Google Earth Engine

http://bit.ly/G4G_SegmentationBreakout

(Spatial) Segmentation Break-Out Session

Jeff Cardille and Morgan Crowley, McGill University
Noel Gorelick, TA

Geo for Good 2019

http://bit.ly/G4G_SegmentationBreakout

Today's outline

1. Why use Segmentation?
2. Two examples from our lab
3. Background on Segmentation
4. Hands-on sample code exploration

http://bit.ly/G4G_SegmentationBreakout

Which flavor of ‘segmentation’?
Some references to segmentation heard this week

1. Temporal segments of indices fitted in a pixel (LandTrendr, CCDC)

2. Segmentation with Neural Nets

3. **Spatial segmentation** - partitioning a single image into spatially compact, spectrally homogenous ‘segments’

Motivation

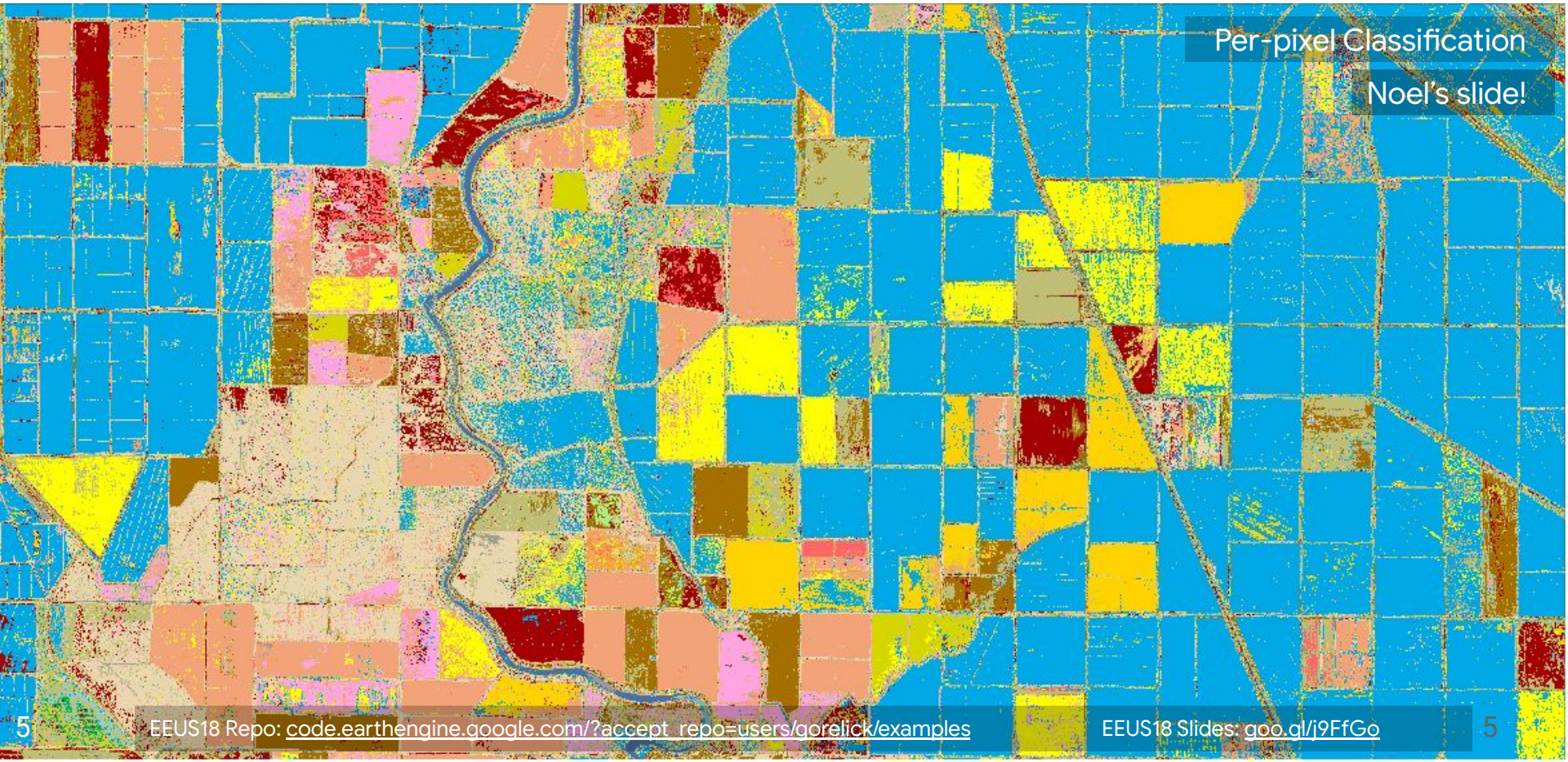
http://bit.ly/G4G_SegmentationBreakout

EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

EEUS18 Slides: goo.gl/j9FfGo

Motivation

http://bit.ly/G4G_SegmentationBreakout



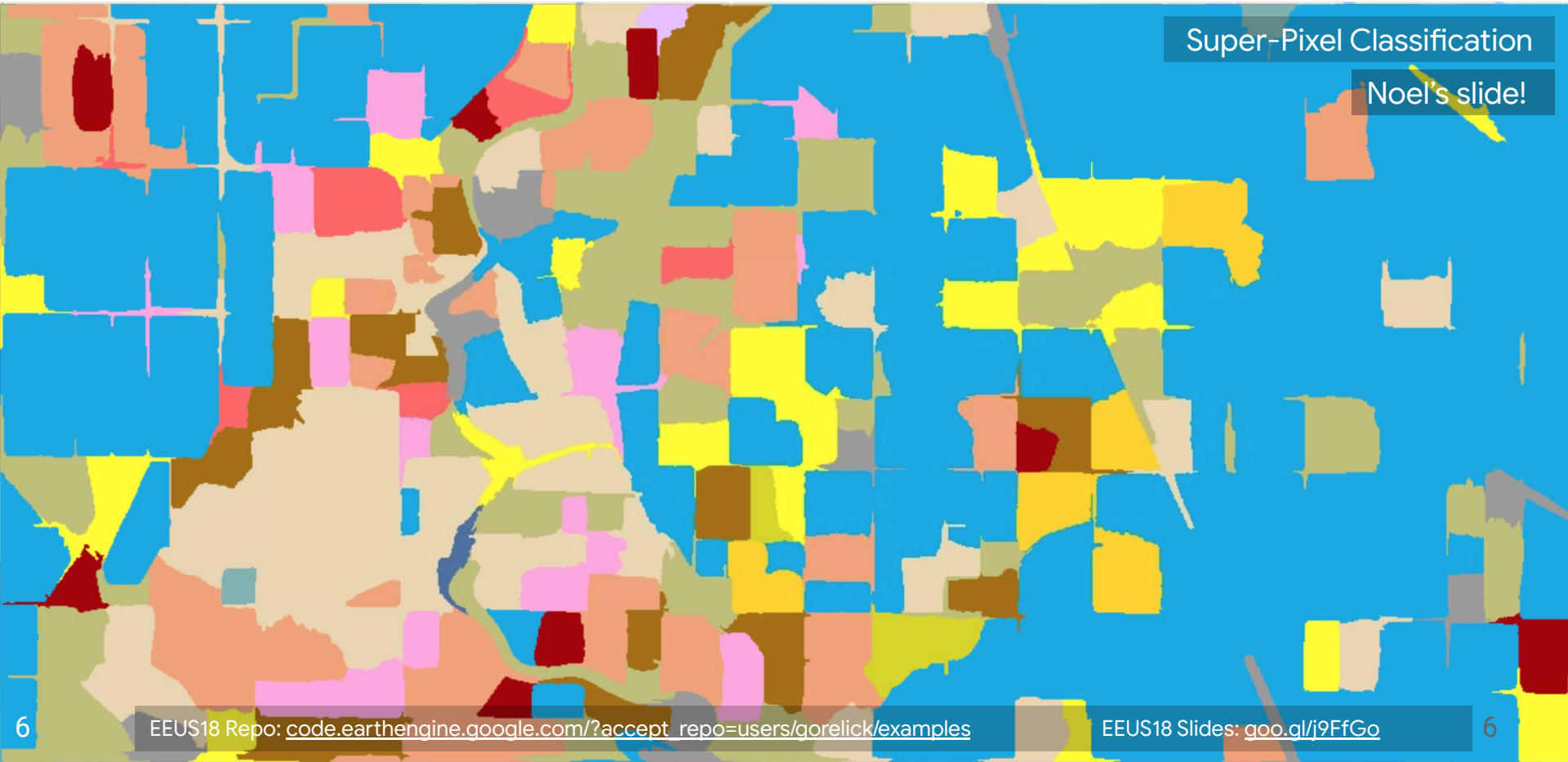
EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

EEUS18 Slides: goo.gl/j9FfGo

5

Motivation

http://bit.ly/G4G_SegmentationBreakout



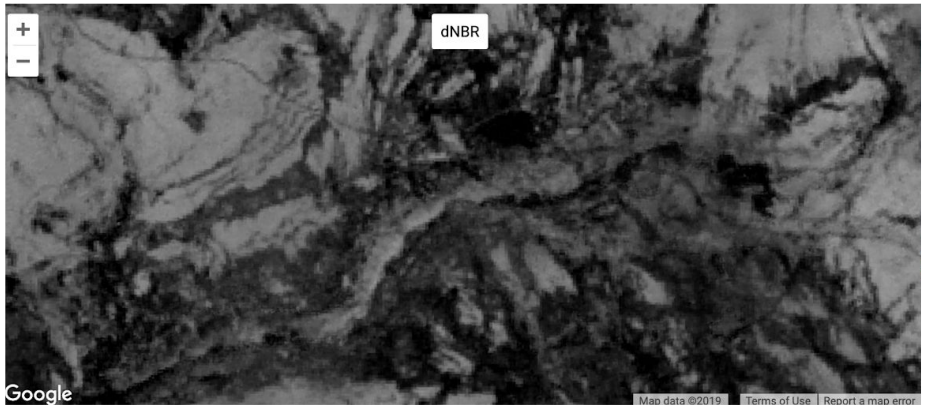
EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

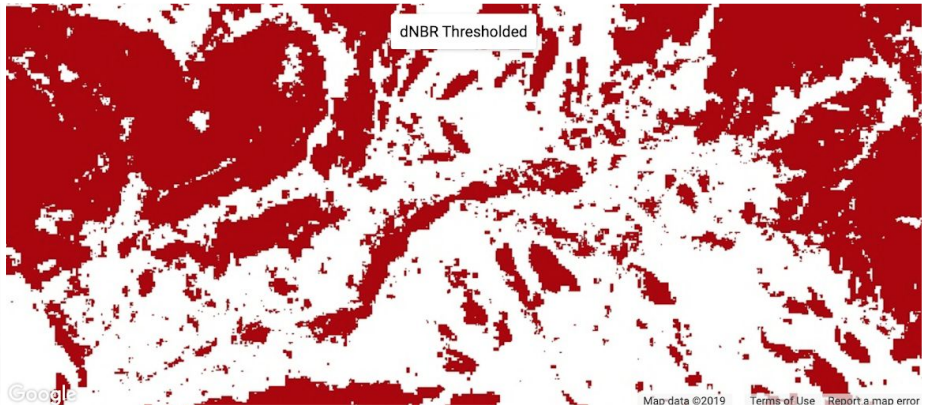
EEUS18 Slides: goo.gl/j9FfGo

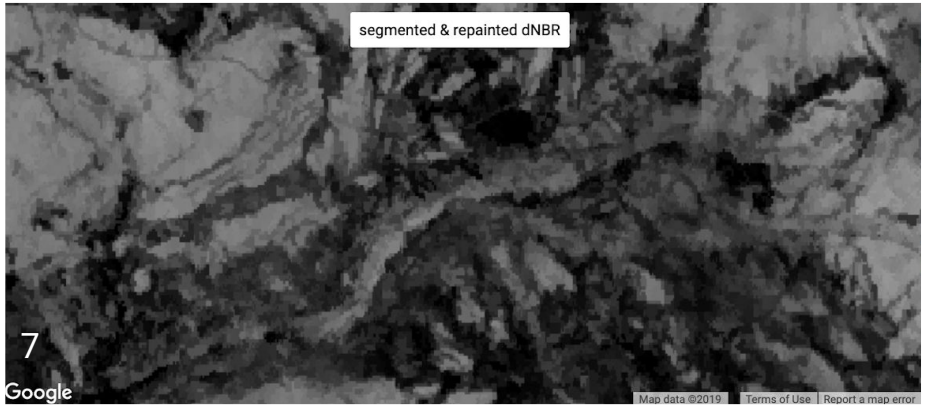
6

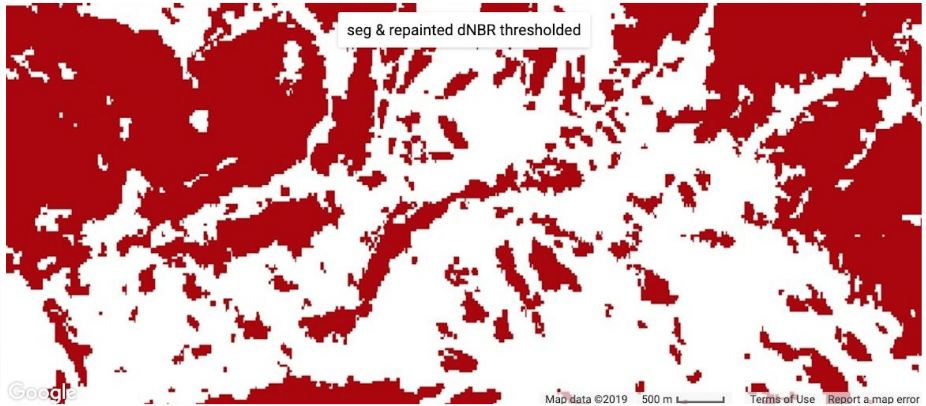
Active fire progression mapping in GEE

2017 Elephant Hill Fire - British Columbia, Canada









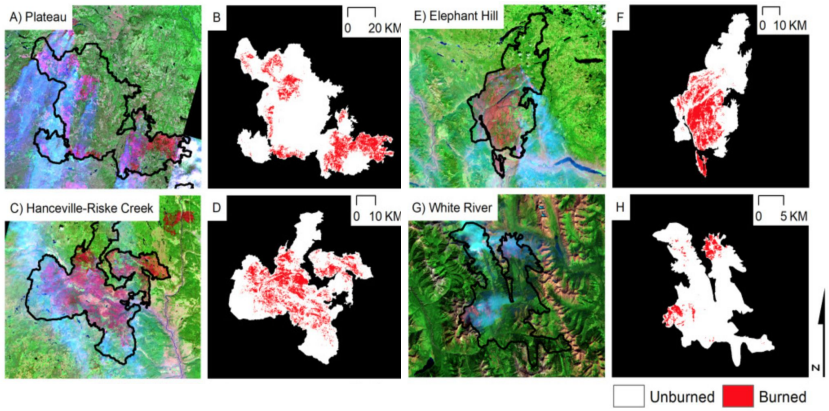
Active fire progression mapping in GEE

ELSEVIER

Remote Sensing of Environment
Volume 232, October 2019, 111295

Generating intra-year metrics of wildfire progression using multiple open-access satellite data streams

Morgan A. Crowley [a], Jeffrey A. Cardille [a], Joanne C. White [b], Michael A. Wulder [b]



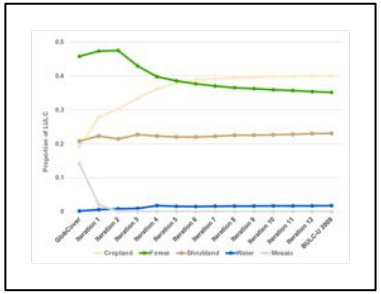
Each active-fire NBR image was segmented into median-NBR objects using the Simple Non-Iterative Clustering (SNIC) segmentation algorithm available in Google Earth Engine (Achanta and Süsstrunk, 2017). Segmentation algorithms like SNIC create pixel clusters using imagery information such as texture, colour or pixel values, shape, and size and is especially useful for forest disturbances (Blaschke, 2010; Wulder et al., 2004). Many fire-detection methods rely on pixel-based approaches, but image segmentation offers advances for the refinement of burned-area imagery (Gitas et al., 2004; Veraverbeke et al., 2012). In particular, SNIC is a bottom-up, seed-based segmentation approach that groups neighboring pixels together into clusters based on input data and parameters such as compactness, connectivity, and neighborhood size. To segment each active-fire NBR image, we set the SNIC parameters as follows: compactness was set to 0.1 to enable larger clusters, connectivity was set to 8, the neighborhood size was set to 8 pixels to avoid tile boundary artifacts, and the seeds were created in a hexagonal pattern using a superpixel seed spacing of 4 pixels.

Remote Sensing of Environment, 232, 111295.

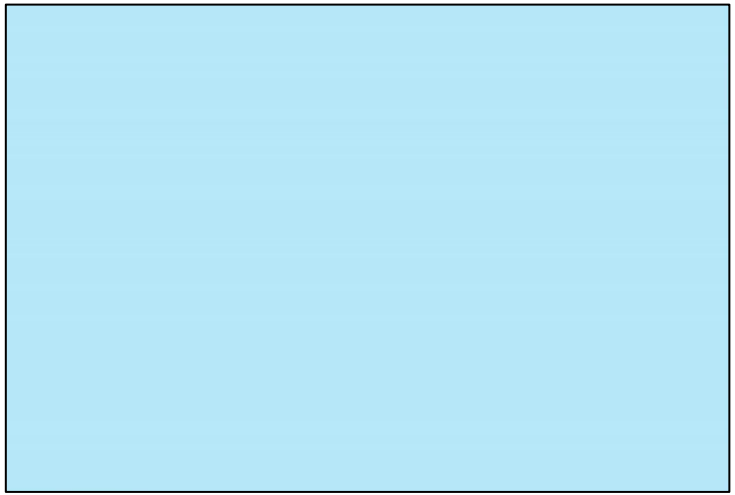
Google

BULC-U: Sharpening Existing Classification

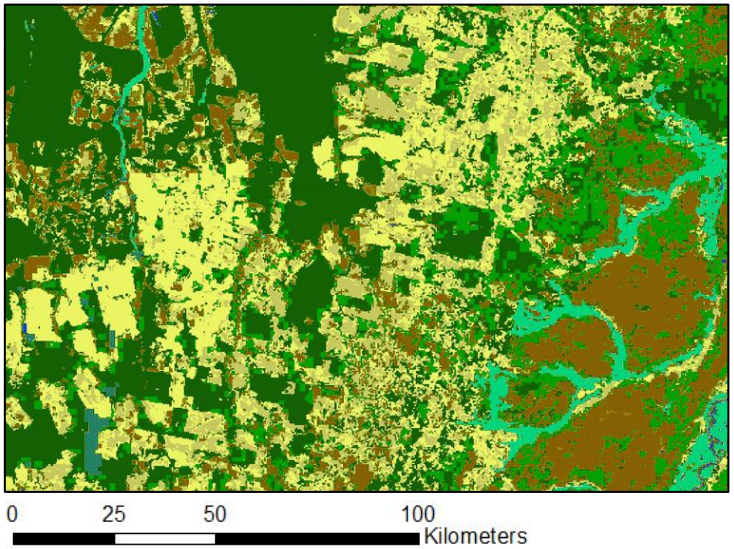
Sharpens GlobCover 2009 (300m) to BULC 2009 (30m)
Mato Grosso, Brazil (With Woods Hole Research Center)



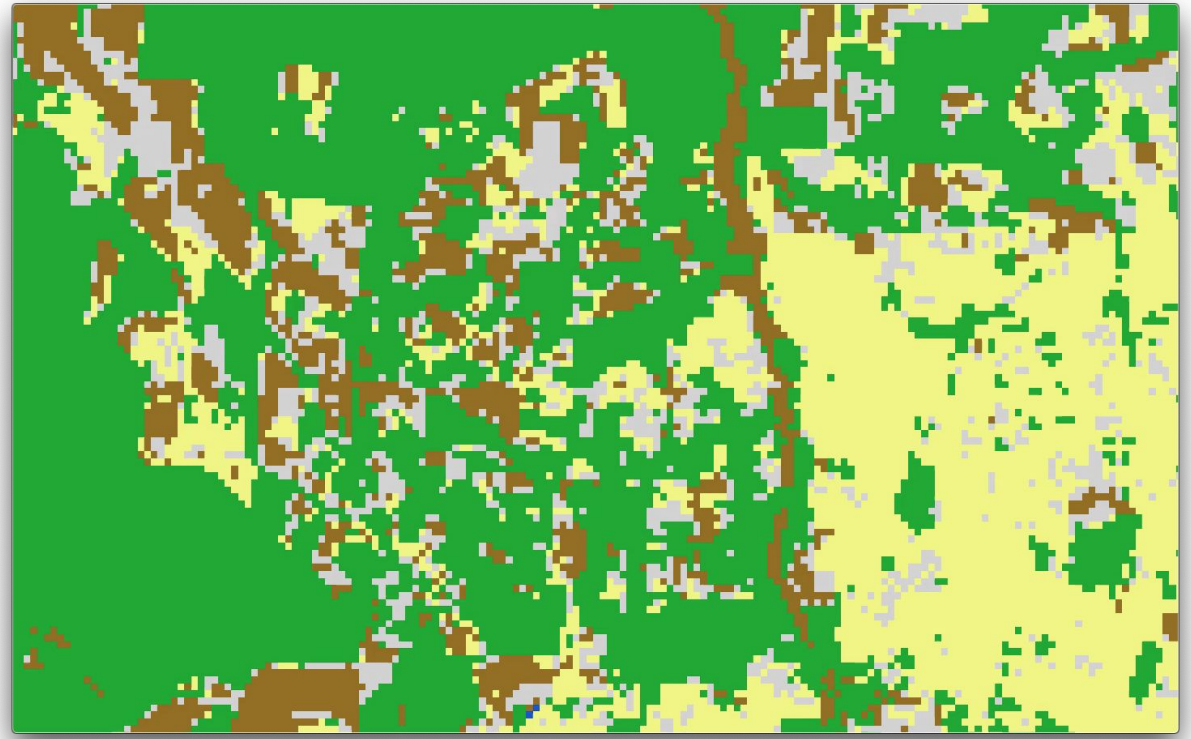
Segmented Images,
unsupervised classification

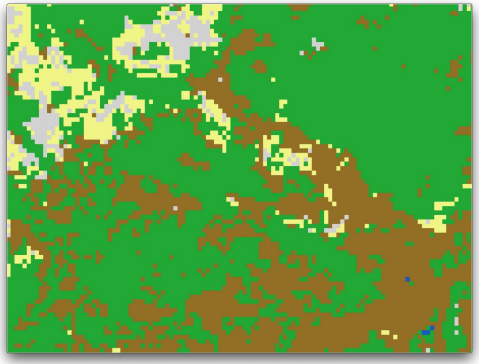


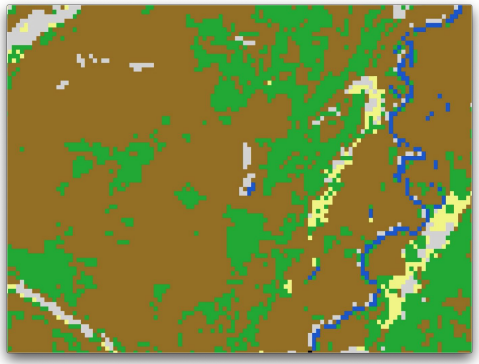
BULC-U 2009
(converging over 12 images)

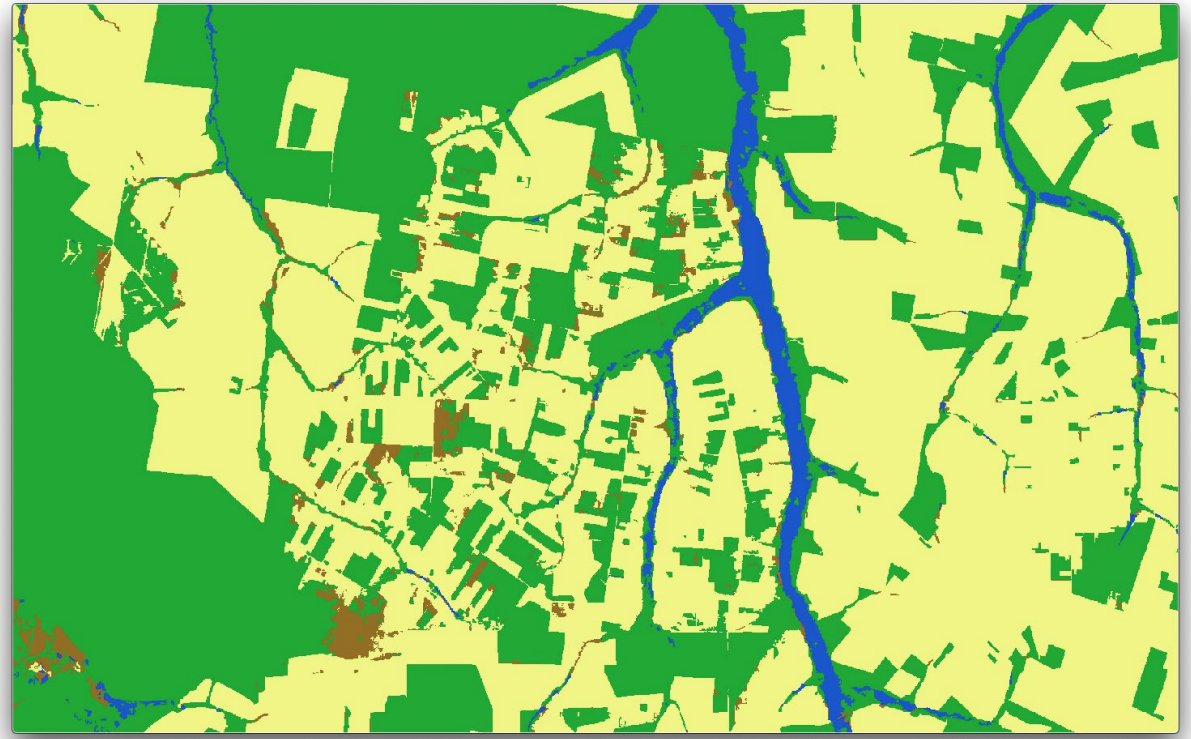


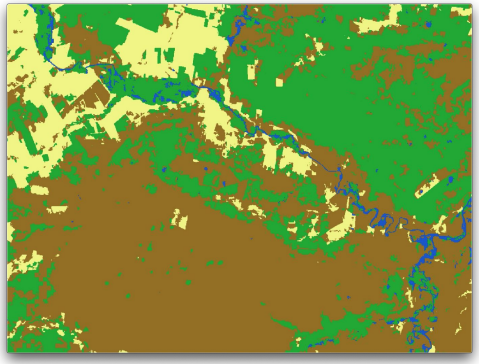
[Remote Sensing, 10(9), p.1455]

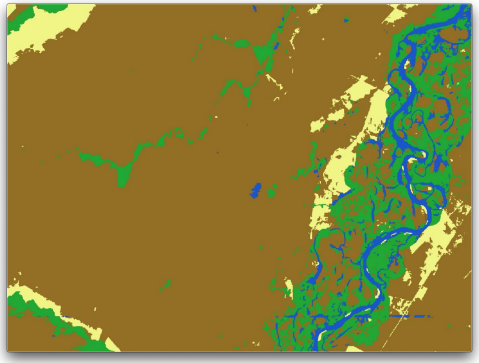




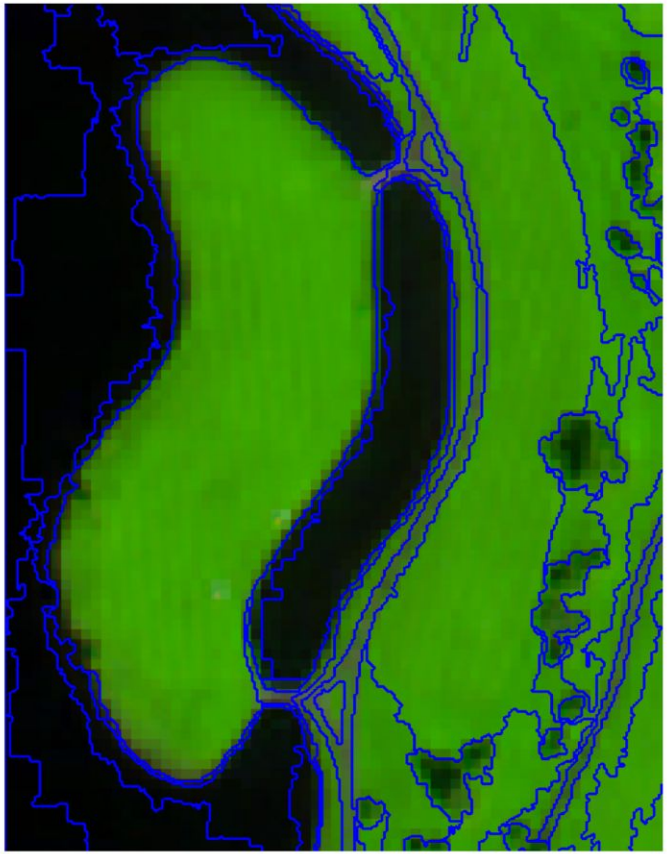








Overview of Segmentation



(adapted from Joyce 2009)

1. Segmentation algorithms **group like-pixels** into into objects

2. Segments are used in **object-based image classifications** rather than pixels

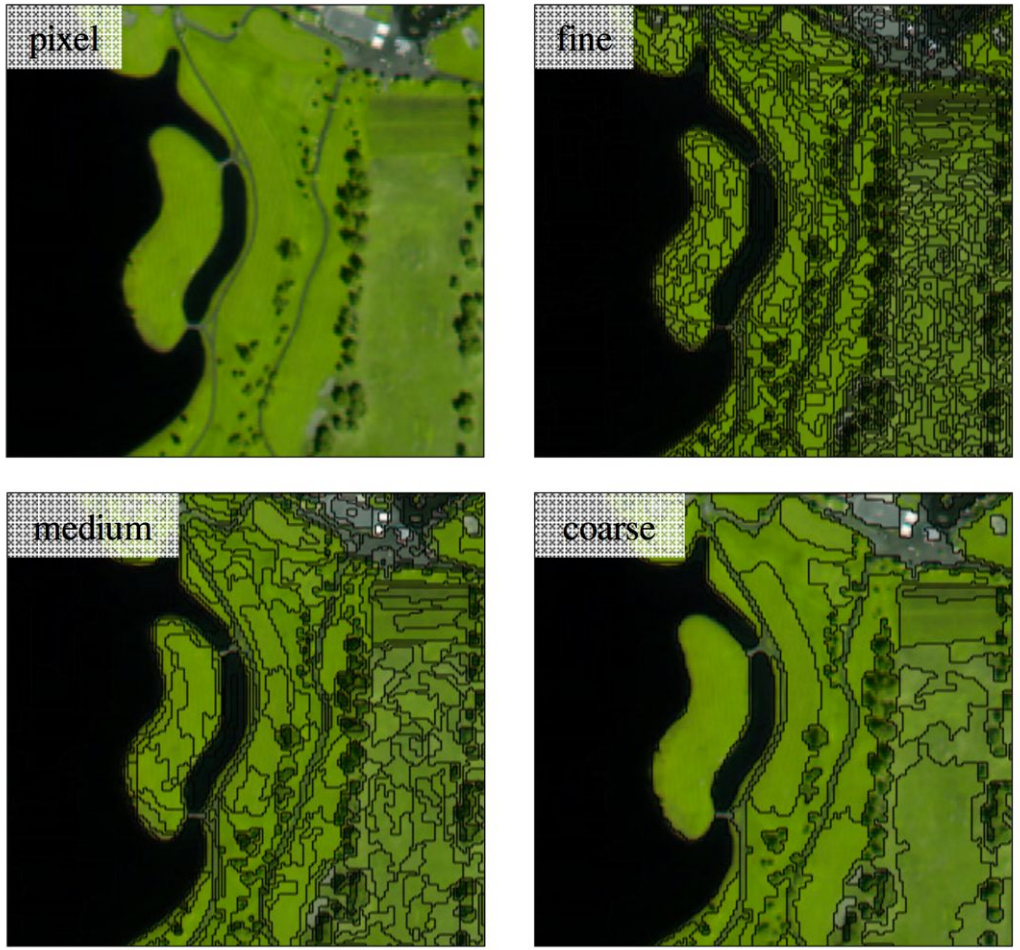
3. Segmentation process is **scale-dependent**

Scale Matters!

1. **Segmentation resolution** will vary to meet objectives

2. **Coarse:** Large objects for broad land-cover types

3. **Fine:** Small objects for more granular class detection



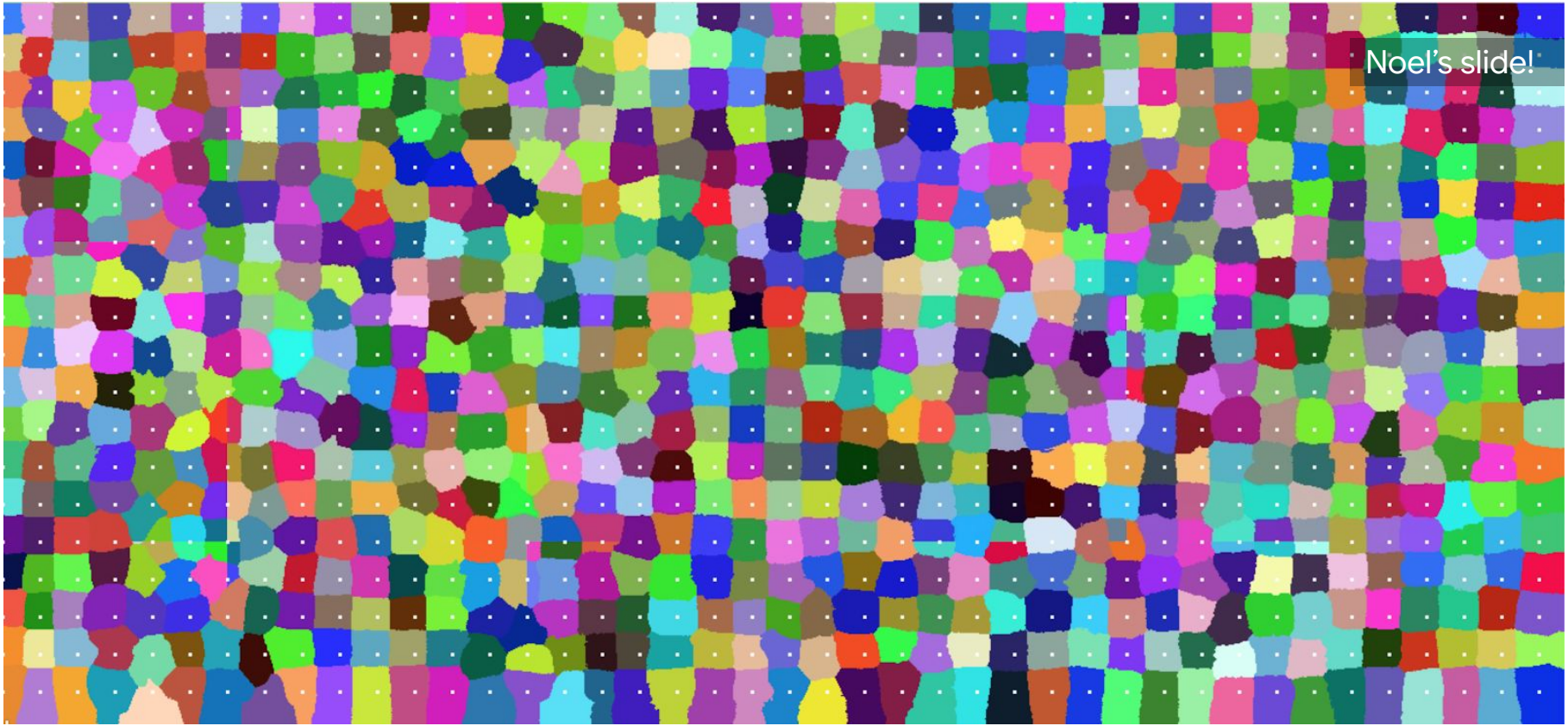
(Joyce 2009)

Segmentation in GEE (SNIC Algorithm, square)

EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

EEUS18 Slides: goo.gl/j9FfGo

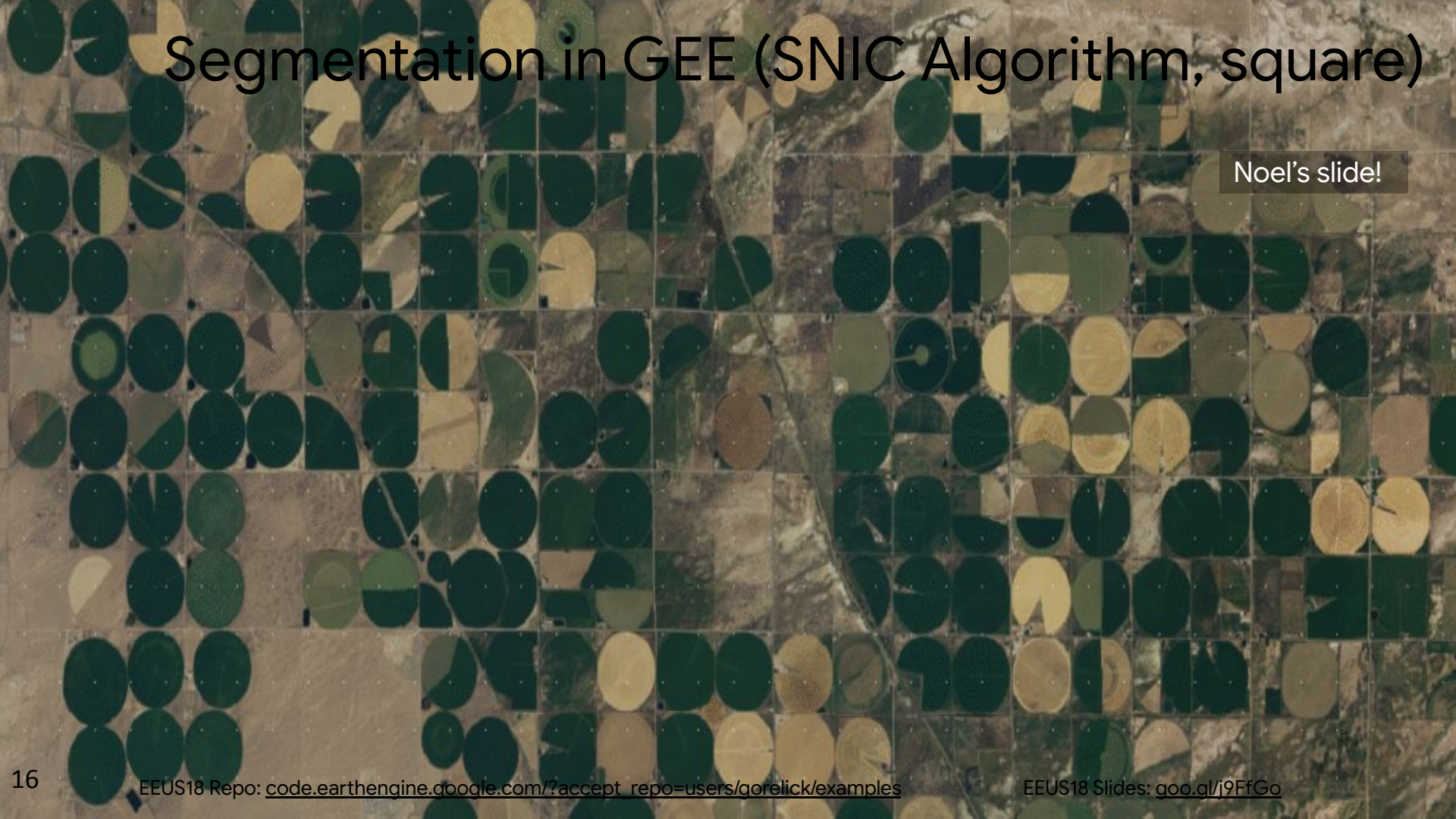
Segmentation in GEE (SNIC Algorithm, square)



EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

EEUS18 Slides: goo.gl/j9FfGo

Segmentation in GEE (SNIC Algorithm, square)

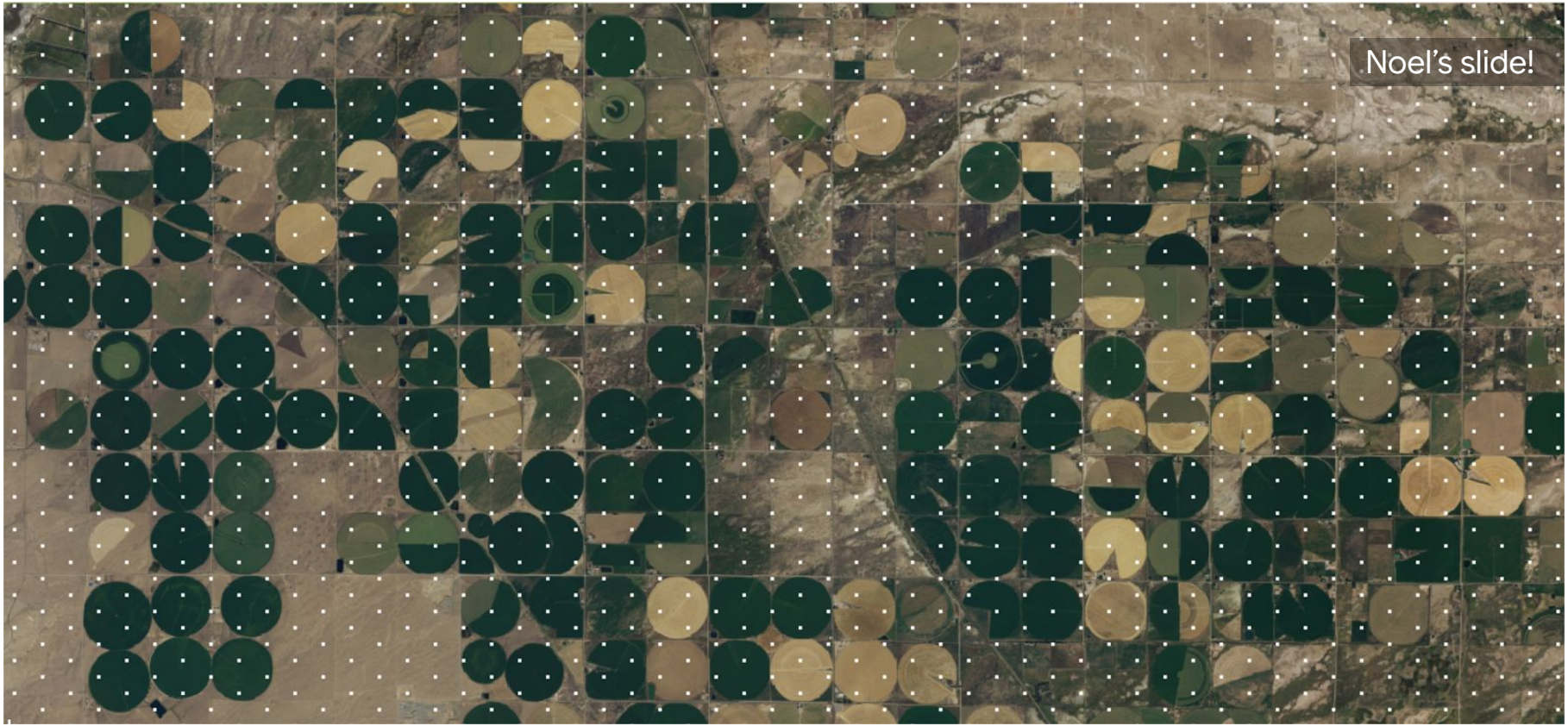


Noel's slide!

EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

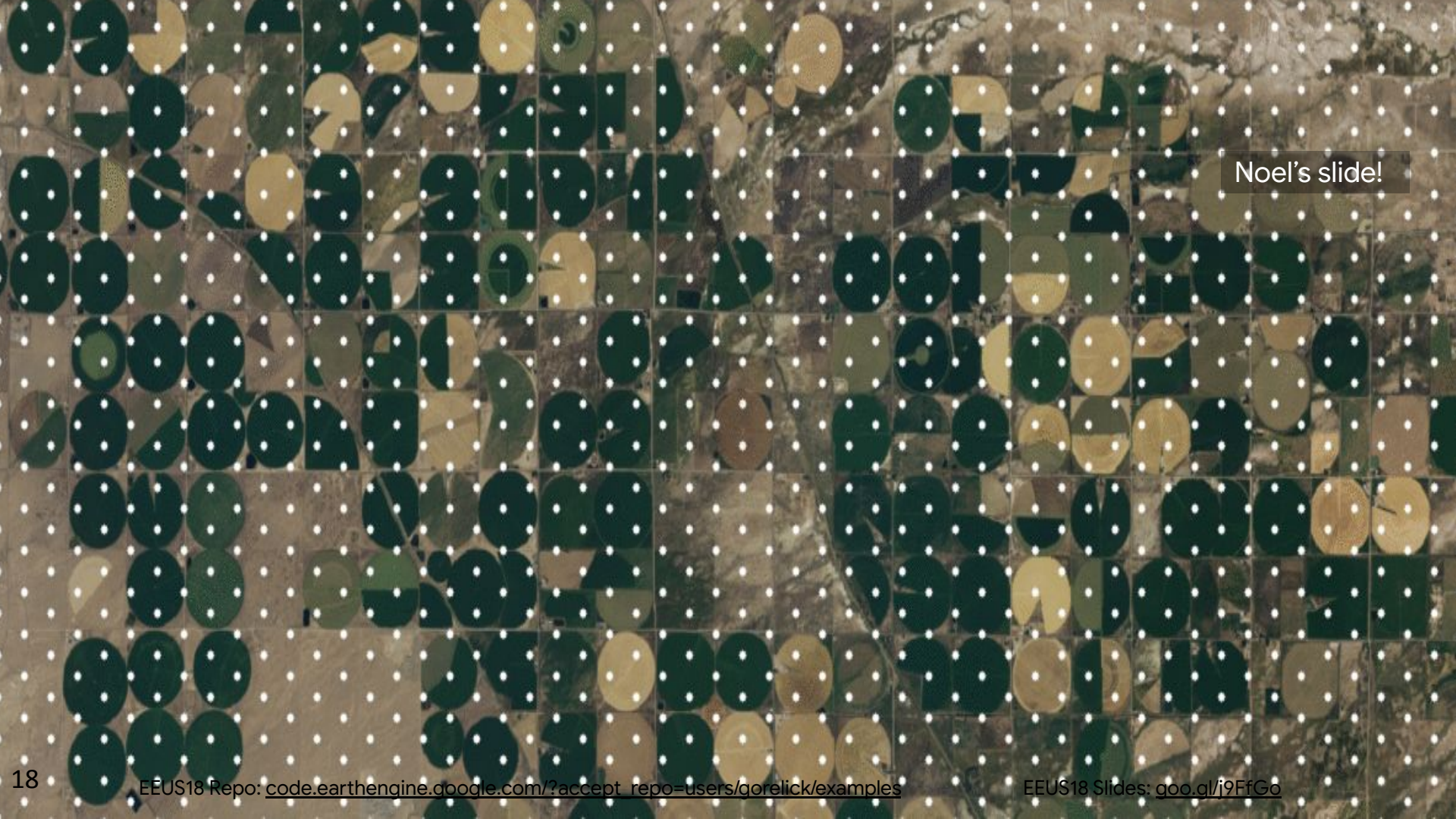
EEUS18 Slides: goo.gl/j9FfGo

Segmentation in GEE (SNIC Algorithm, hex)



EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

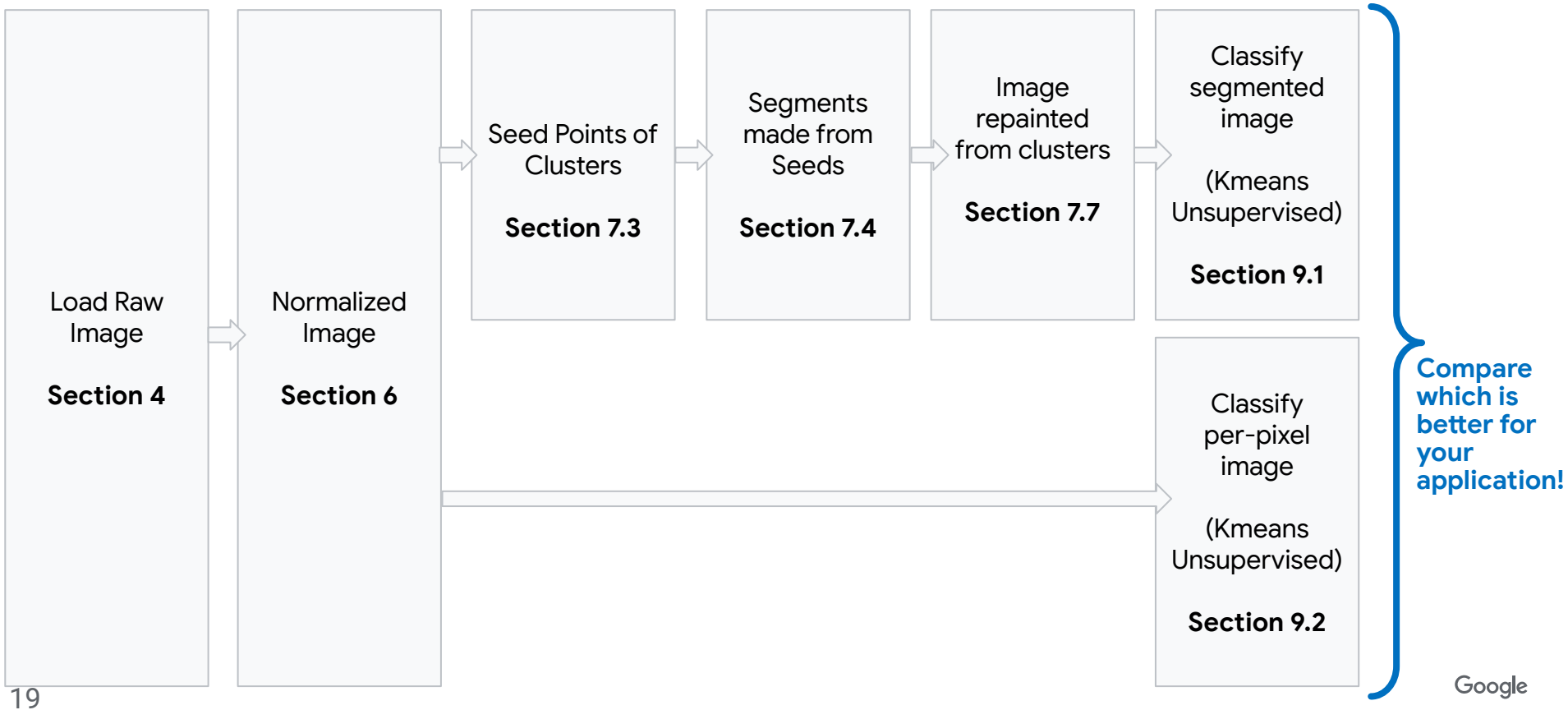
EEUS18 Slides: goo.gl/j9FfGo



EEUS18 Repo: code.earthengine.google.com/?accept_repo=users/gorelick/examples

EEUS18 Slides: goo.gl/j9FfGo

Today's sample code:



Let's Go!

http://bit.ly/G4G_SegmentationBreakout

Phase 1

Access, Duplicate, and Explore

a. Log in and access this script
b. 'SaveAs' a copy to your own space
c. **Learn by playing with parameters on lines 20-23 and 32**

Phase 2

New Images

a. Change the image to one of the other predefined ones by changing value of whichImage on line 53
b. Change the image to one of your own?
c. Customize line 42 to save these assets to your account
d. We are making a database of what parameter values work best in practice. Please fill this out as you go!
Start down at line 75

After today, what else can you do?

1. Give class names to Kmeans clusters
2. Swap in supervised classifier for unsupervised classifier
3. Compare the impacts of scale and extent on the segment creations
4. Compare the ‘best’ parameters between different landscapes
5. Assess accuracy of classification and reference data

Additional Resources:

Resources: Segmentation in Earth Engine

1. Amani, M., Mahdavi, S., Afshar, M., Brisco, B., Huang, W., Mirzadeh, S. M. J., White, L., Banks, S., Montgomery, J., & Hopkinson, C. (2019). Canadian Wetland Inventory using Google Earth Engine: The First Map and Preliminary Results. *Remote Sensing*, *11*(7), 842.
2. Crowley, M. A., Cardille, J. A., White, J. C., & Wulder, M. A. (2019). Generating intra-year metrics of wildfire progression using multiple open-access satellite data streams. *Remote Sensing of Environment, 232*, 111295.
3. d'Andrimont, R., Lemoine, G., & Van der Velde, M. (2018). Targeted grassland monitoring at parcel level using sentinels, street-level images and field observations. *Remote Sensing*, *10*(8), 1300.
4. Lee, J., Cardille, J. and Coe, M. (2018). BULC-U: Sharpening Resolution and Improving Accuracy of Land-Use/Land-Cover Classifications in Google Earth Engine. *Remote Sensing, 10*(9), p.1455.
5. Mariathasan, V., Bezuidenhoudt, E., & Olympio, K. R. (2019). Evaluation of Earth Observation Solutions for Namibia's SDG Monitoring System. *Remote Sensing*, *11*(13), 1612.
6. Mahdianpari, M., Salehi, B., Mohammadimanesh, F., Homayouni, S., & Gill, E. (2019). The first wetland inventory map of newfoundland at a spatial resolution of 10 m using sentinel-1 and sentinel-2 data on the google earth engine cloud computing platform. *Remote Sensing*, *11*(1), 43.

Resources: Segmentation (broadly)

1. Joyce (2009) slides
2. Su, T., & Zhang, S. (2017). Local and global evaluation for remote sensing image segmentation. *ISPRS Journal of Photogrammetry and Remote Sensing*, 130, 256-276.
3. Schiewe, J. (2002). Segmentation of high-resolution remotely sensed data-concepts, applications and problems. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, 34(4), 380-385.
4. Neubert, M., Herold, H., & Meinel, G. (2006). Evaluation of remote sensing image segmentation quality–further results and concepts. *International Archives of Photogrammetry, Remote Sensing and Spatial Information Sciences*, 36(4/C42).
5. Meinel, G., & Neubert, M. (2004). A comparison of segmentation programs for high resolution remote sensing data. *International Archives of Photogrammetry, and Remote Sensing and Spatial Information Sciences*, 35(Part B), 1097-1105.
6. Farag, A. A., Mohamed, R. M., & El-Baz, A. (2005). A unified framework for map estimation in remote sensing image segmentation. *IEEE Transactions on Geoscience and Remote Sensing*, 43(7), 1617-1634.
7. Blaschke, T. (2010). Object based image analysis for remote sensing. *ISPRS Journal of Photogrammetry and Remote Sensing*, 65(1), 2-16.
8. Blaschke, T., Lang, S., Lorup, E., Strobl, J., & Zeil, P. (2000). Object-oriented image processing in an integrated GIS/remote sensing environment and perspectives for environmental applications. *Environmental Information for Planning, Politics and the Public*, 2, 555-570.

Doing two passes through the SNIC segmenter

This can help identify outlier pixels and give them their own segment.

Code link to come here! If you're looking for this code and it's not here, contact us at jeffcardille@gmail.com and we'll track it down for you!