

SANDSNAP: PHASE I ON THE **CLOUD & OUTREACH ACTIVITIES**

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Goal

Amass a Nationwide Beach Grain Size Database by Engaging Citizen Scientists

Motivation Coasts are a Data Rich Environment

- Topo & Bathymetric
 - o LiDAR
 - Photogrammetry
- o Shoreline Position
 - o Satellite and Aerial Imagery
- Wave Information
 - o Buoys
 - WIS
 - o Coastal Hazard System









Beach Grain Size Database Uses

- o Large-scale Preliminary Studies
- Depth of Closure Studies
- o Analysis of Spatial and Temporal Gradation Variation
 - Improved Life Cycle Analysis and Uncertainty
 - o Beach Compatibility



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Hartman and Kennedy (2016)



3.

Sample Methodology





Results Thank you for helping us build our sediment database! Your efforts will help researchers and resource managers make better decisions and provide students with the opportunity to use authentic data in the classroom! 0.243 mm d, 4 mm (2.52 in 32 mm (1.26 in.) d16 0.268 mm 16 mm (0.63 in.) 8 mm (.32 in.) d25 0.302 mm 4 mm (0.16 in.) 2 mm (0.08 in.) 1 mm (0.04 in. d_{so} 0.427 mm Coars 0.5 mm (0.02) at = 0.427 mm Medium -0.25 mm (0.01 Rine des 0.539 mm -0.125 mm Very Fine 0.062 mm d₇₅ 0.657 mm -0.031 mm 0.016 mm -0.008 mm daa 0.818 mm Fin 0.004 mm 0.965 mm d90 d mean 0.454 mm Click Here to Download Results Fact your medium grained sand beach is similar to South Beach, Edgartown, MA. usA where the movie Jaws was filmed Click Here for more infol YourImage Share Your Results! O @sandsnap_usa f SandSnap 🈏 @Sand_Snap Save Report

Sample Methodology



5.





SediNet model for beach grain size Machine Learning: SediNet

input: (None, 1024, 2048, 1) conv2d_1: Conv2D output: (None, 1022, 2046, 8) Convolution lavers. are filters that share (None, 1022, 2046, 8) input: weights spatially, conv2d_2: Conv2D output: (None, 1020, 2044, 16) sensitive to a hierarchy of Pooling layers repeating patterns input: (None, 1020, 2044, 16) reduce the spatial max_pooling2d_1: MaxPooling2D output: (None, 510, 1022, 16) dimensions of an image for computational Feature (None, 510, 1022, 16) input: efficiency and to conv2d_3: Conv2D extracting output: (None, 508, 1020, 24) help prevent model layers overfitting (memorizing input: (None, 508, 1020, 24) Four "convolutional max_pooling2d_2: MaxPooling2D the training data output: (None, 254, 510, 24) blocks" each rather than learning consisting of a general trend). convolutional filter, input: (None, 254, 510, 24) conv2d_4: Conv2D batch normalization, output: (None, 252, 508, 32) and max pooling layers **Batch normalization** applies a input: (None, 252, 508, 32) transformation max_pooling2d_3: MaxPooling2D output: (None, 126, 254, 32) that helps prevent overfitting input: (None, 126, 254, 32) atch_normalization_1: BatchNormalization output: (None, 126, 254, 32) (None, 126, 254, 32) input: global_max_pooling2d_1: GlobalMaxPooling2D (None, 32) output: Dropout layer Multilayer input: (None, 32) dropout_1: Dropout perceptrons output: (None, 32) For model regularization (to prevent overfitting (one for each output) the model to the data) using linear regression input: (None, 32) dense_1: Dense (None, 1024) to estimate grain-size sutrut: input: (None, 1024) (None, 1024) input: (None, 1024) input: P10_output: Dense P50_output: Dens output: (None, 1) output: (None, 1) output: (None, 1) d10 d50 d90

Input image

(1024 x 1024 x 3 pixels)

- SediNet (Buscombe 2019):
 - Deep Learning Model.
 - Convolutional Neural Network with multiple processing layers.
 - Estimates grain size information from imagery.
 - <u>https://github.com/MARDAScience/SediNet</u>
 - Can estimate up to 9 numeric grain size metrics.
 - Can also calculate categorical variables
 (grain shape, population, color).
 - Uses GPU for computations with tensorflow package in python.
- <12% d₅₀ error from *in situ* test images.
- Can be trained on a wide range of sediments – applied more generally.

Buscombe 2019



Retrained SediNet Model

- Images cropped to avoid coin.
- Sub-Images -1024x1024 pixels.
- Sub-Images Flipped Horizontally.
- 50% for Training.
- 50% for Testing.

Assateague, MD Image



| | Site | # Images | # Sub-Images for Training/Testing | Mean d ₅₀ Error |
|---|---------------------|----------|--------------------------------------|-------------------------------|
| 1 | Assateague, MD | 12 | 116 | 62.3 % |
| | False Cape, VA | 12 | 106 | 47.8 % |
| | Calvert Cliffs, MD | 4 | 32 11.5% | 17.1/% |
| | Biloxi, MS | 7 | 74 11.2% | 14.5 % |
| | Gulfport, MS | > 9 | 88 <mark>8.1%</mark> | 19.05 % |
| | Ocean Springs, MS | 7 | 68 15.2% | 19.2 % |
| | in situ Test Total: | 27 54 | 262 484 11.2% | 33.5 % |

Gulfport, MS Image

- Retrained model:
 - 16 new sites.
 - + 56 images.
- 17% error for all sites.





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Retrained w/ High-Quality Images





SandSnap

Upload Imagery

Data Viewer

Leaderboard

Landscape View of Upload Imagery

Note the extra space Is filled with an image



Thank you for helping us build our sediment databasel. Your efforts will have researchers and authentic data in the classroom.

Location



Address

Please let us know your town and state.

Sand Picture

To take the best image

- Find a part of the dry beach that seems representative of the area.
 Scrape the top 1/2 inch from the surface of the beach and pat the sand down to create. smooth surface for the photo)



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FY21 Activities



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Outreach – With Social Distancing



American Shore & Beach Preservation Association Advocating for healthy coastlines

STEM Activities:

- "Sorting It Out" (Sieve & Sand Castle)
- "That Settles It" (Settling Tube)
- "Digging In Deeper" (Petri Dish & Hand Lens)
- SandSnap

TEST LOCATIONS:

- John Jermain Memorial Library in Sag Harbor, NY
- Nature Center at Jones Beach State Park in Jones Beach, NY

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Outreach – In Person

Public Engagement & Girl Scout Event Jones Beach, NY – 5 June 2021

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Five Activities:

- "Coastal Clone" (Mini-Wave Basin)
- "Sort It Out" (Sieve & Sand Castle)
- "Seashore Detective" (Observation)
- "Mineral Madness" (Various Rocks & Sands)
- SandSnap



"Seashore Detective" (Observation)



Outreach – In Person

Jones Beach, NY – 5 June 2021

Staffed:

- 2 James Madison University (JMU) Professors
- 3 JMU Undergraduates
- 2 NAN Engineers
 - Danielle Tommaso
 - Lynn Bocamazo
- I Park Employee
- 1 ERDC researcher

Participation:

- 22 Children (18 Girl Scouts) + Parents
- Distributed 80 SandSnap Stickers



"Coastal Clone" (Mini-Wave Basin)

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Outreach – In Person

Jones Beach, NY – 5 June 2021

The Good:

- Talked to at least 80 people about SandSnap
- Got more than 20 children excited about coastal engineering and science

The Bad:

Only 4 SandSnap images uploaded

Lessons Learned:

- Setup activities as close to the beach as possible
- We need to improve the location acquisition strategy for SandSnap
- Promote longer for better participation
- Target future locations with more kids (schools)

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"Sort It Out" (Sieve & Sand Castle)

Summary

- An Interactive Web Application is Being Created
- **o** Outreach Activities are Being Piloted & Lessons Learned





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