

# SANDSNAP: ONE SMALL STEP FOR SAND, ONE GIANT LEAP FOR MANKIND

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18 Apr 2024

**COASTAL INLETS RESEARCH PROGRAM**  
FY23 IN PROGRESS REVIEW



U.S. ARMY




US Army Corps of Engineers®



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**SandSnap**


A collaborative project engaging citizen scientists in creating a sand grain database and educating the next generation about coastal processes.



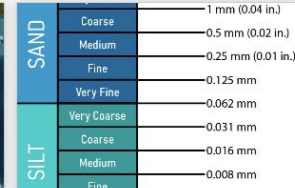
**SandSnap Now!**  
Your efforts will help researchers and resource managers make better decision and provide students with the opportunity to use authentic data in the classroom.



**Learn More**  
To understand how and why coastlines change, we must know the grain size of the sand on the beach.



**Explore Database**  
Our interactive dashboard provides a summary of data collected by our SandSnap Citizen Scientist contributors and computed grain size measurements.



**Get the Data**  
All of our data is accessible to the public and available for download in CSV, JSON, or Shapefiles and through a Feature Map Service.

SAND	Coarse	1 mm (0.04 in.)
	Medium	0.5 mm (0.02 in.)
	Fine	0.25 mm (0.01 in.)
SILT	Very Fine	0.125 mm
	Very Coarse	0.062 mm
	Coarse	0.031 mm
	Medium	0.016 mm
	Fine	0.008 mm

[Click here to find a recently submitted SandSnap](#)





# PROBLEM STATEMENT



The lack of a nationwide beach grain size database is a fundamental knowledge gap in the composition of our beaches and coastlines.

- Grain size often has the largest uncertainty in sediment transport modeling (Soulsby, 1997).
- Lack of grain size information also inhibits beneficial reuse of dredge material.

It is unfeasible to collect beach grain size data on a nationwide scale with traditional methods (e.g., sample collection and sieve analysis).

This deficiency critically limits USACE morphology modeling capability and beach and nearshore renourishment potential (need 70% by 2030)

## SON's:

2020-NAV-1528: Creating a Beach Sediment Database through "Citizen Scientist" Engagement

2020-FRM-1529: Creating a Beach Sediment Database through "Citizen Scientist" Engagement - Improve Beach-Fill CRSM Performance

2020-ENV-1528 Creating a Beach Sediment Database through "Citizen Scientist" Engagement

## USACE R&D Priorities:

Mitigate and adapt to climate change

Support resilient communities

Revolutionize and accelerate decisions making

General Spellman 70% BU Memorandum

FINAL YEAR

## Major Advancements:

SandSnap V1.1 hotfix for several major bugs in V1.0

SandSnap V2.0 w/ all new coin detection and grainsize analysis ML models

SandSnap V2.1 latest version (released February 2024):

New filters.

Major improvements to image processing.

Mean percent error < 9% for all metrics.

JP to be submitted next week (Coastal Engineering).

[sandsnap-erdcchl.hub.arcgis.com](https://sandsnap-erdcchl.hub.arcgis.com)

Scan Me!





# CAPABILITY AND STRATEGIC IMPACT



**This project has created a nationwide beach grain size database from cell phone images collected by citizen scientists, representing up to \$1.3M/year in value.**

**This database will improve regional-scale studies and capture spatial and temporal gradation variations to improve nourishment life cycle analysis and uncertainty and increase range of beach compatible sediment. Additionally, engaging citizens in the data collection will garner more public support for USACE coastal projects.**





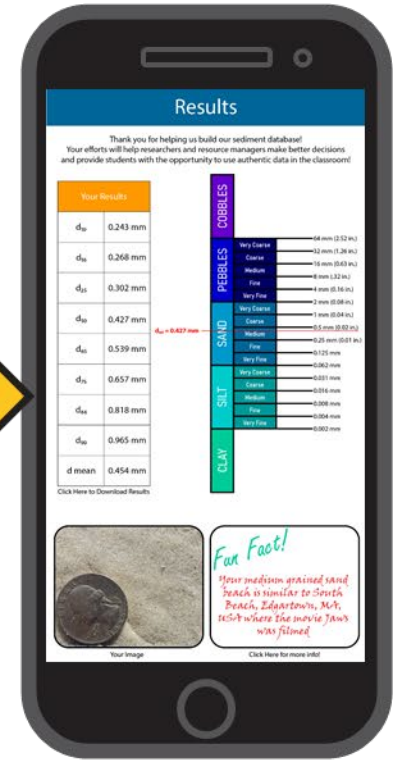


# WHAT IS SANDSNAP?



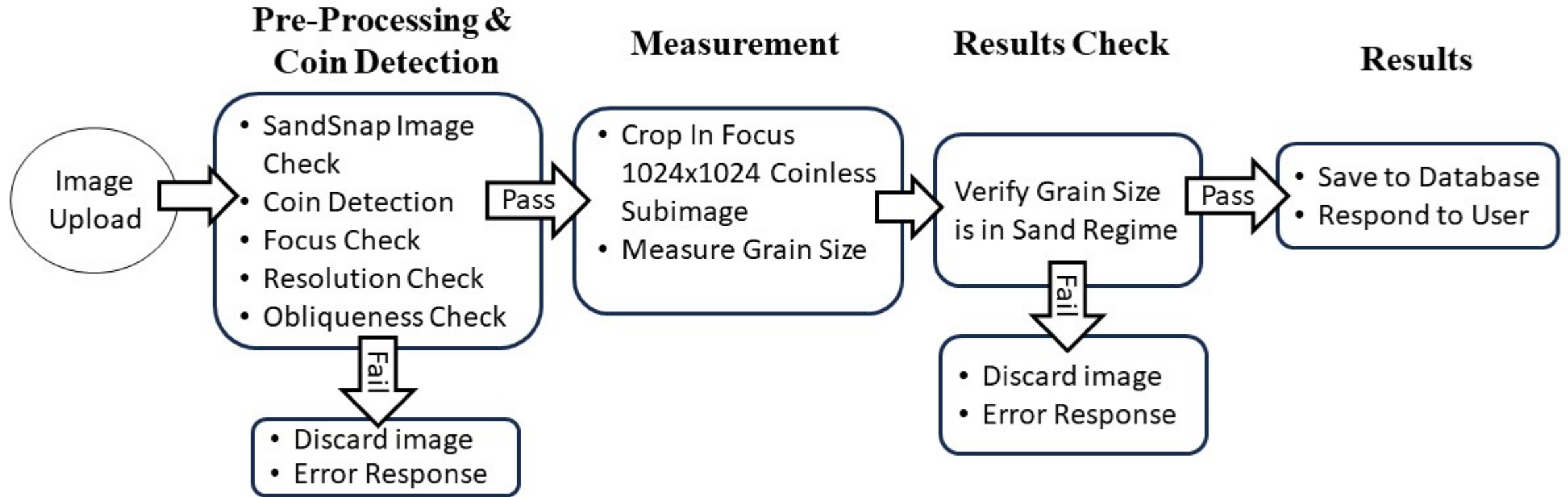
[sandsnap-erdchhl.hub.arcgis.com](https://sandsnap-erdchhl.hub.arcgis.com)

- Interactive web app.
- Citizen scientists collect beach sand images.
- App uploads to GovCloud.
- Processed with two AI/ML algorithms.
- Measures grainsize distribution.
- Nationwide Database.





# SANDSNAP V2.1 WORKFLOW



## Preprocessor #1 - Sand Snap Image Check

- Sand Snap General Verification model
- Shell Hash Detection Model
- Debris Detection Model

## Preprocessor #2 – Image Focus

- Parent and Child Images
- Preprocessor #3 - Coin Pixel Filtering
- Preprocessor #4 - Oblique Detection





# QUALITY CONTROL MODELS



Model	Accuracy	Precision	Recall	F1	Support
General SandSnap	1.00	1.00	1.00	1.00	182
Shell Hash detection	0.98	0.97	1.00	0.98	122
Debris detection	0.98	0.98	0.98	0.98	60

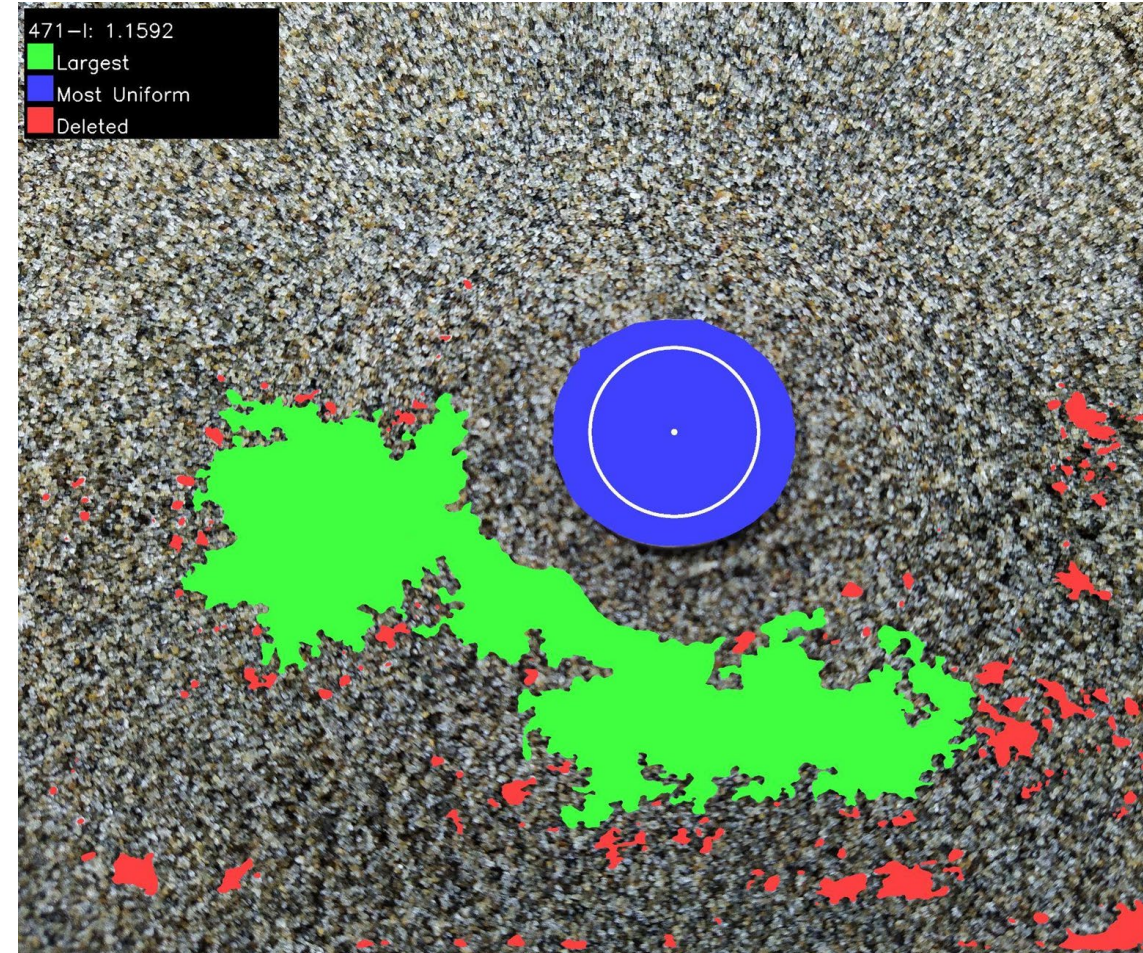




# OTHER FILTERS AND IMPROVEMENTS



- **Shellhash and Debris Detection**
  - In V3.0 these will get passed to segmenteverygrain (Sylvester 2023).
  - Size larger “grains” with segmenteverygrain and crop largest “sand portion” for standard SandSnap workflow.
- **Image focus check**
- **Coin pixel filtering algorithm using connected components labeling.**
- **Oblique photo detection.**
- **Coin type identification (quarter, nickel, dime, Euro coins, etc.).**



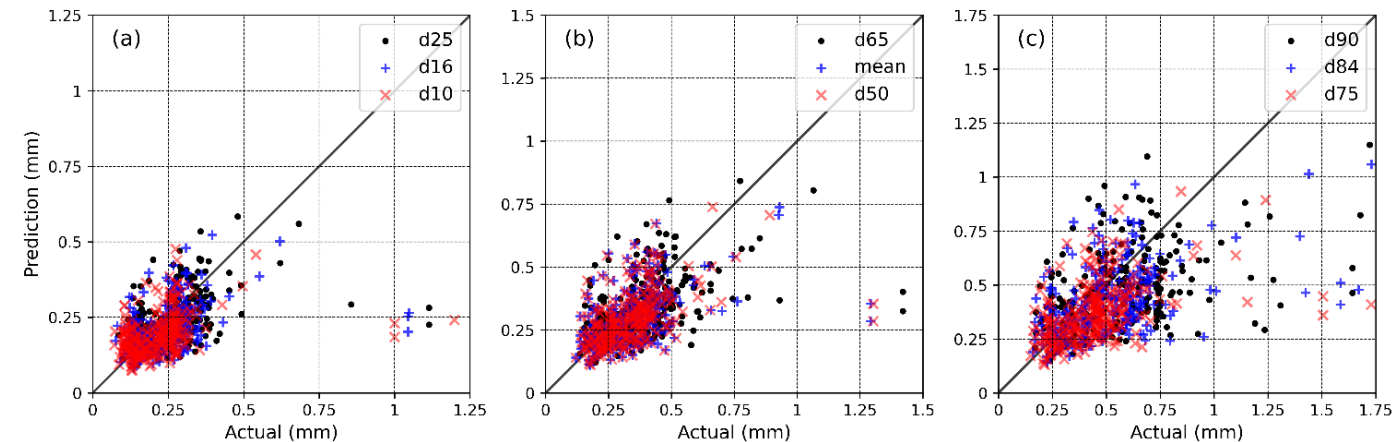


# SANDSNAP V2.1 ACCURACY



Metric	Bias (mm)	Mean Percent Error (%)	Median Absolute Percent Error (%)
$d_{10}$	-0.024	-0.1	26.1
$d_{16}$	-0.027	-1.8	25.4
$d_{25}$	-0.029	-3.4	24.3
$d_{50}$	-0.042	-6.5	22.4
$d_{50}$	-0.046	-7.2	22.9
$d_{\text{mean}}$	-0.055	-7.6	23.2
$d_{65}$	-0.073	-8.6	25.6
$d_{75}$	-0.101	-8.7	26.5
$d_{84}$	-0.130	-8.7	26.5
$d_{90}$	-0.130	-7.8	29.2

- Biased slightly low.
- Mean percent error is negative, less than 9% for all metrics.
- Median absolute percent error around 25%.







# SUMMARY



## FY23 Milestones & Accomplishments:

- **2800 images**
- SandSnap v1.1 hotfix
- SandSnap v2.0
- **SandSnap v2.1 w/ improved filters, image processing**
  - <https://sandsnap-erdchhl.hub.arcgis.com/>
- SandSnap Admin Console w/ v2.1
- **JP submission next week**
- **In The Trenches citizen science article submitted**
- **SandSnap v2.1 Special Report Submitted**
- Published training data.
- Coastal Sediments (11-15 April 2023)
- CIRN Week (May 10-12, 2023)
- ERDC's RD24 Workshop
- Poster/Flyer for ERDC BOD Meeting
- SandSnap Storyboard
- **FY23 ERDC Communications Award**
- ASBPA Presentation October 2023.
- Ocean Sciences Poster February 2024.
- **Gen Spellman Civil Works R&D Brief – October '23**
- **SAD Coastal Monthly Meeting – November '23**
- **Collab w/ NASA (Ryan Ewing) testing SandSnap on Lunar and Martian stimulants.**

## FY23 Milestones & Accomplishments (cont.):

- CoAST SB presentation
- SandSnap display Dare County Library, NC
- SandSnap Demo FRF Ribbon Cutting Ceremony
- **SandSnap Demo to ERDC BOD**
- ERDC-CHL AI/ML Initiatives BCER Meeting (Massey)
- **CHL AI/ML Workshop**
- **ERDC AI/ML Workshop**
- CIRP Technical Discussion
- **Presentation to Dir. of Contingency Ops for Homeland Security (Mr. Stephen Hill).**

