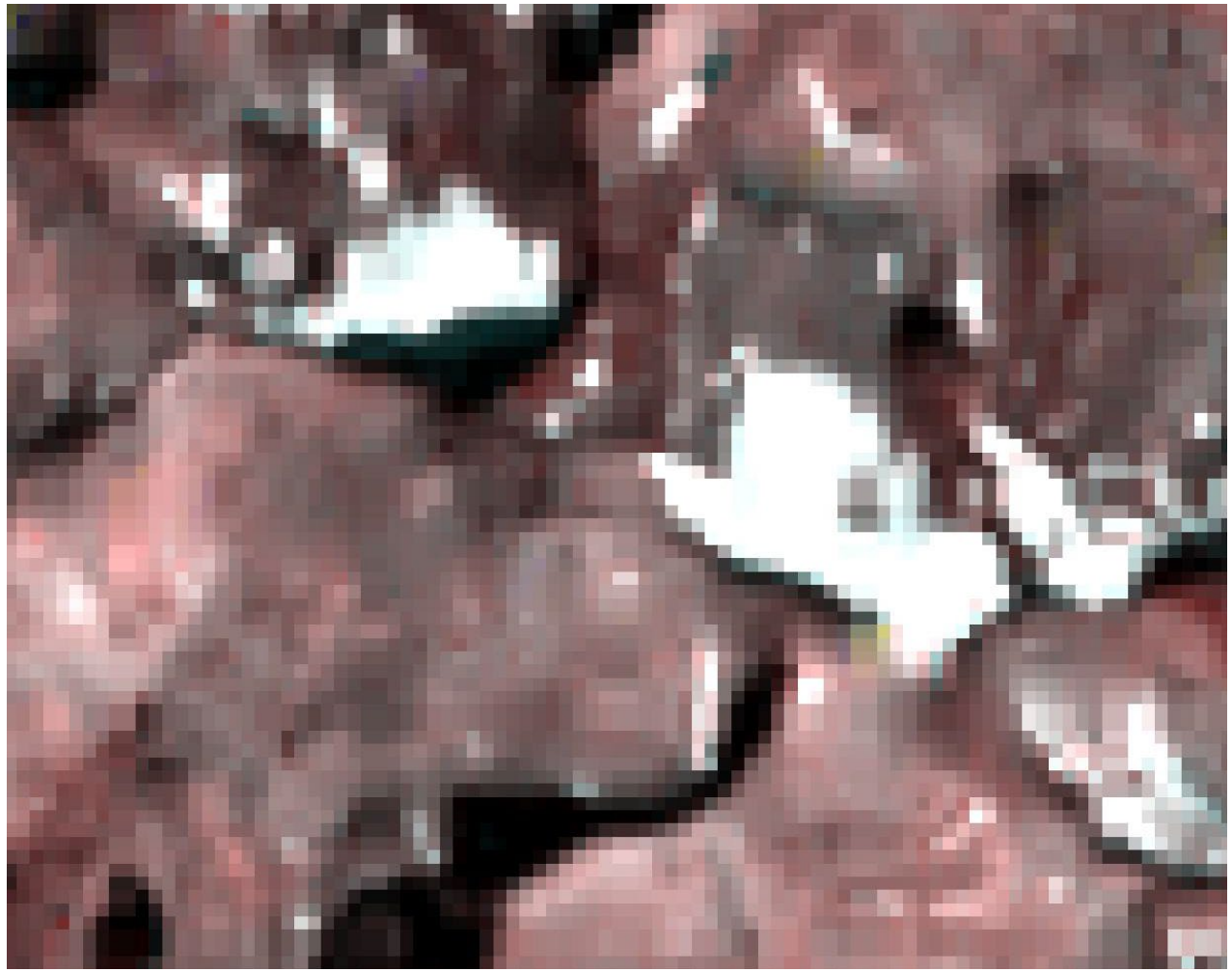
True color

- 1999
- 27th September
- Path 42, row 34
- LE70420341999270EDC00
- 164 x 149 pixels
- 24,436 pixels
- 28.33 x 28.33 m pixels size



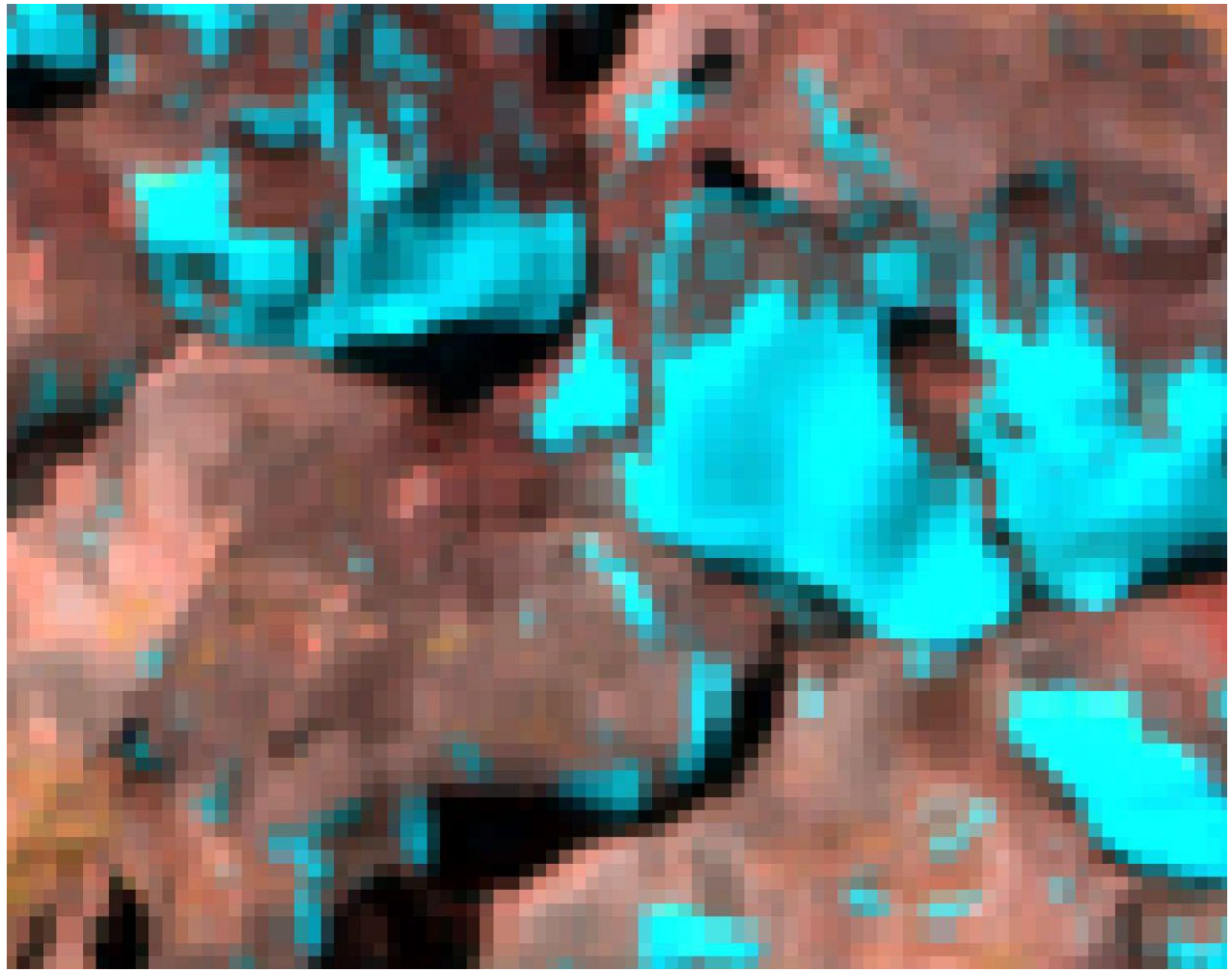
True color

- 2016
- 25th September
- Path 42, row 34
- LE70420342016269EDC01
- 164 x 149 pixels
- 24,436 pixels
- 28.33 x 28.33 m pixels size



False color

- 1999
- “543”
- Red: Band 5/Short-wave IR
- Green: Band 4/Near-Infrared
- Blue: Band 3/Red
- Cyan is snow



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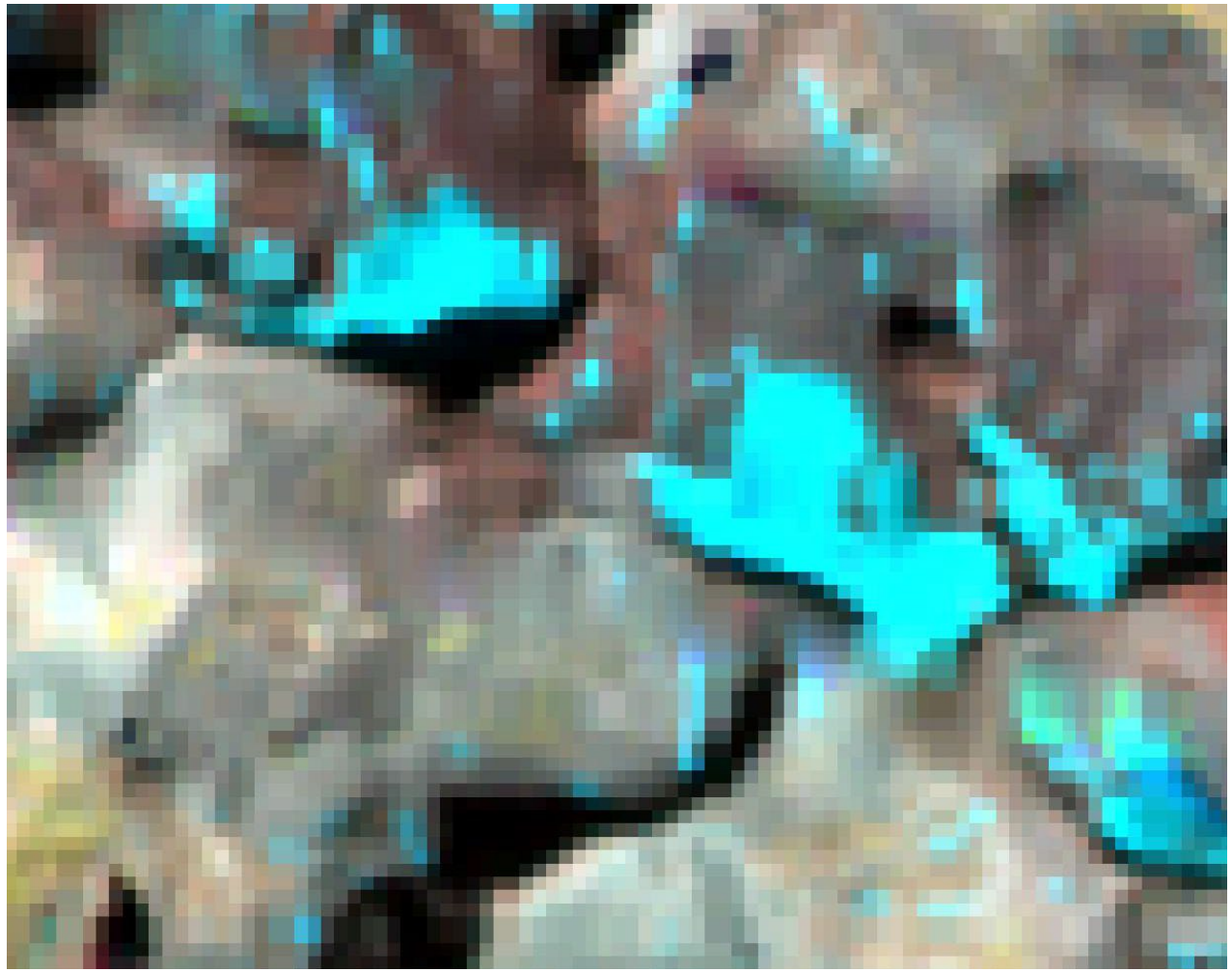
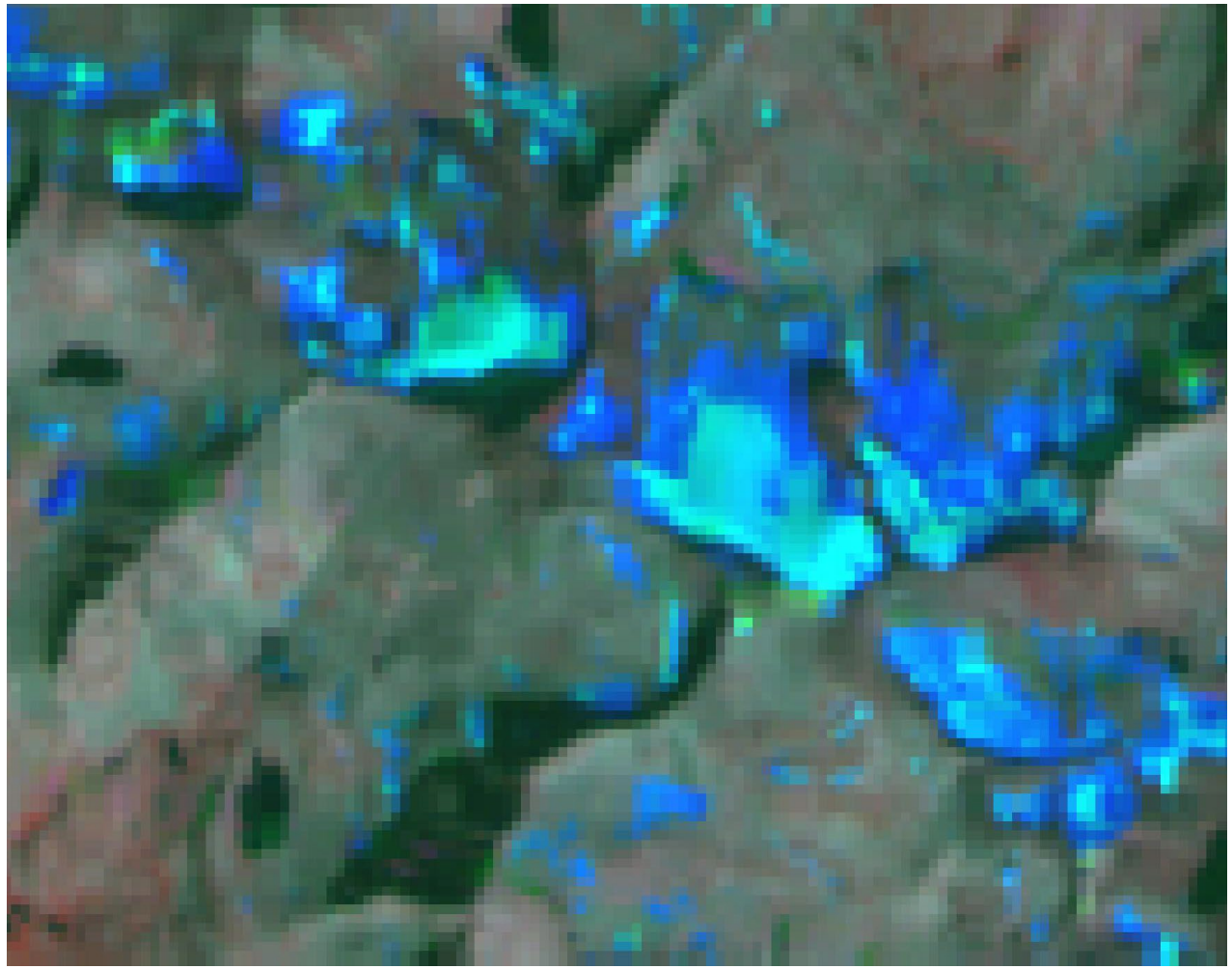


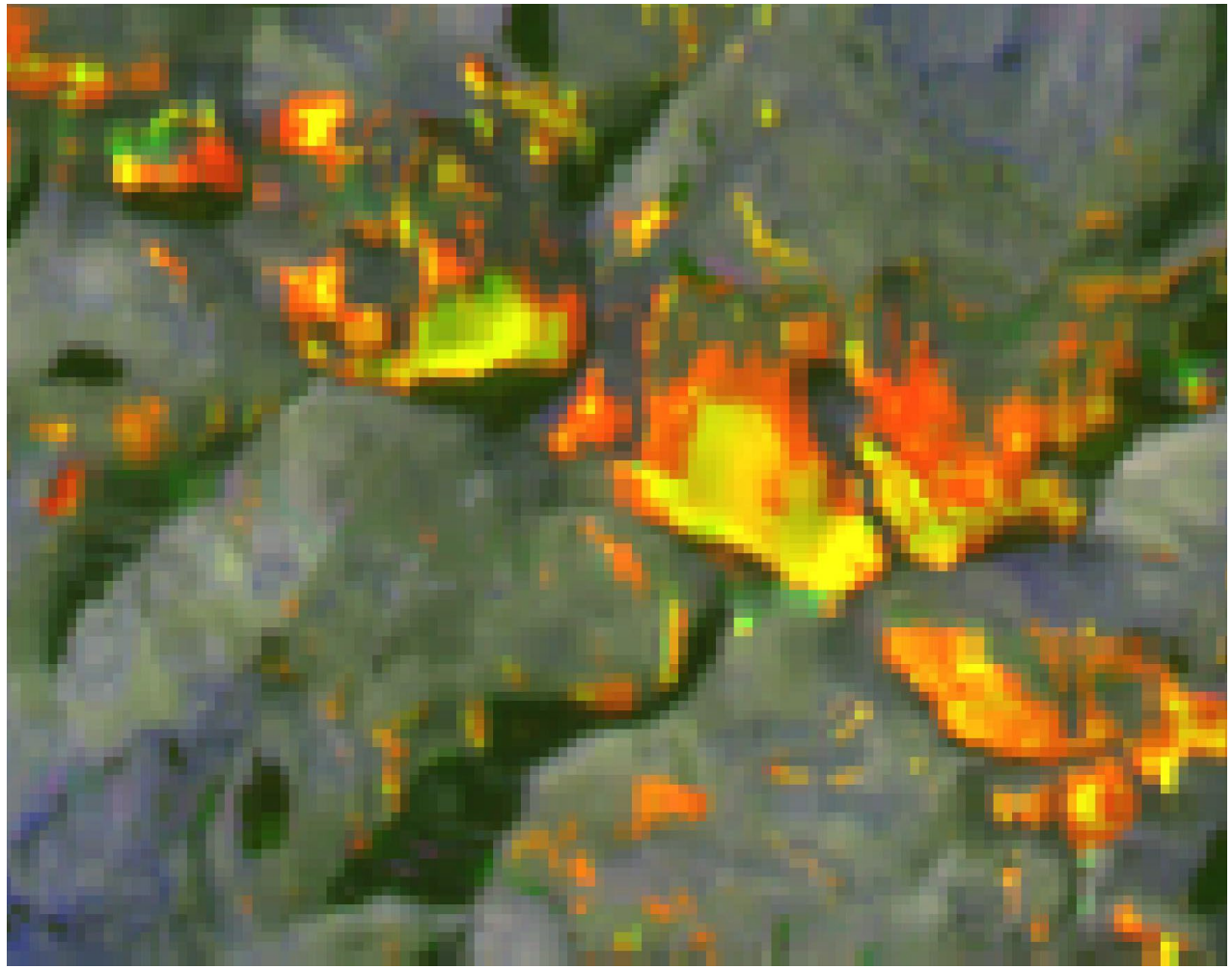
Overall change

- False color image
  - Red: band 5 (1999)
  - Green: band 2 (2016)
  - Blue: band 2 (1999)
- Cyan is snow
- Blue is loss of snow



Overall change

- False color image
  - Red: band 2 (1999)
  - Green: band 2 (2016)
  - Blue: band 5 (1999)
- Yellow is snow
- Orange is loss of snow



NDSI

- 1999
- Band 2/Green
- Band 5/Short-wave Infrared
- (Band2–Band5)/(Band2+Band5)
- >=0.4 indicates presence of snow

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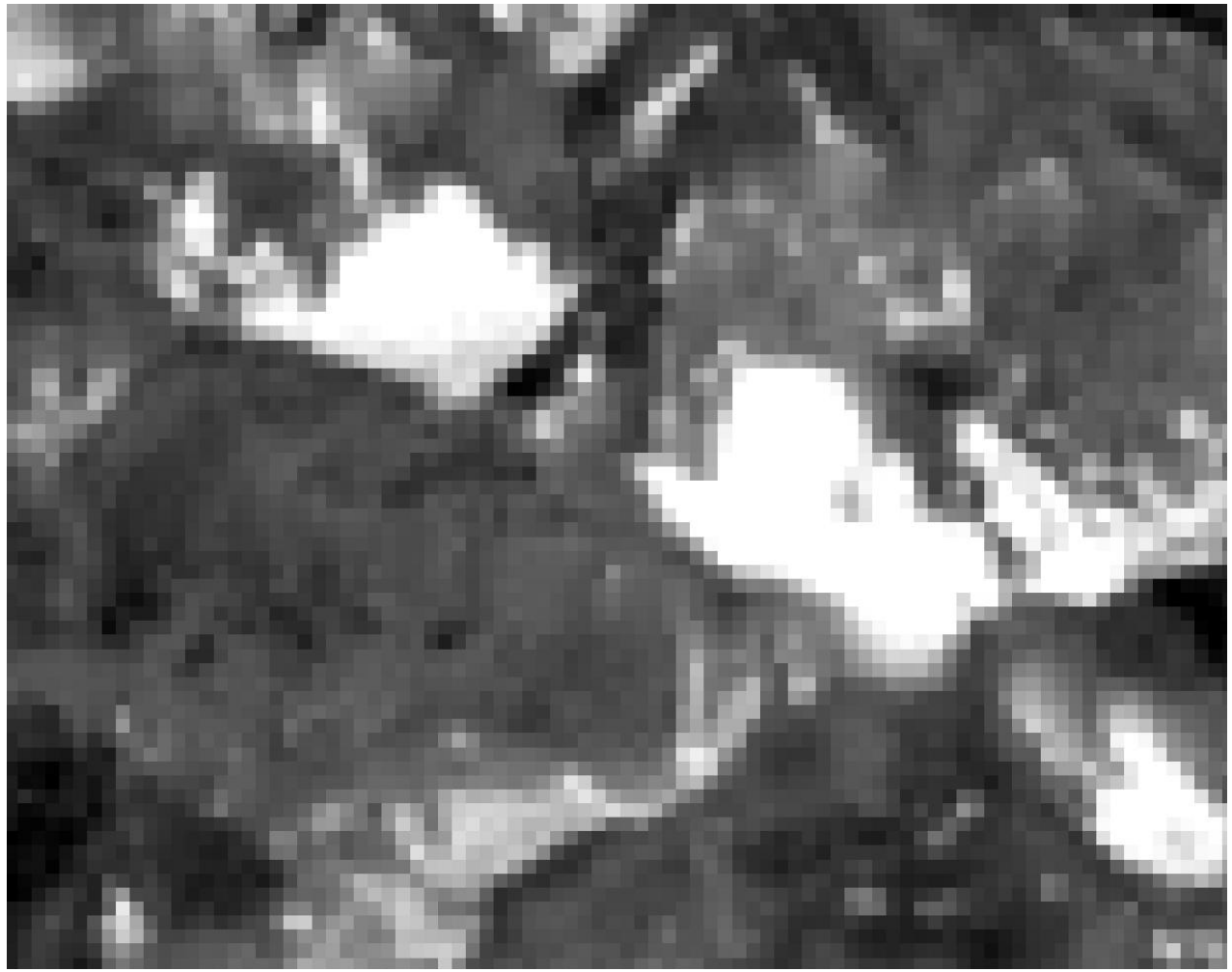
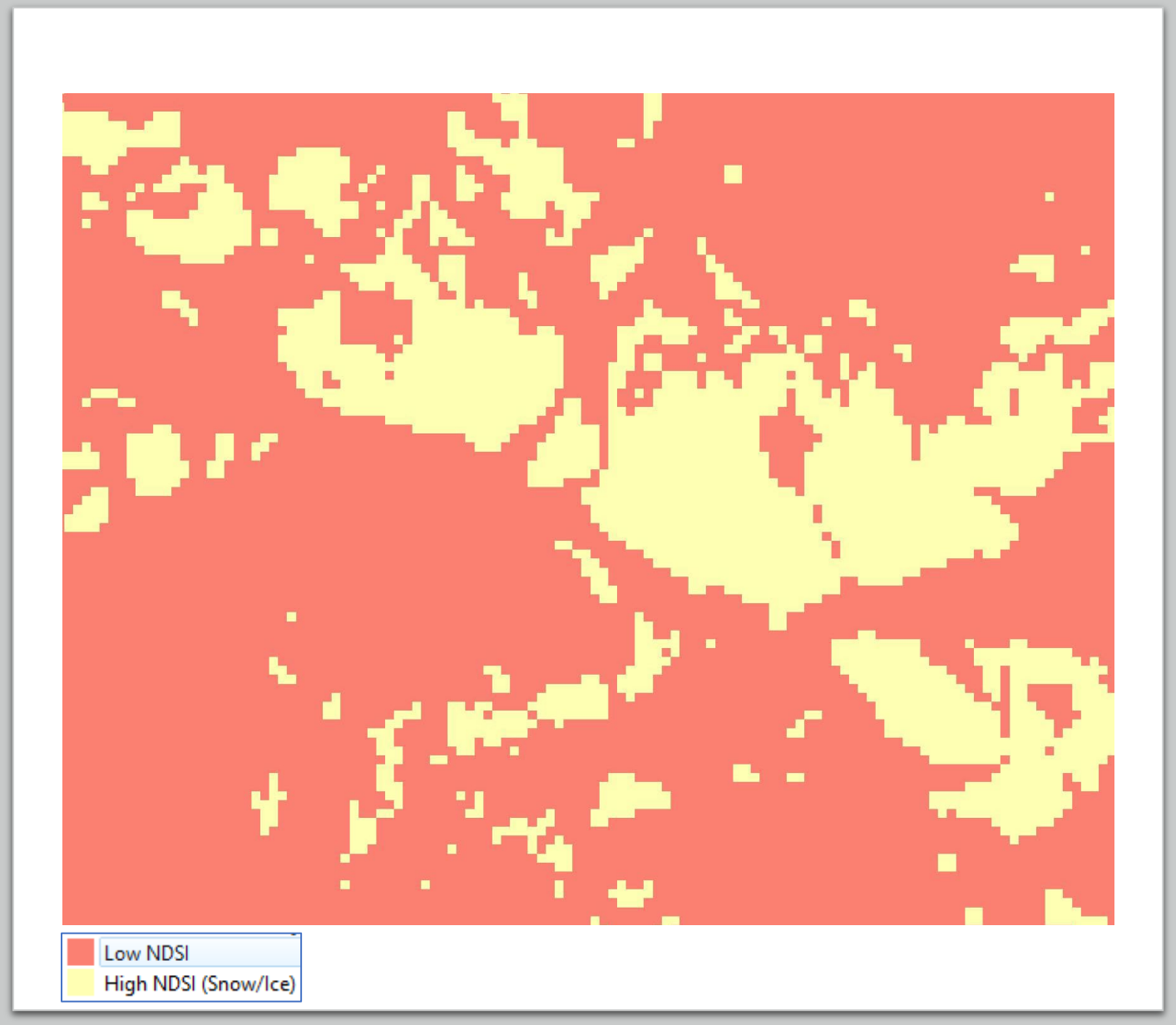


Reclassified NDSI

- 1999
- Threshold 0.4



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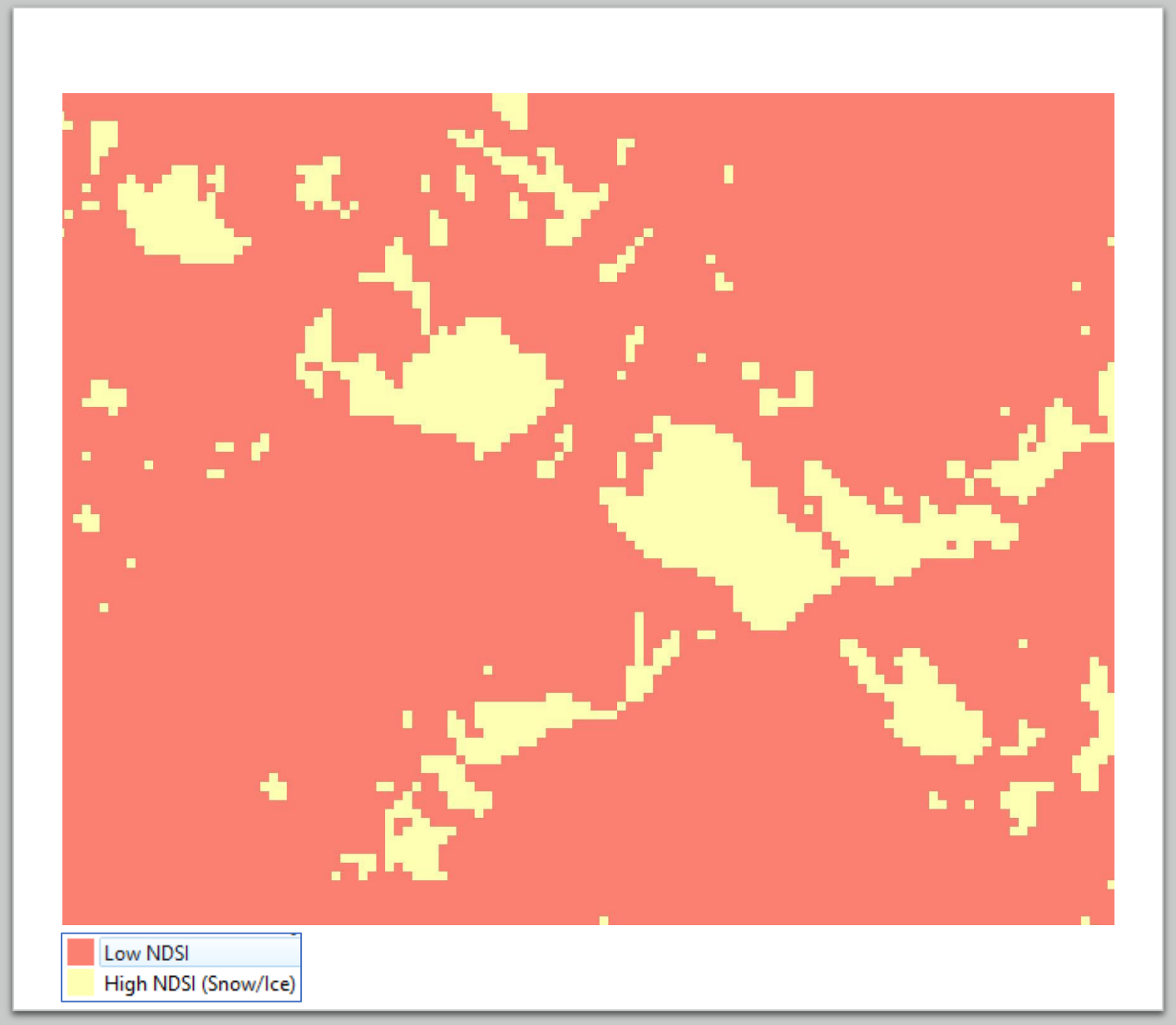
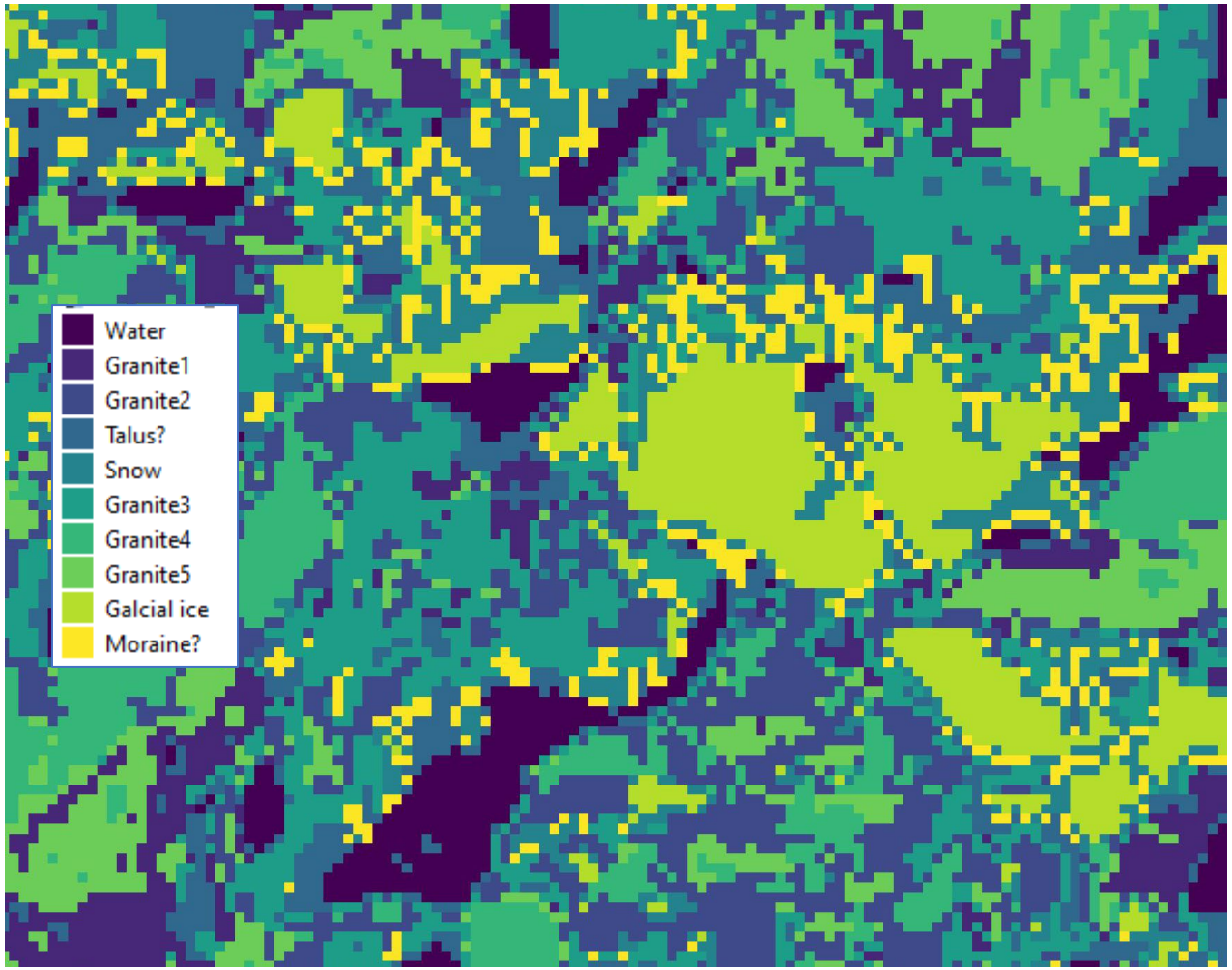


Unsupervised classification

- 1999
- K-means cluster algorithm
- 10 clusters
- 6 iterations
- Random assignment of colors



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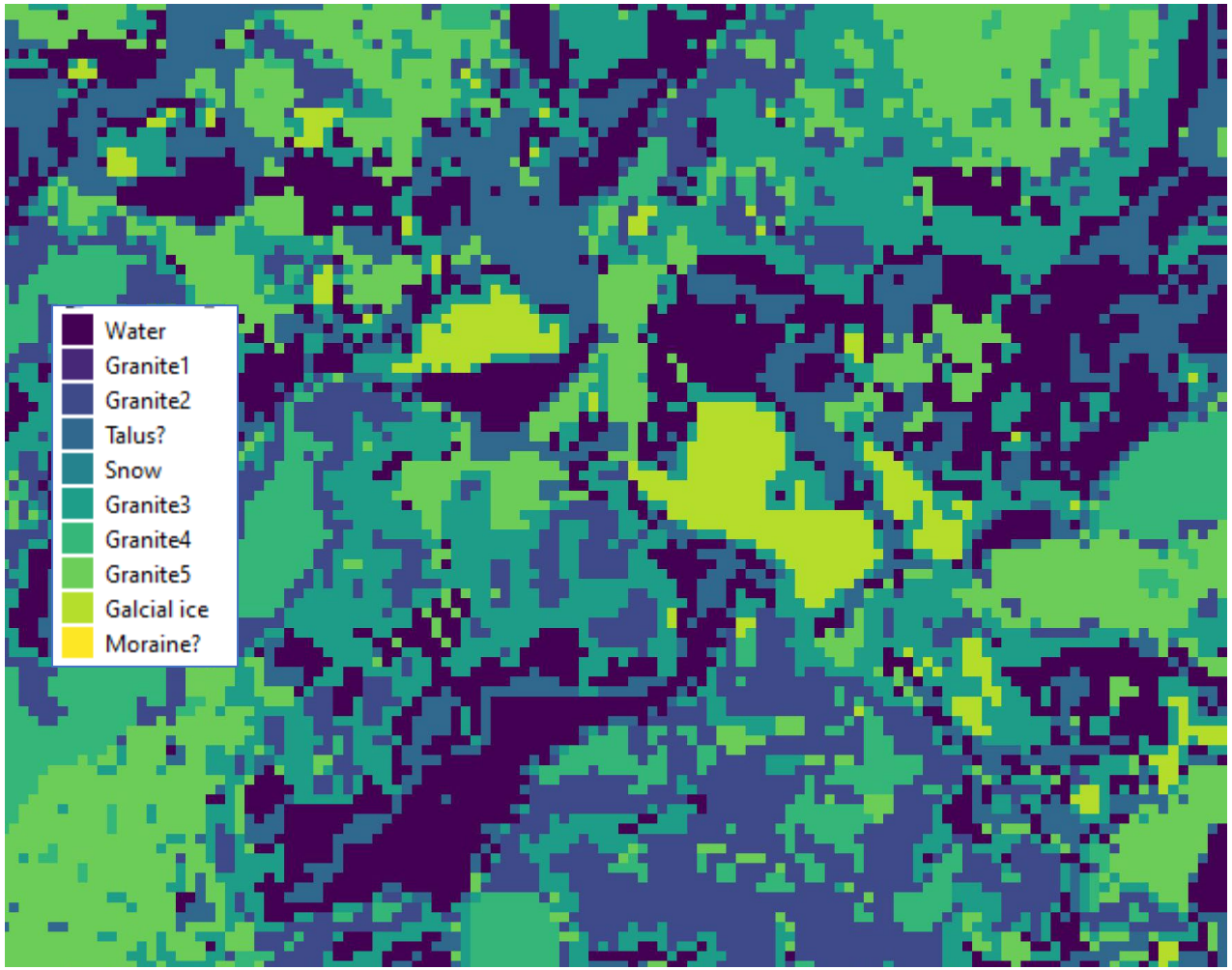
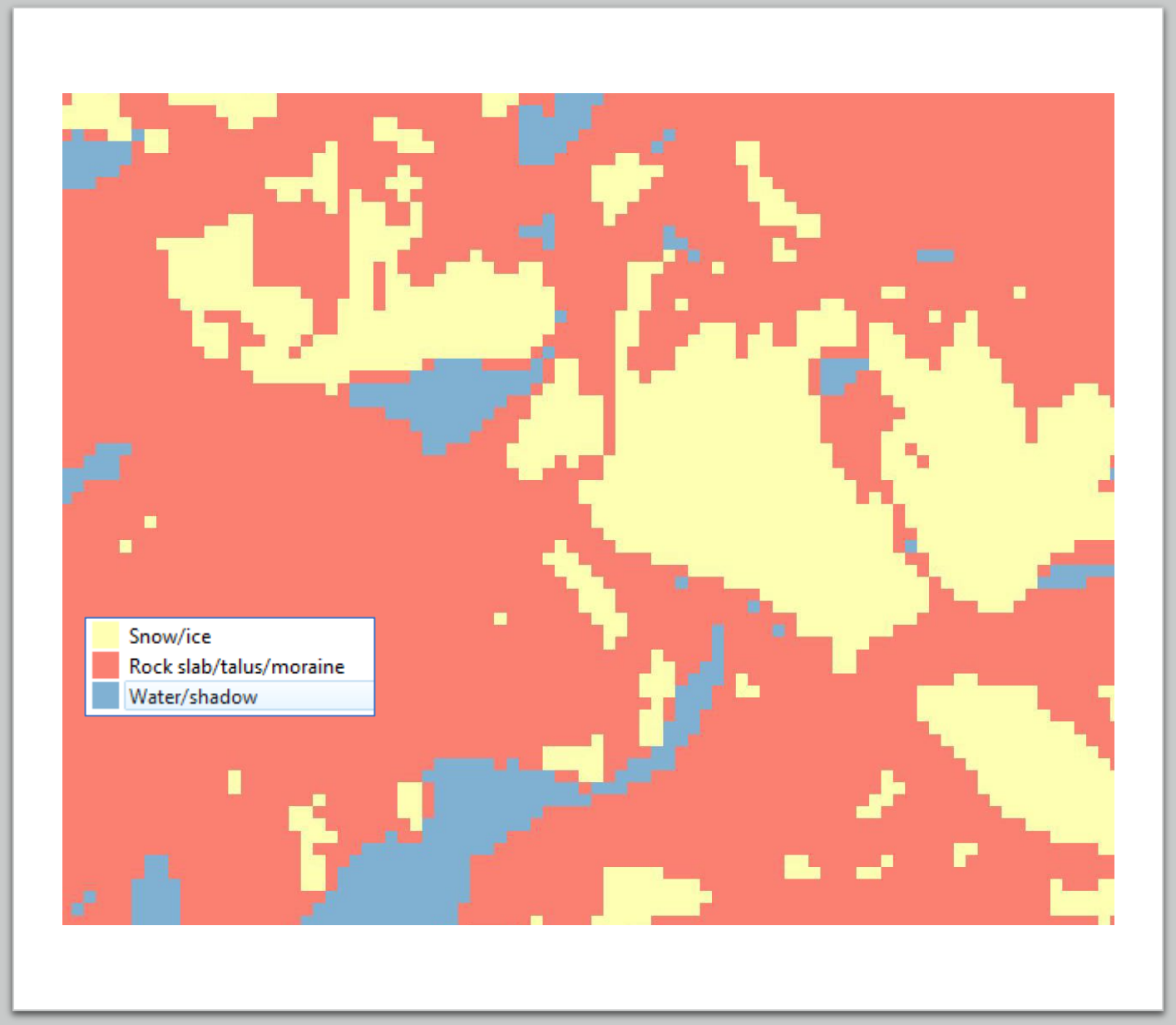


Manual reclassification of unsupervised results

- 1999
- 6 classes consolidated into “rock”
  - Granite slab
  - Talus
  - Moraine
- 2 classes consolidated into “water/shadow”
  - Confusion between water and deep shadow on North side of ridges.
- 2 classes consolidated into “snow/ice”



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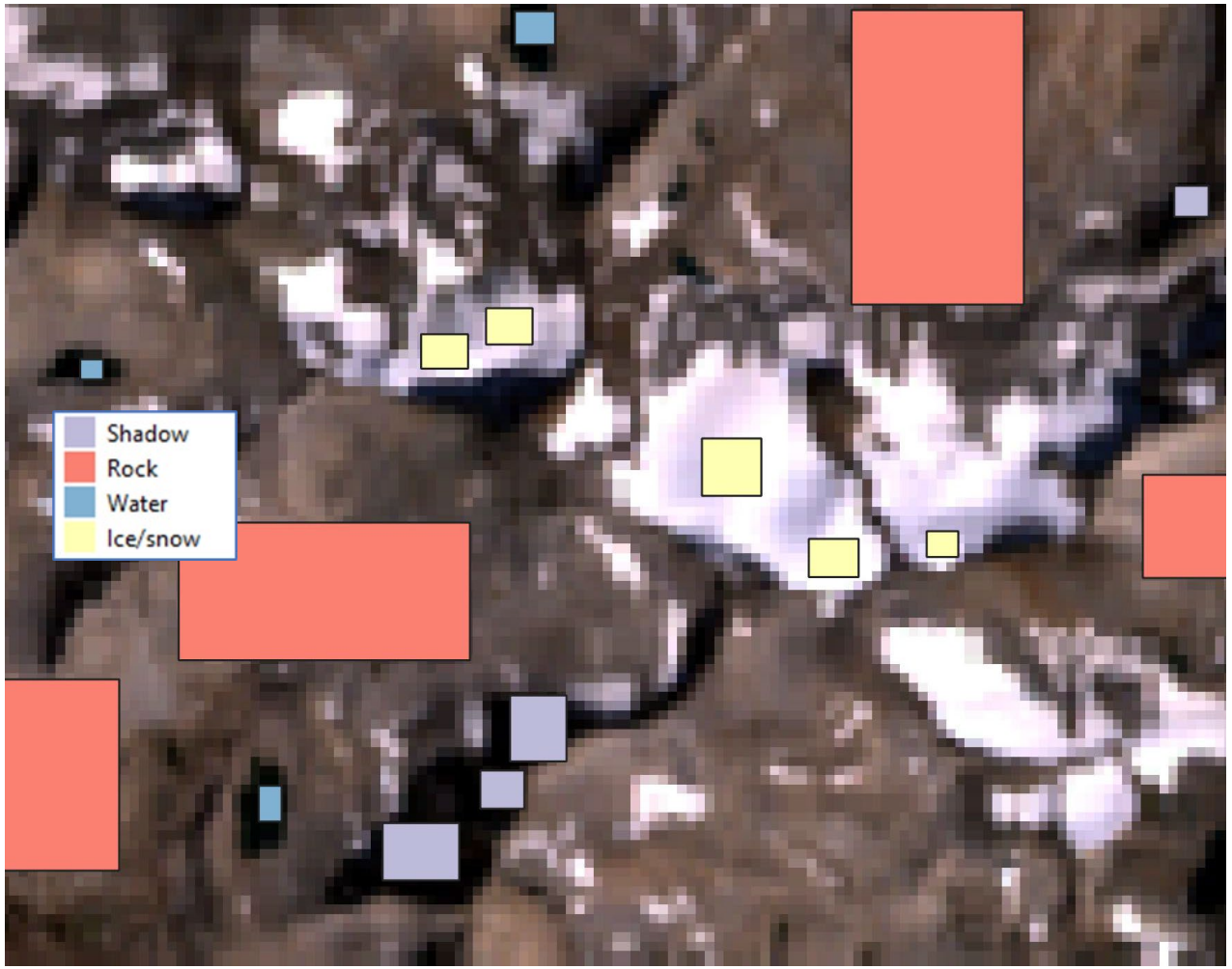
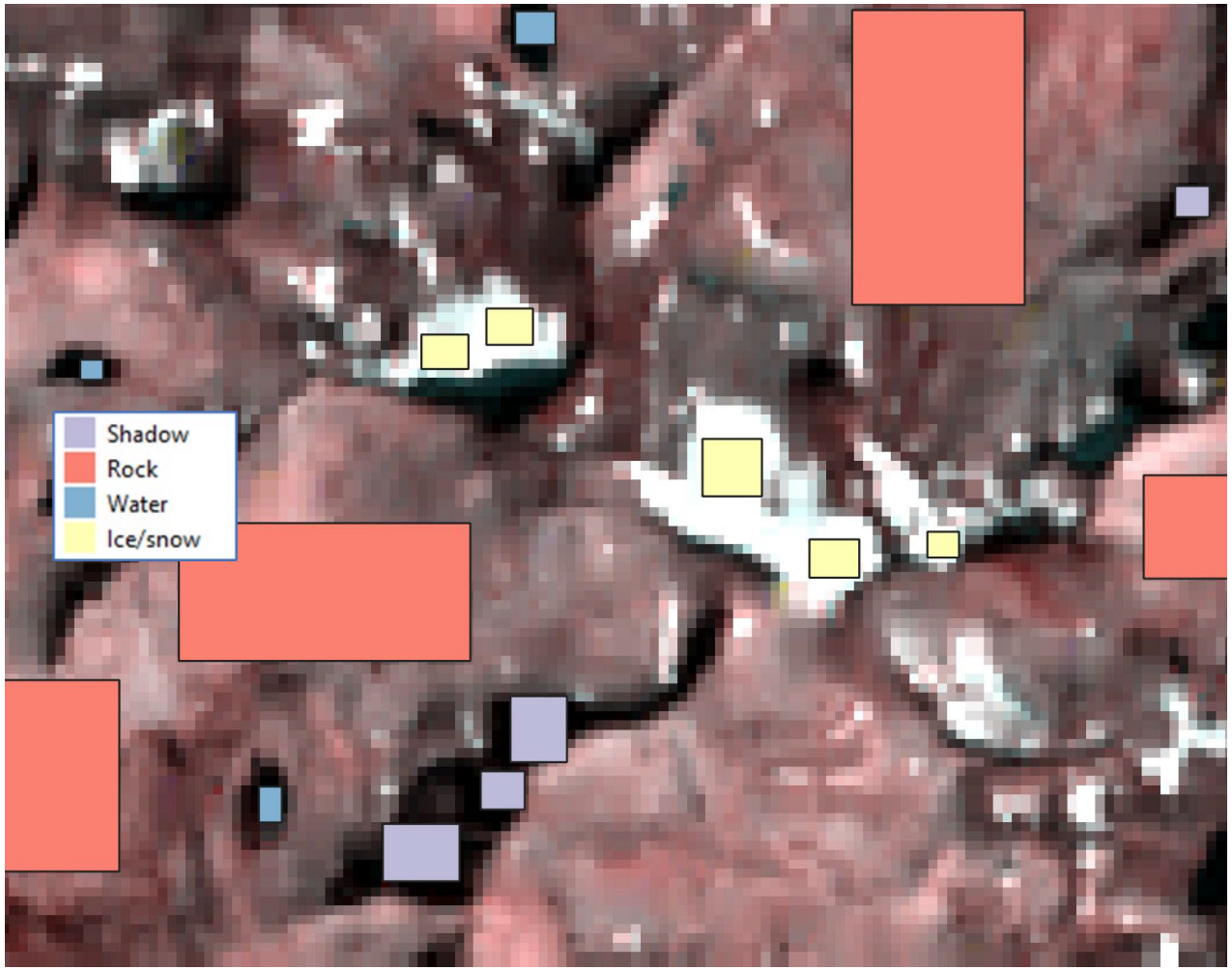
Supervised classification, training polygons

- 1999



Supervised classification, training polygons

- 2016
- Same polygons as 1999



Supervised classification

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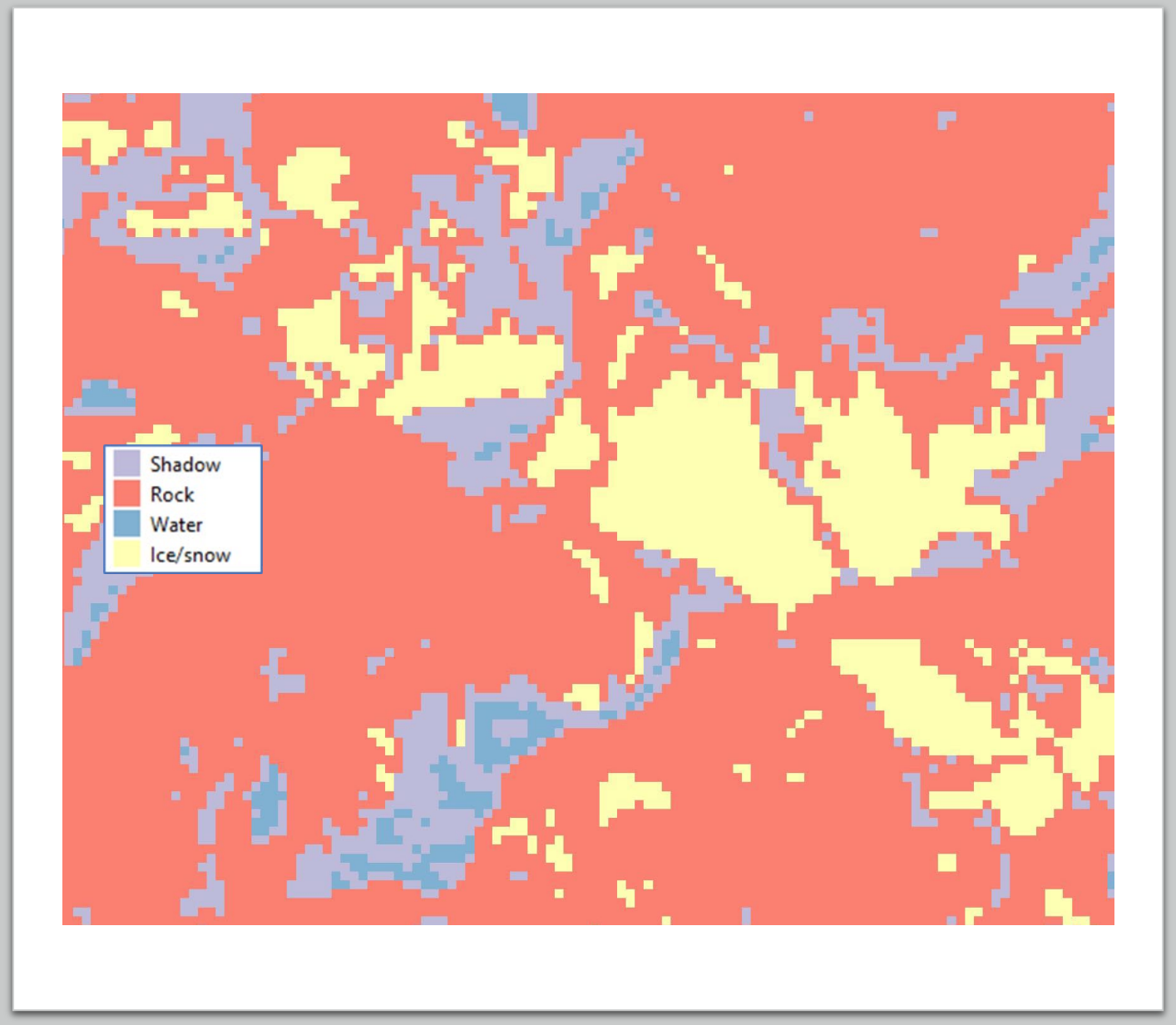
- Minimum distance gave best results
- Confusion between water and deep shadow



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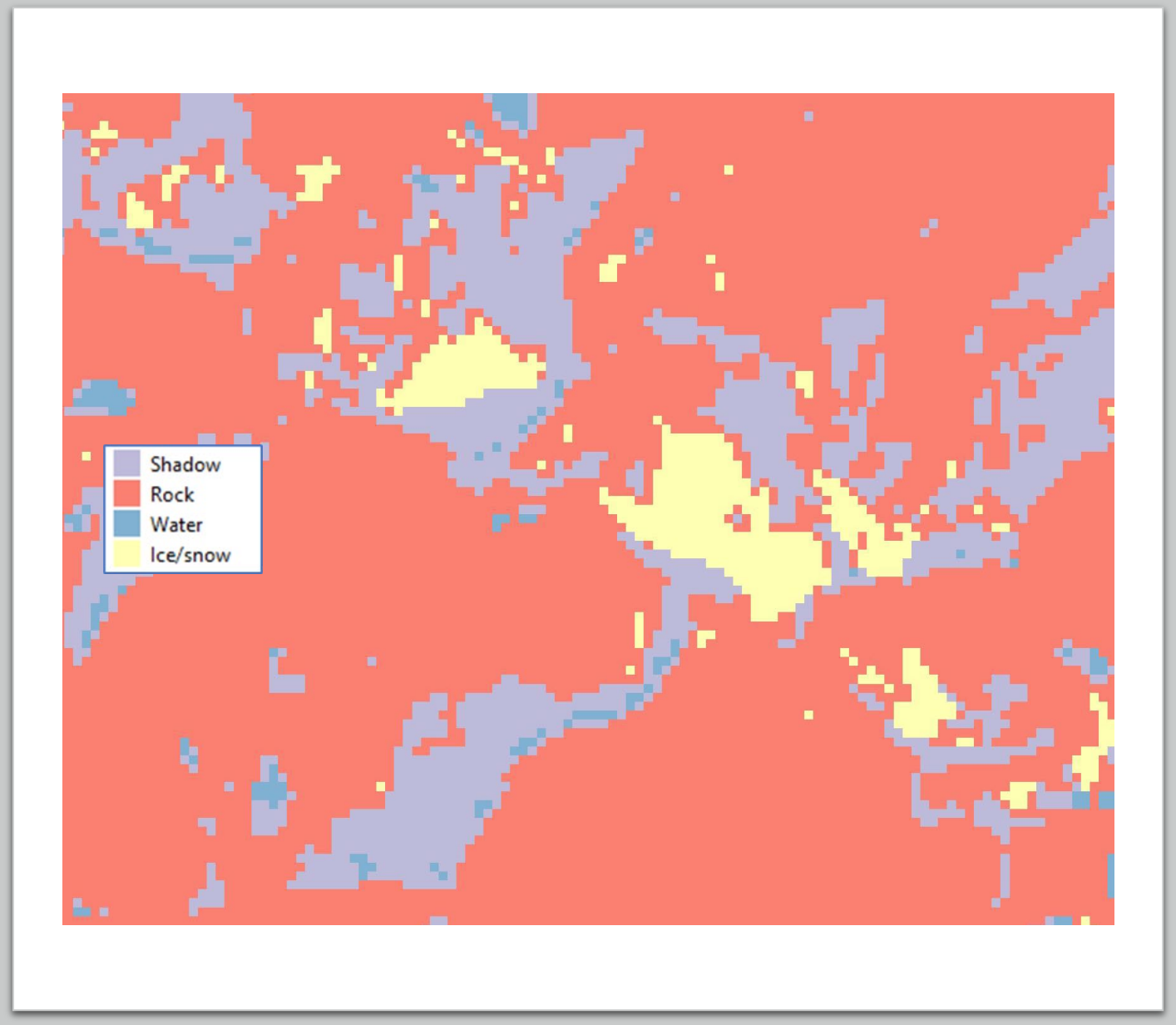


Results

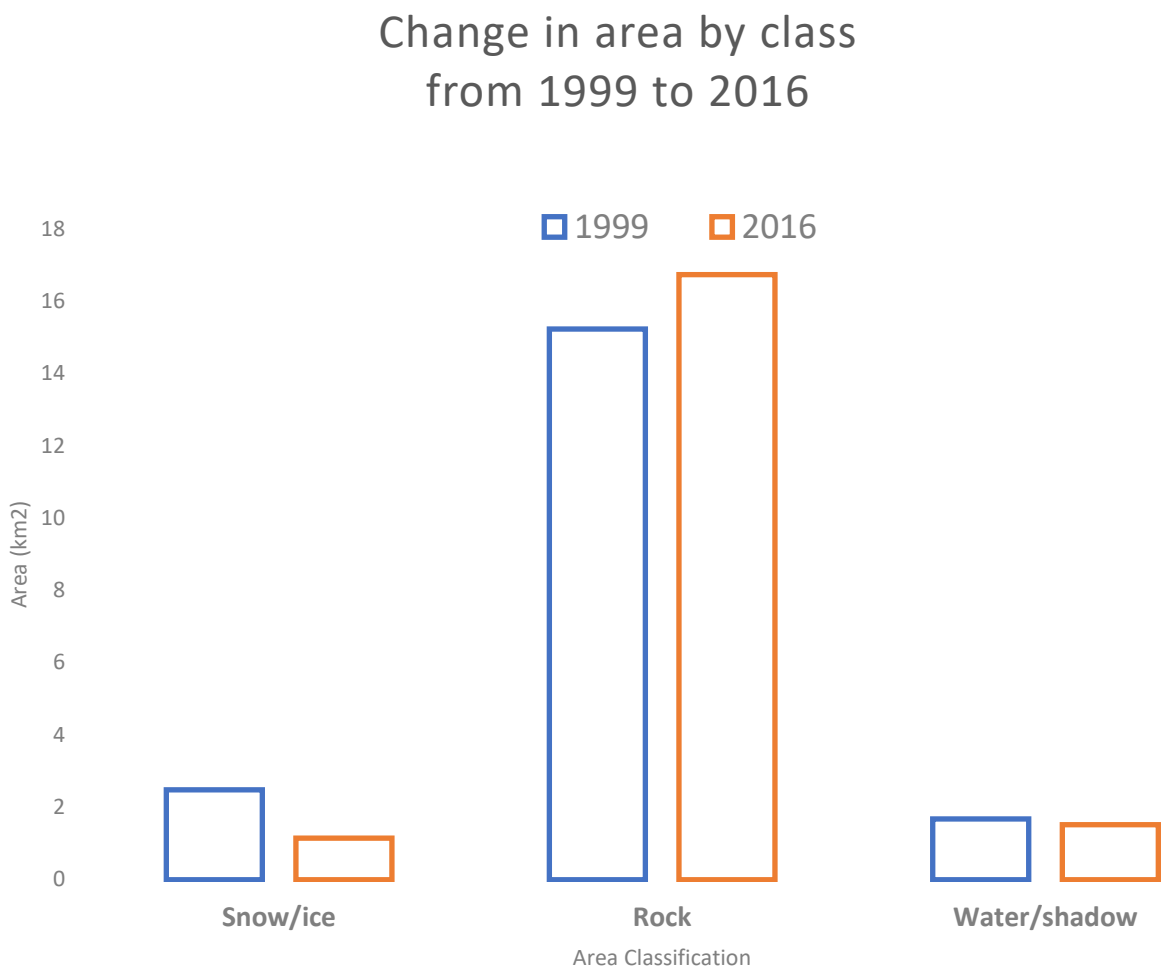
Results from unsupervised classification:

- 53.9% reduction in snow/ice
- 9.6% reduction in water

	Area km^2			
	1999	2016	Change	% Change
Snow/ice	2.49	1.15	(1.34)	-53.9%
Rock	15.24	16.74	1.50	9.9%
Water/shadow	1.68	1.52	(0.16)	-9.6%
	19.40	19.40	0.00	

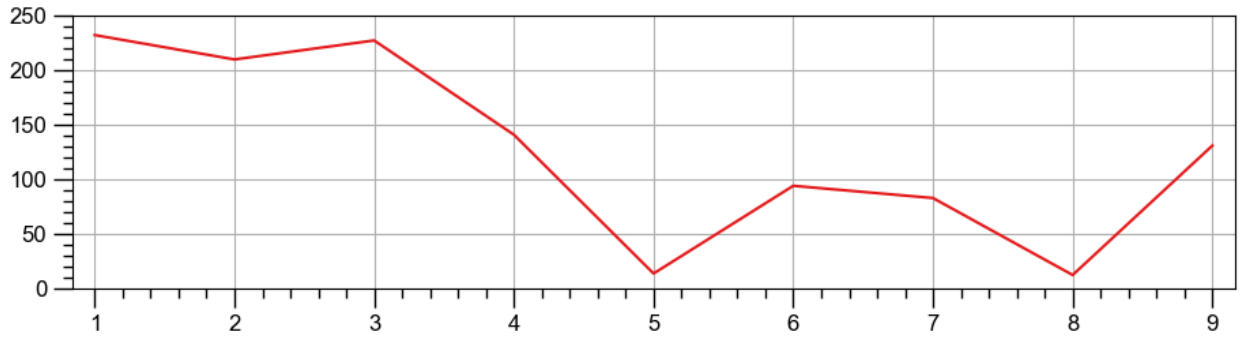
Conclusions

- Lyell and Maclure Glaciers are receding.
- Area of water has also declined.
- Unsupervised classification gave better results than supervised classification.
- Confusion between shadow and water.
- With more effort, supervised classification might be taught to discriminate water from shadow.



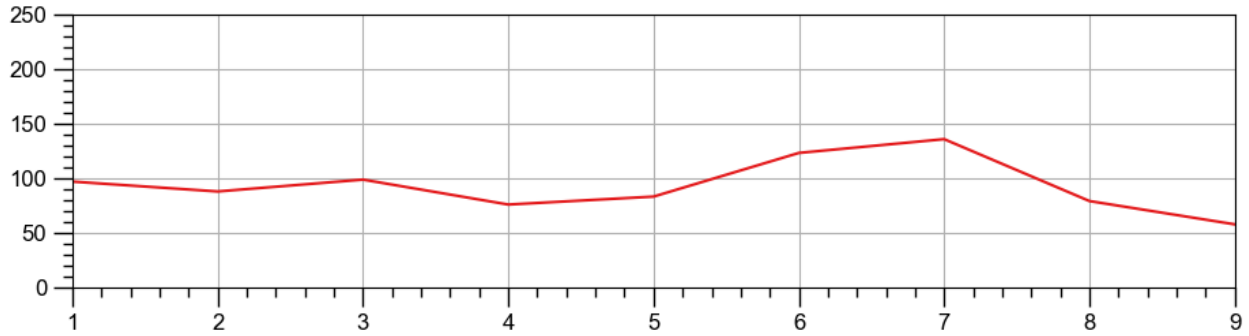
Snow

- Spectral reflectance



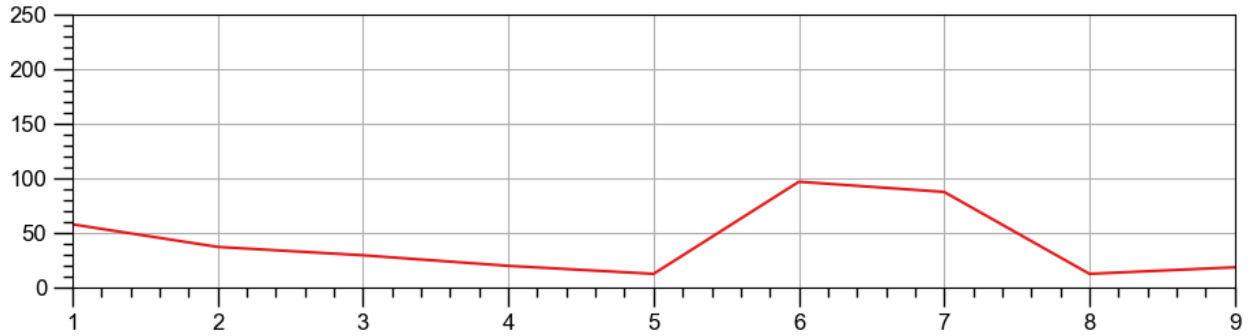
Rock

- Spectral reflectance



Shadow

- Spectral reflectance



Water

- Spectral reflectance