DIGITAL GRAIN-SIZE IMAGERY ANALYSIS AND CITIZEN SCIENCE

INLET GEOMORPHOLOGY

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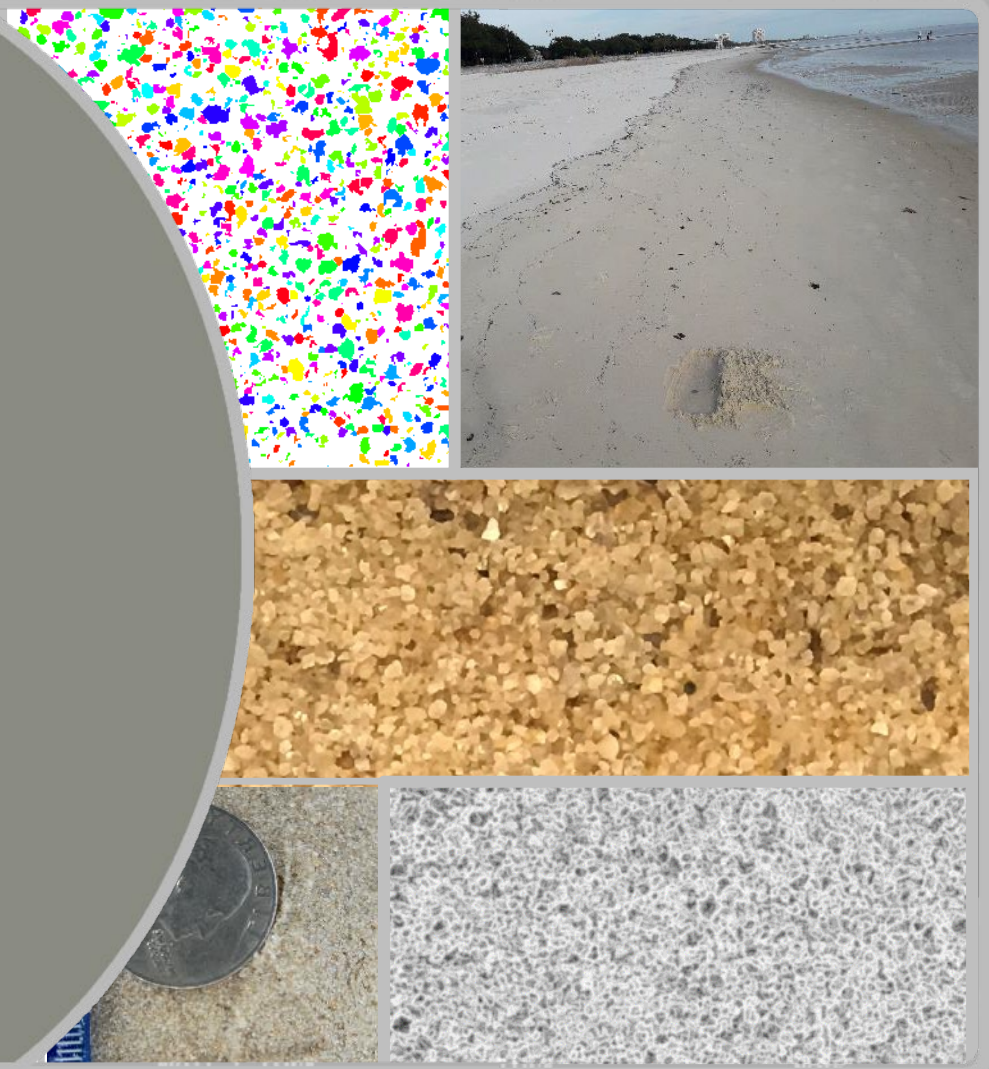

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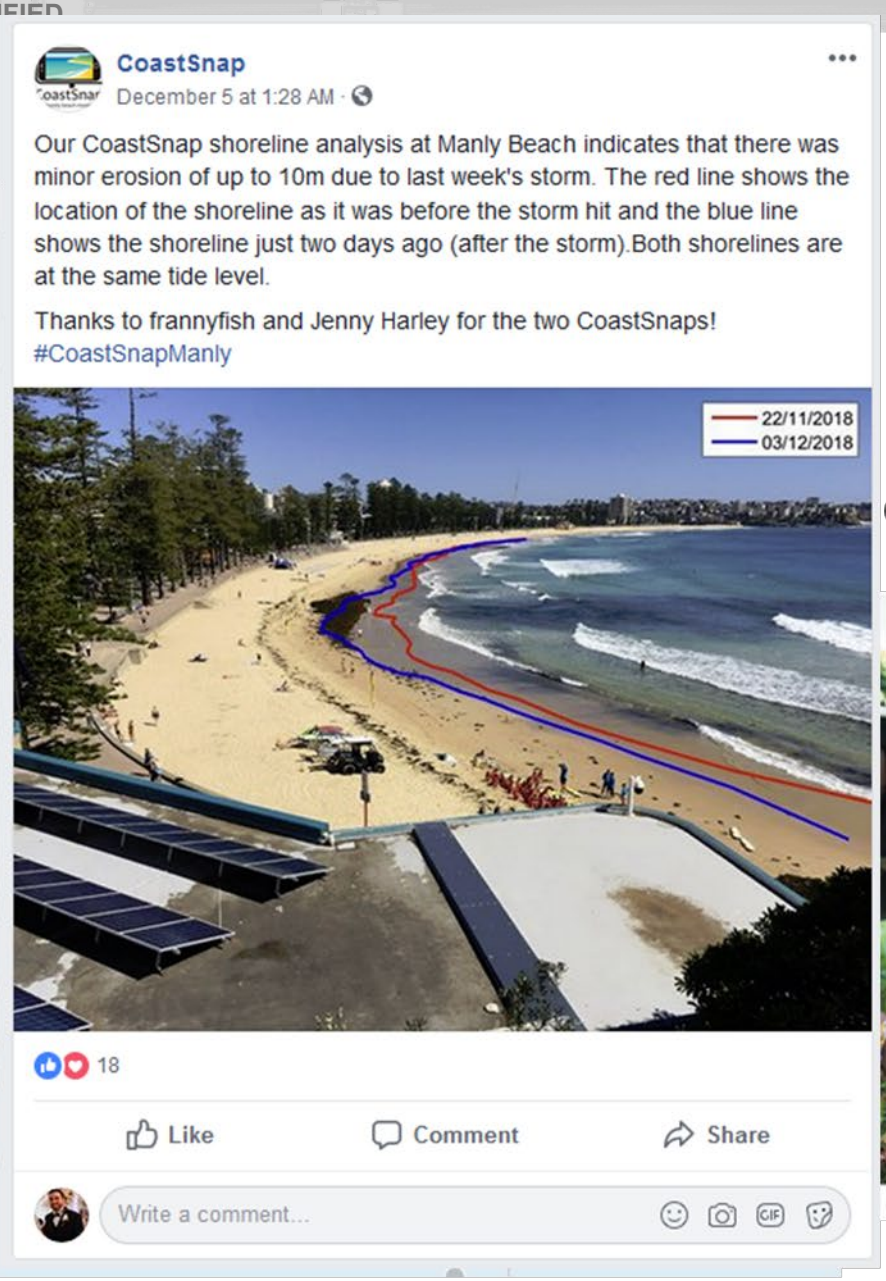
BLUF

National citizen scientist collected grain size data could enhance regional predictive capabilities and improve public engagement. Techniques were collaboratively investigated and appear promising, but need further refinement.

Background and Inspiration

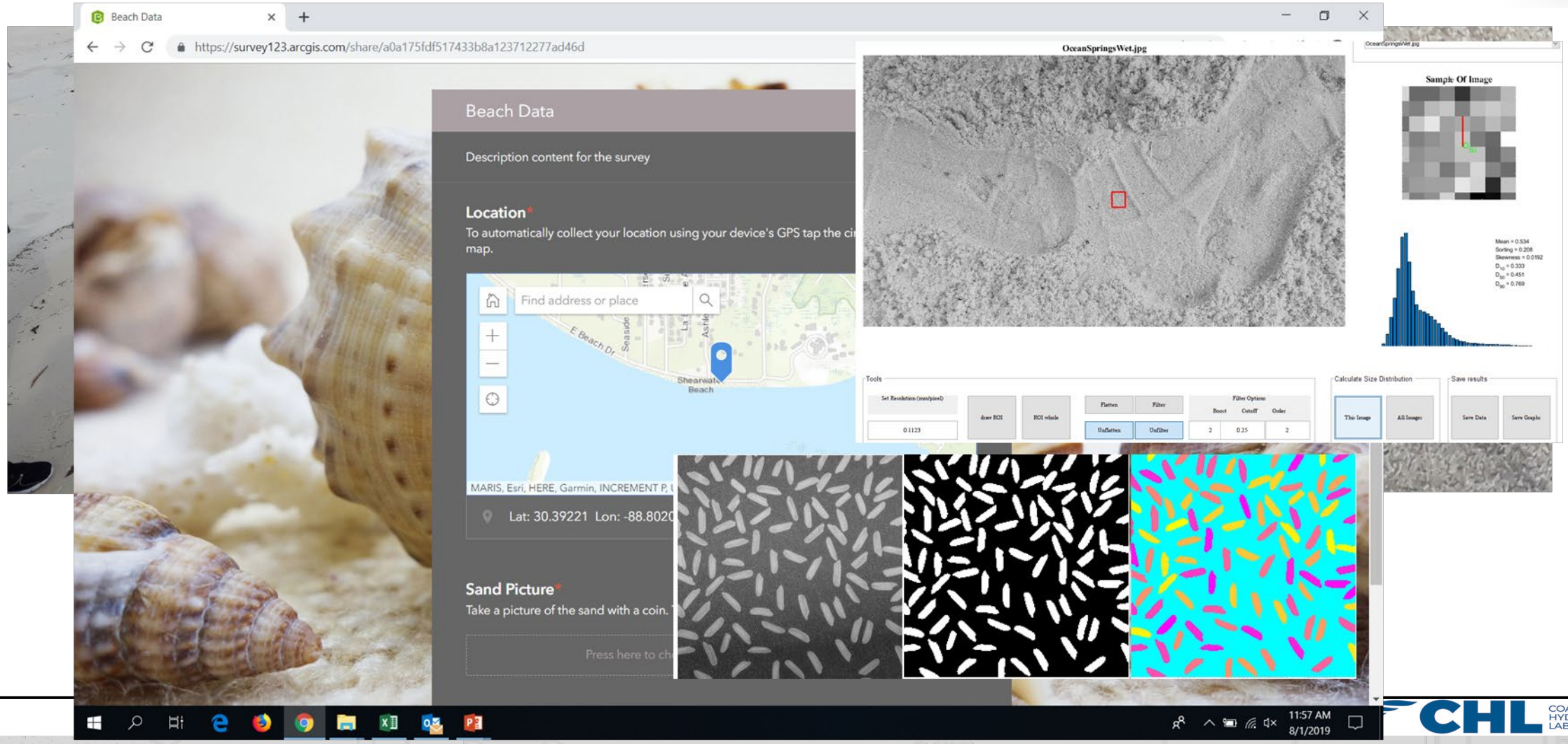


es

observations with iNaturalist.

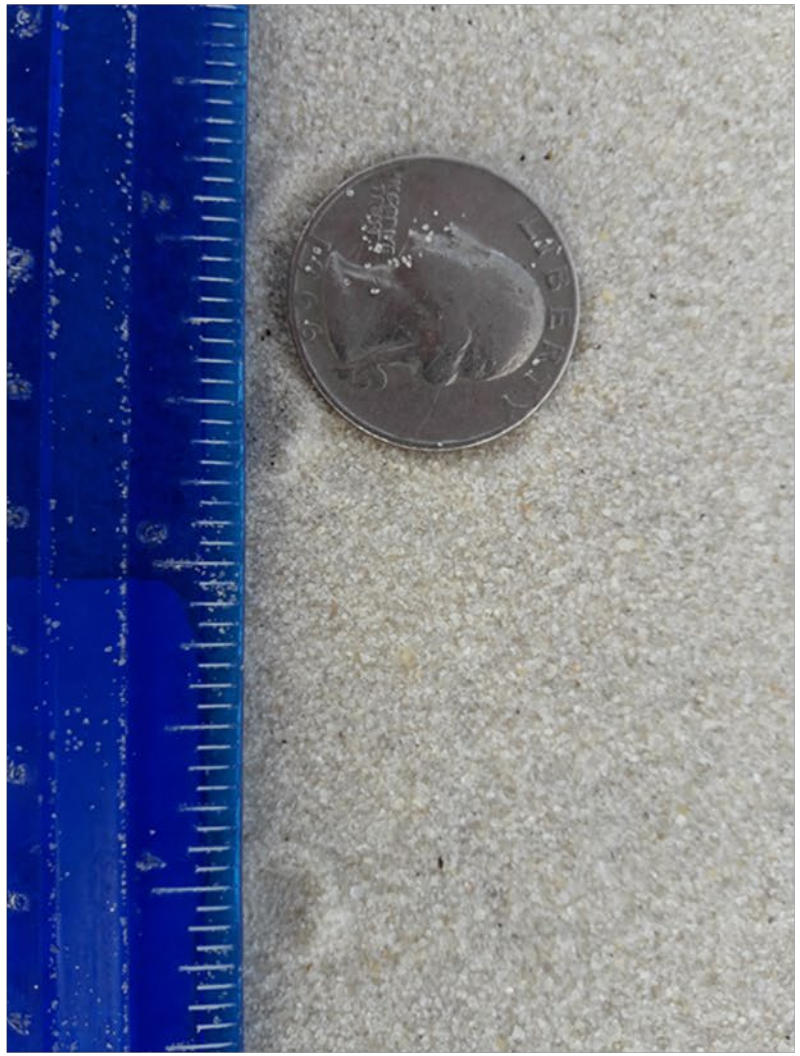
Methodology and Methods Investigated

- **Concept Methodology:**

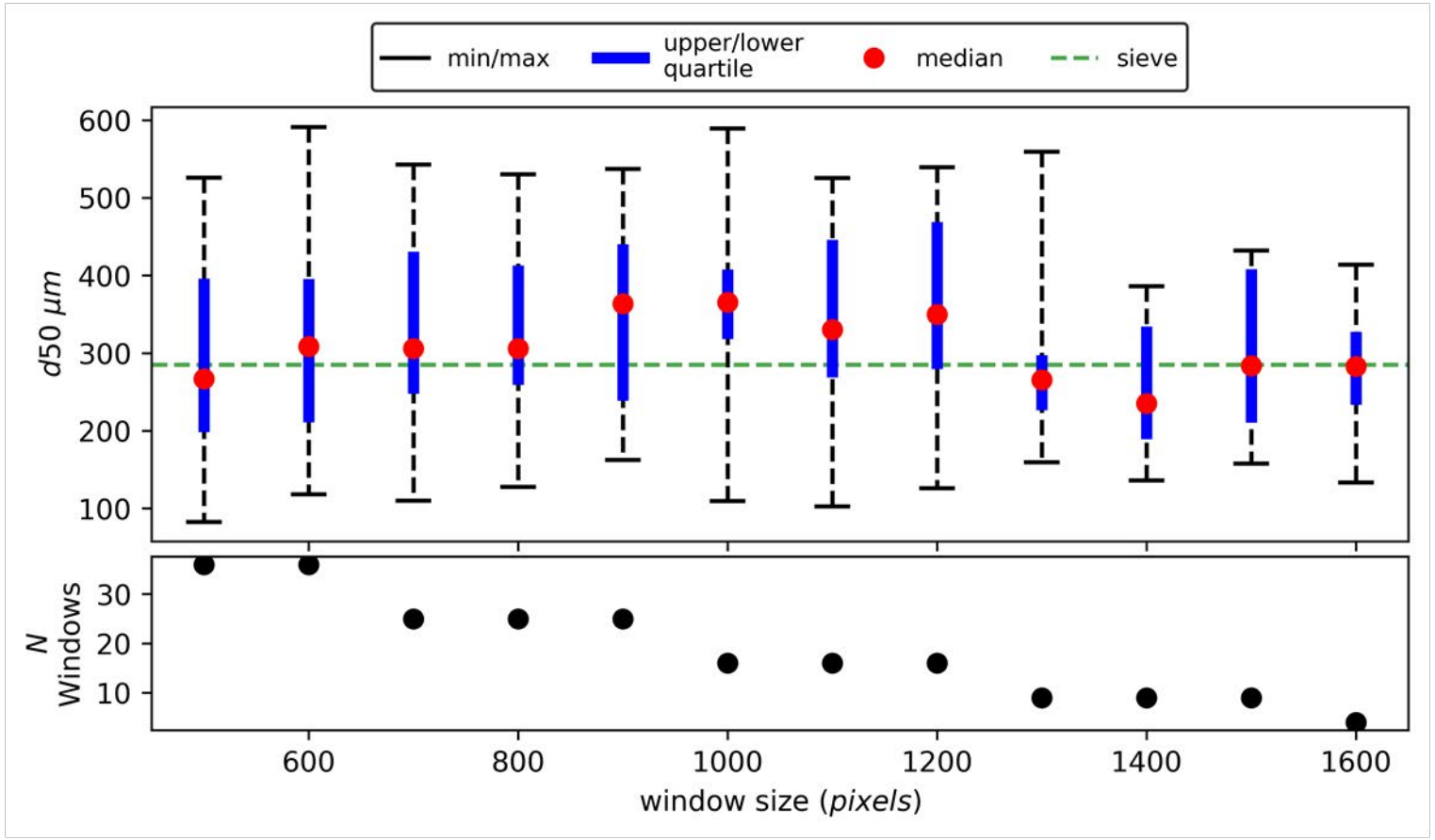


Digital Grain Size Wavelet Analysis

Pixel intensity wavelet grain size estimations



- Some success determining spatial frequencies in rows of pixel intensities
- pyDGS – Buscombe (2013): https://github.com/dbuscombe-usgs/pyDGS
- Window size can alter results in spectral approaches, including pyDGS



Grain Size Distribution with Image Processing

Original Image

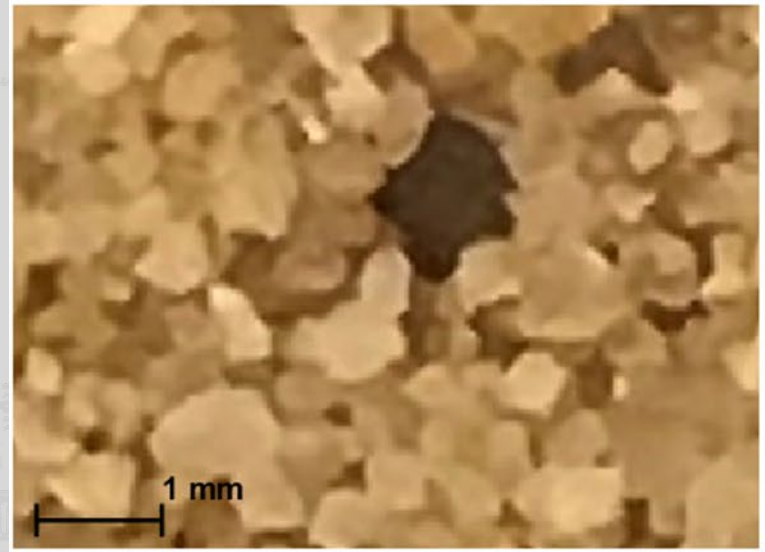
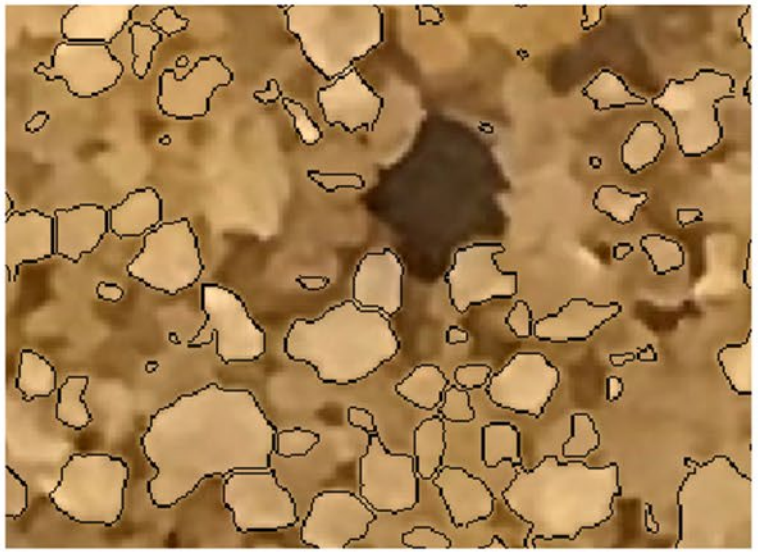


Image Analysis (IA) Results



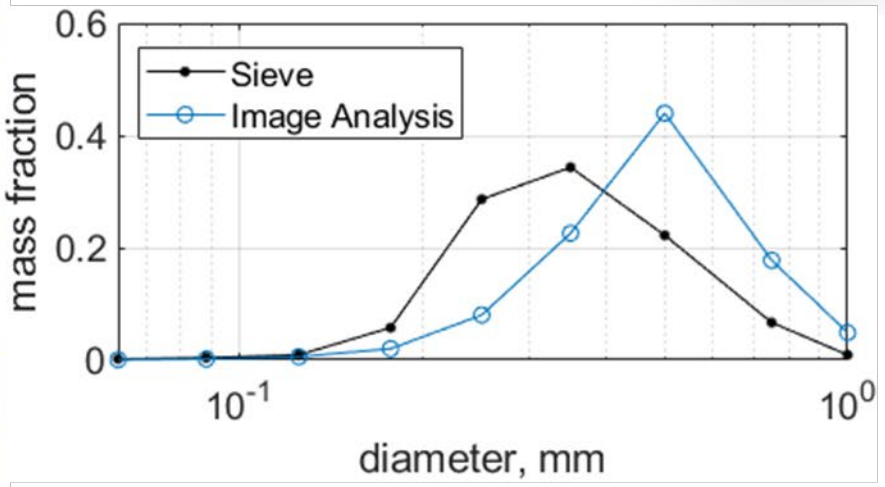


Image Analysis (IA): Matlab Image Processing toolbox

Thresholding (based on intensity/brightness) + Separate touching

- Resolve "top" layer of grains
- Resolves particle shape
- Better resolution of larger grains
- Not resolving "dark" grains
- Some grains hard to separate
- Some grains partly identified

Reasonable agreement with sieve: IA slightly coarser
(expected, e.g. Sime and Ferguson, 2003; Graham et al., 2005)

Particle Size Distribution by Mass

	Sieve	Image Analysis
D_{10} [mm]	0.26	0.34
D_{50} [mm]	0.41	0.58
D_{90} [mm]	0.72	0.92

***(IA D_{10}, D_{50}, D_{90} ~ 1.4x higher)**

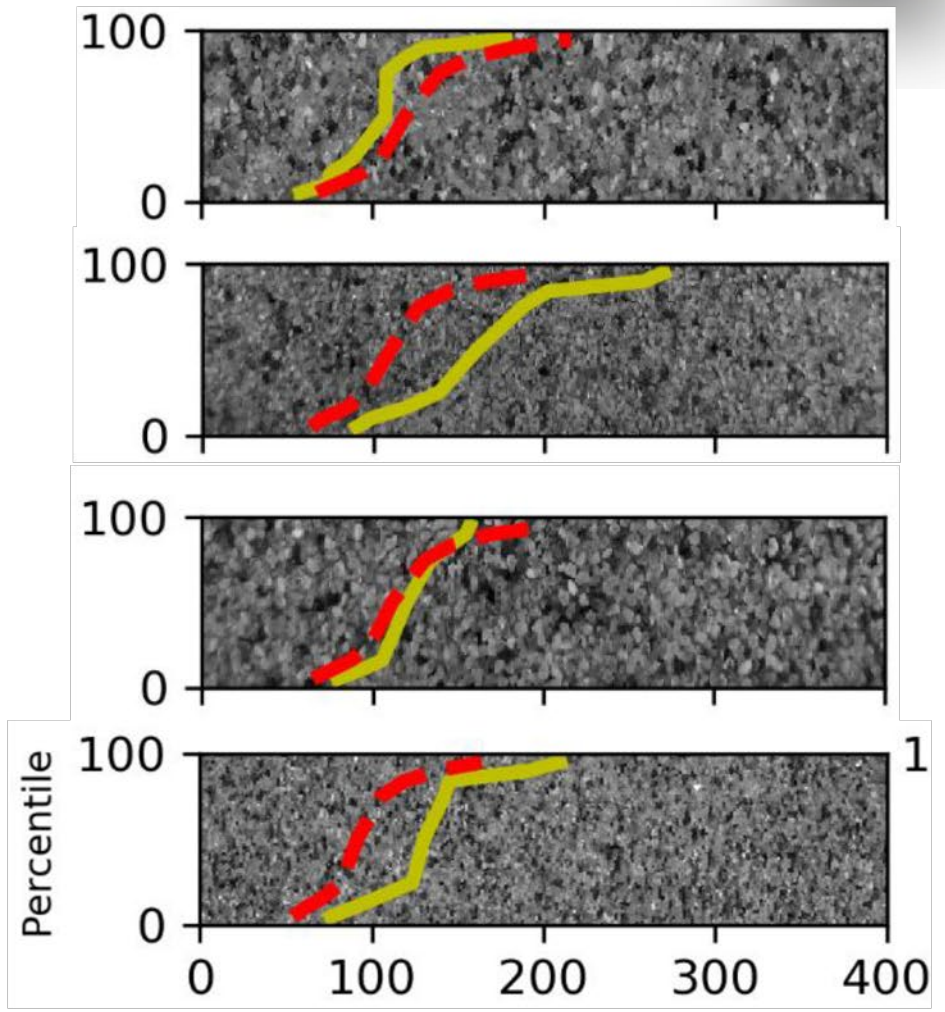
Future Work

SediNet: deep learning optical granulometry

- configurable deep learning framework to estimate sedimentological variables from imagery
- “Off-the-shelf", alternate models, or user training sets
- Potential for citizen-scientist based sediment imagery
- Model accuracy (Buscombe, 2019):
  - Full training set: 24 - 45%
  - Sieved beach sand training set: 16 - 29%
  - Without image scale: 22%
- Encourages user data submission to improve models

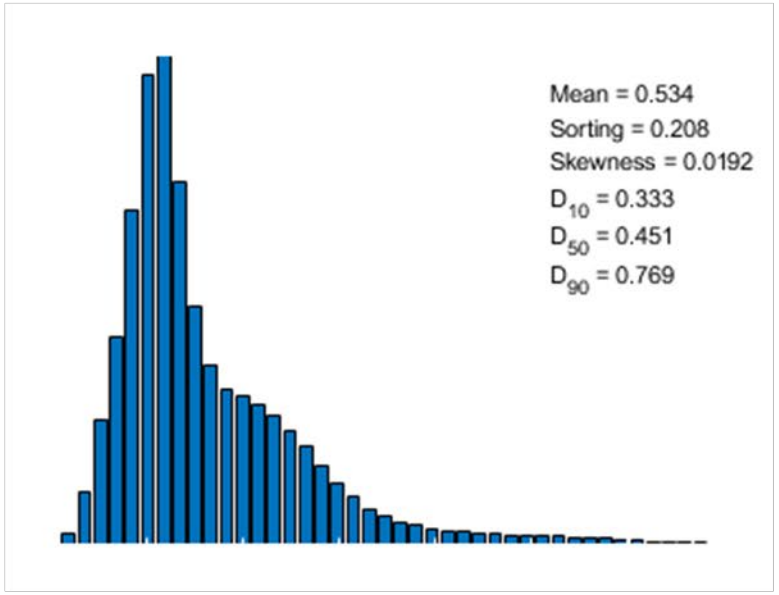
https://github.com/MARDAScience/SediNet

Buscombe, D. (2019, in review). SediNet: a configurable deep learning model for mixed qualitative and quantitative optical granulometry. Submitted to Earth Surface Processes and Landforms



Future Work

- **IF TECHNICALLY FEASIBLE – NEXT STEPS**
- School and Community Engagement
  - Phase 1: University students, Identified State Parks, Coastal Districts
  - Phase 2: Promote at conferences: ASBPA, GSA, etc. and promote with nature-centric groups: Master Naturalist Association, Audubon Society, Coastal State Parks
- App or Website Creation
- Identify Storage Location and Data Access (Link with SAGA?)
- Identify Best Ways to Keep Citizens Engaged:
  - Reply Email with Results from Photo
  - Online Scoreboard for Most Submissions



Summary

FY19 major advances

- Collaboration begun with Shelley Whitmeyer and Celes Woodruff at James Madison University and Daniel Buscombe at Northern Arizona University.
- Wavelet and thresholding/watershed analysis of citizen scientist imagery investigated.
  - Promising results, but refinement is likely required.

FY20 key products/advances (next steps)

- Machine learning optical granulometry
- Expansion from Technical Note summarizing FY19 findings to Technical Report summarizing FY19 and FY20 findings