SandSnap: A Pocket-Sized Beach Lab and Open Database

Brian McFall, David Young, Brooke Walker
U.S. Army ERDC Coastal and Hydraulics Laboratory

Shelley Whitmeyer
James Madison University

Daniel Buscombe
MARDA Science, LLC

Jacob Stasiewicz
ORISE Fellow

FSBPA National Conference
6 February 2025

US Army Corps of Engineers®

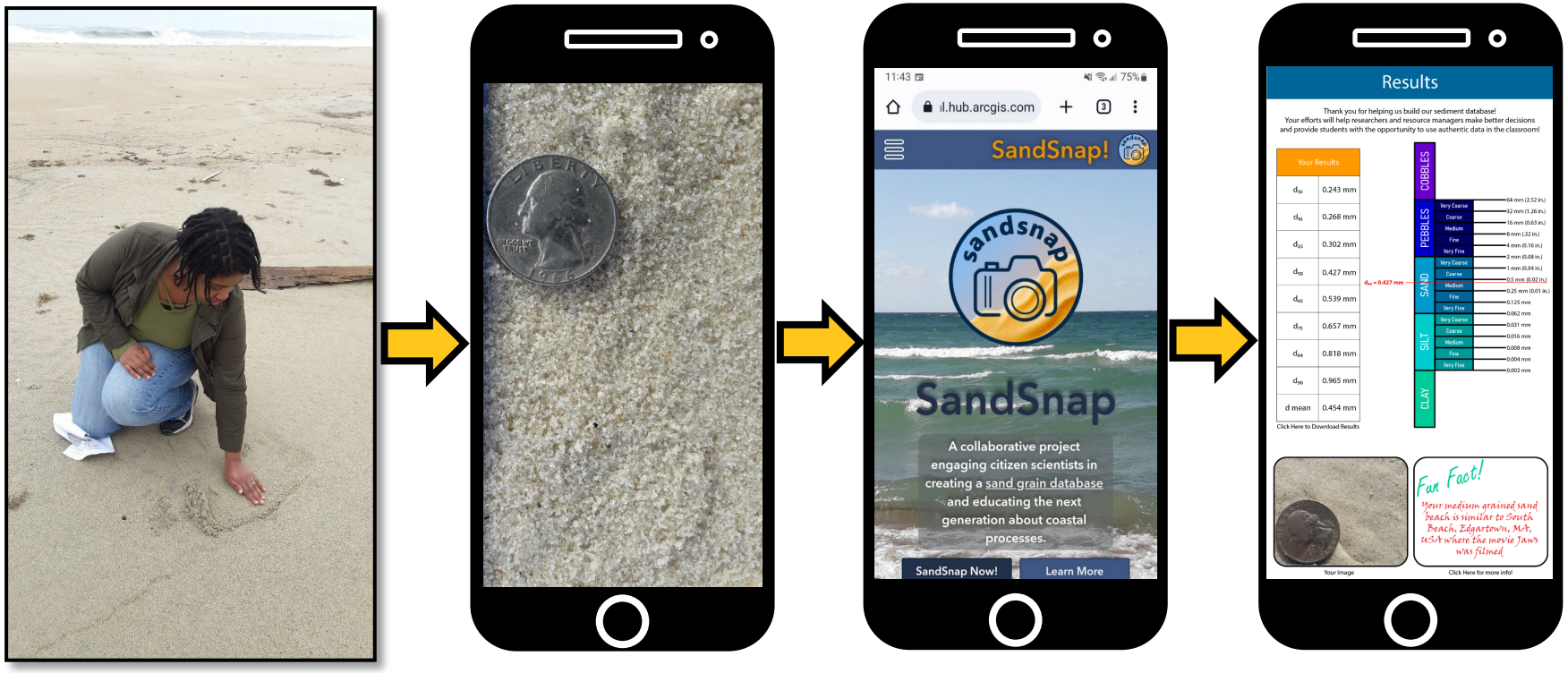
CHL COASTAL & HYDRAULICS LABORATORY

What is SandSnap?

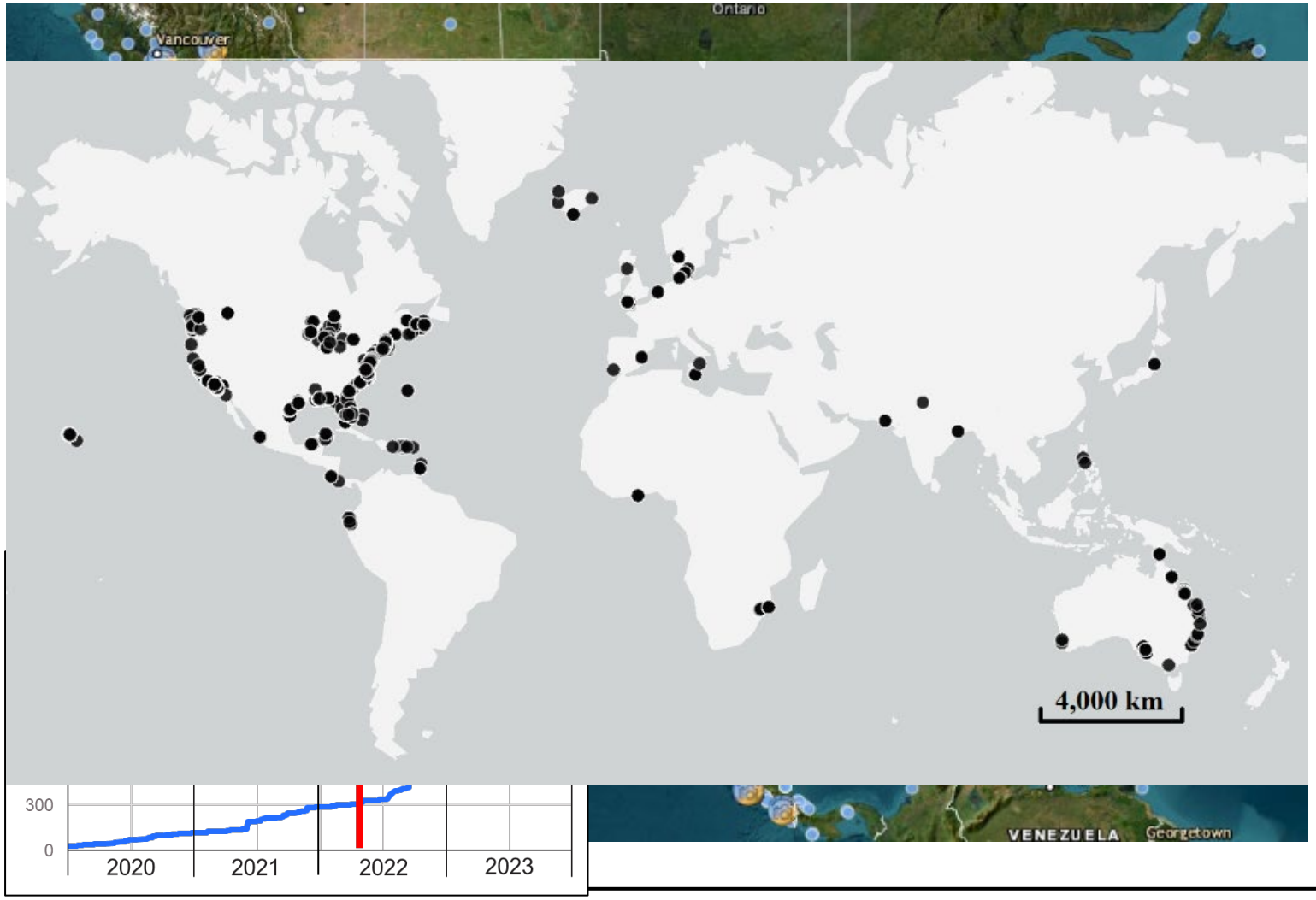
- Interactive web app.
- Citizen scientists collect beach sand images.
- App uploads to GovCloud.
- Processed with AI/ML algorithms.
- Measures grainsize distribution.
- Gamification incentivizes participation.

sandsnap-erdcchl.hub.arcgis.com

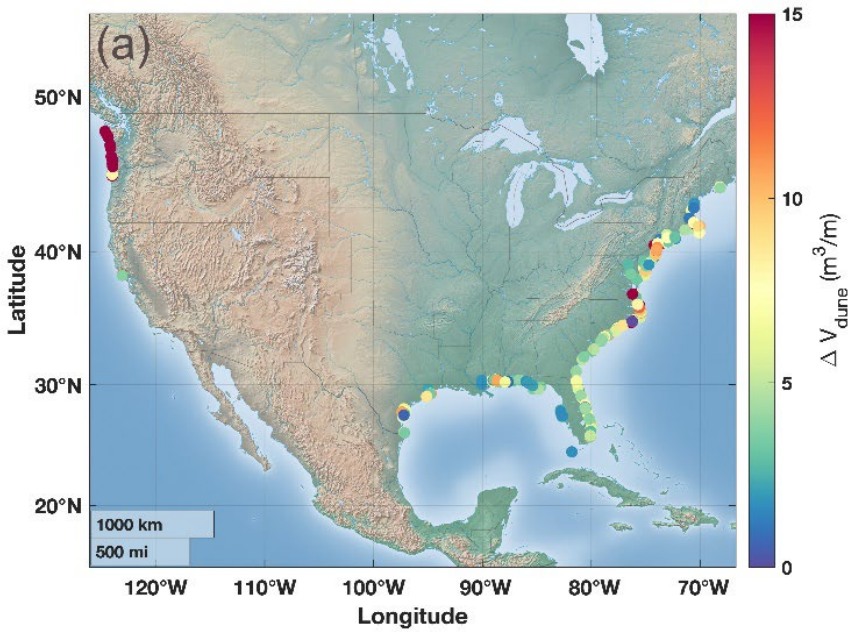
Scan Me!

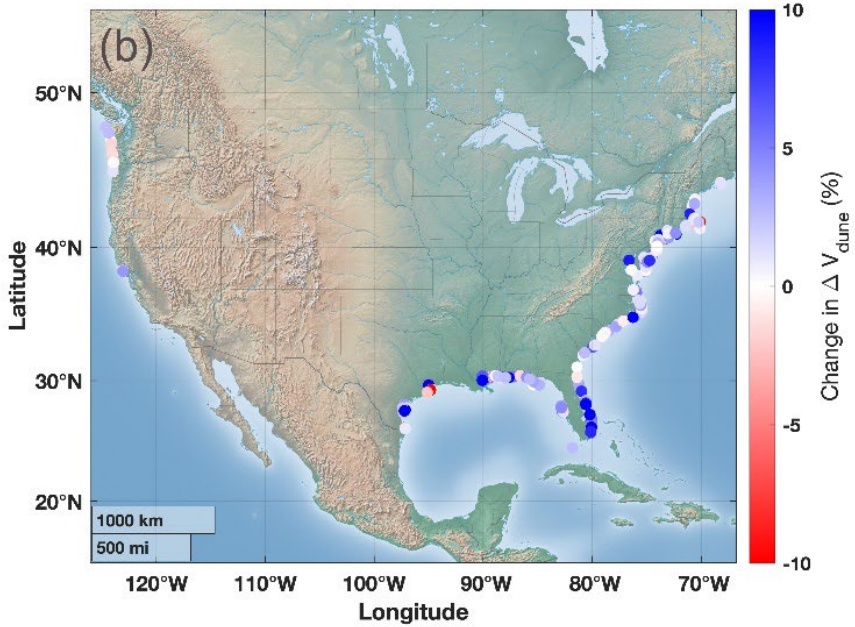


Why is SandSnap Important?



- **Build open beach grain size database.**
  - **Doesn't currently exist.**
  - **Grainsize largest uncertainty source in morphology models.**
- **Save money.**
  - **Crowdsourcing sediment data collection saves $500/sample -> estimated value creation of $2M/year.**





Applications

- **Beneficial Use of Dredged Sediment**
  - **USACE dredges NAV channels**
  - **Many states have strict gradation requirements for beach nourishment**
- **Wind-blown sediment transport modeling.**
  - **AeoLiS - Δ dune volume w/ d_{50} vs full gradation.**
  - **Pacific NW saw decrease in dune growth.**
  - **8% sites had increase in dune growth > 10%**
- **Coastal Resilience and Vulnerability Studies**
- **Project Scoping and Initial Feasibility Studies**

How Does SandSnap Work?

Image Upload

Pre-Processing & Coin Detection

- Resolution Check
- SandSnap Image Check
- Gravel/Debris/ Shell Hash Checks
- Blurriness Check
- Coin Detection
- Obliqueness Check

Pass

Measurement

- Crop In Focus Subwindow
- Measure Grain Size

Fail

Error Response

Results Check

Verify Grain Size is in Sand Regime

Fail

Error Response

Pass

Results

- Save to Database
- Respond to User

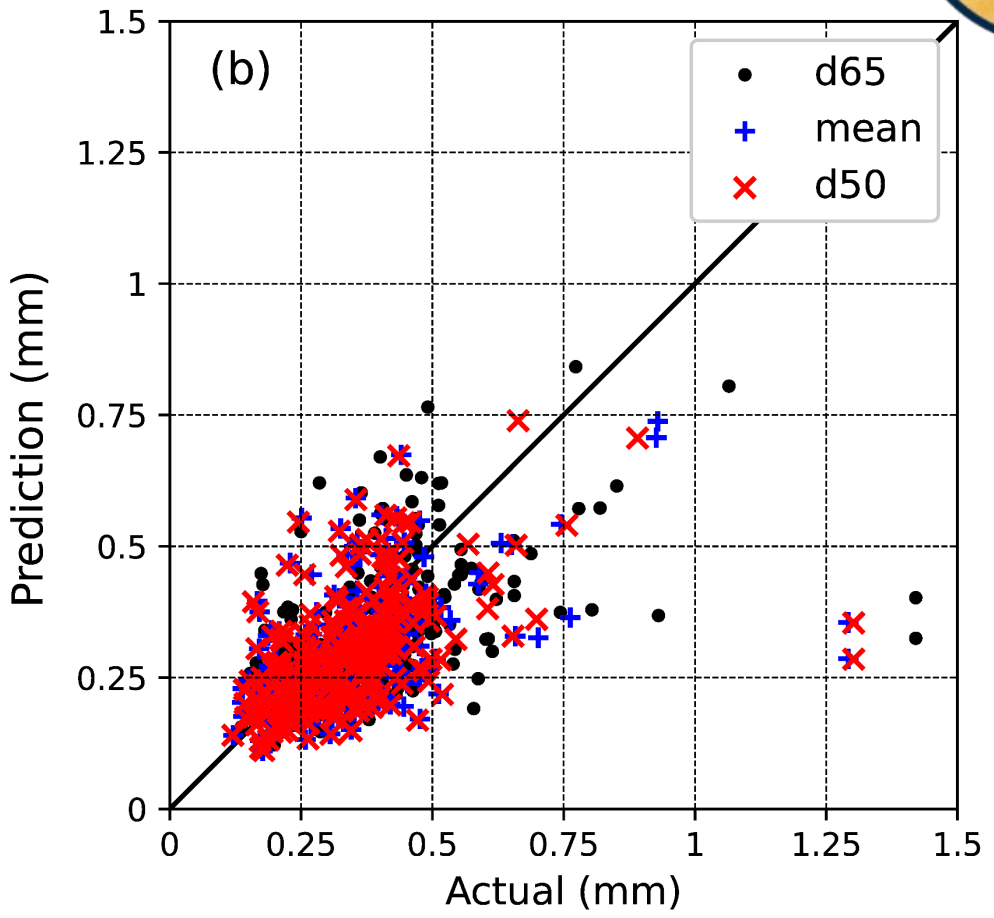
User Interface

- **Survey123 (ESRI)**
  - Geo-tagging.
  - Mapping.
  - Data export.
  - Submission form.
    - Location (tries to use phone GPS).
    - Beach Name.
    - Town (tries to auto-populate).
    - State (tries to auto-populate).
    - Country (tries to auto-populate).
    - Coin type (nickel, penny, etc.).
    - Beach location (berm, swash, etc.).
  - Image Upload.
- **Databricks Backend**

Gradation Accuracy

- 263 Test Images
- 113 Different Sites
- Ranging:
  - Sedimentology
  - Phone Cameras
  - Users

- d_{50} Results:
  - Bias: -0.045 mm
  - Mean Percent Error: -7.2%
  - Median Abs Percent Error: 22.4%



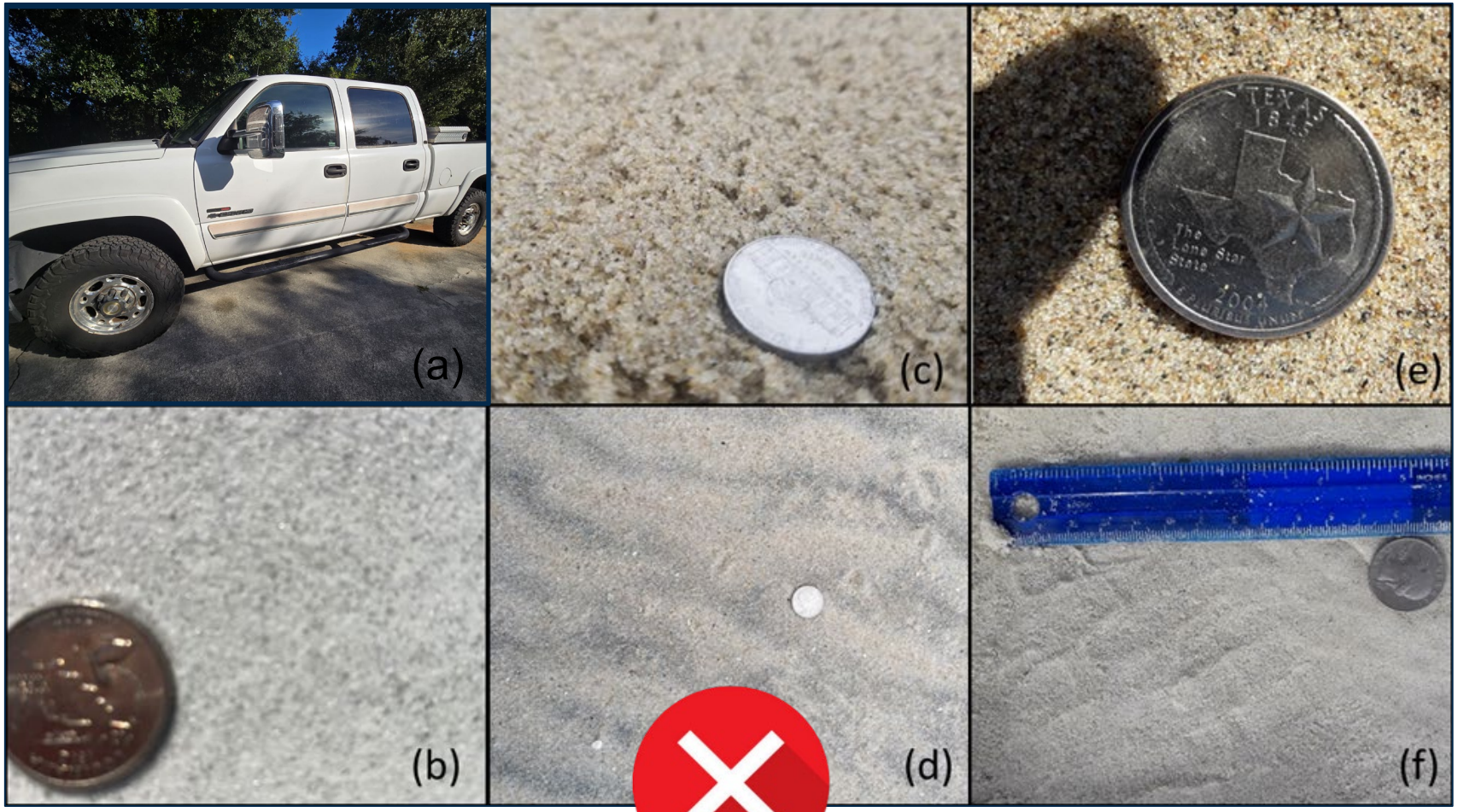
Location Accuracy

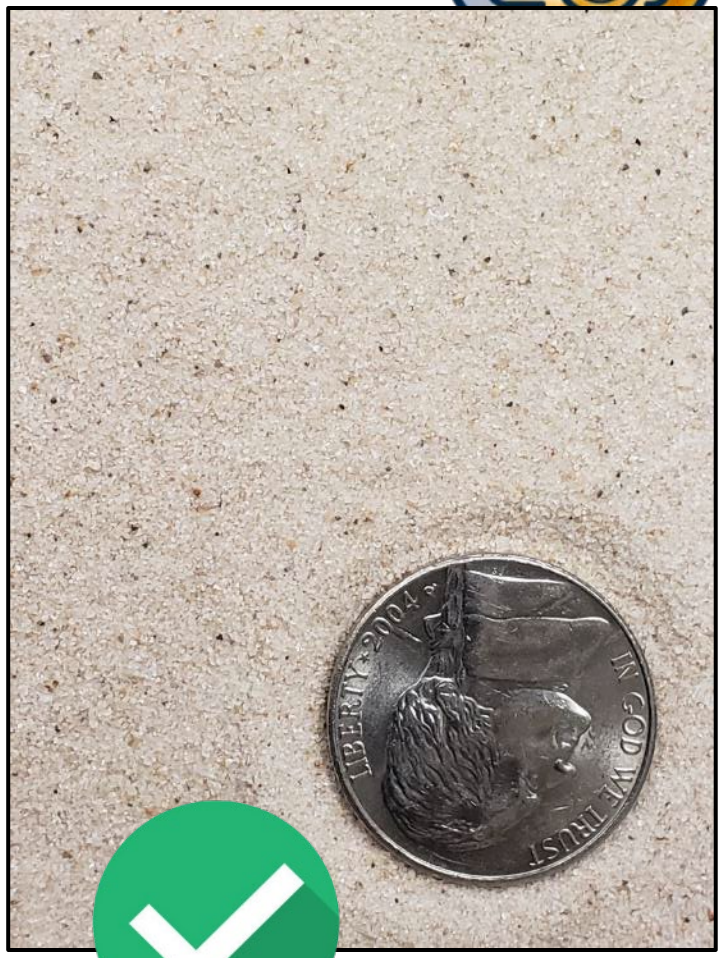
- Duck, NC
- USACE and Locals on the Beach
- 25 Submissions
- Submission point surveyed with RTK GPS

- Average Error of 12.7 m

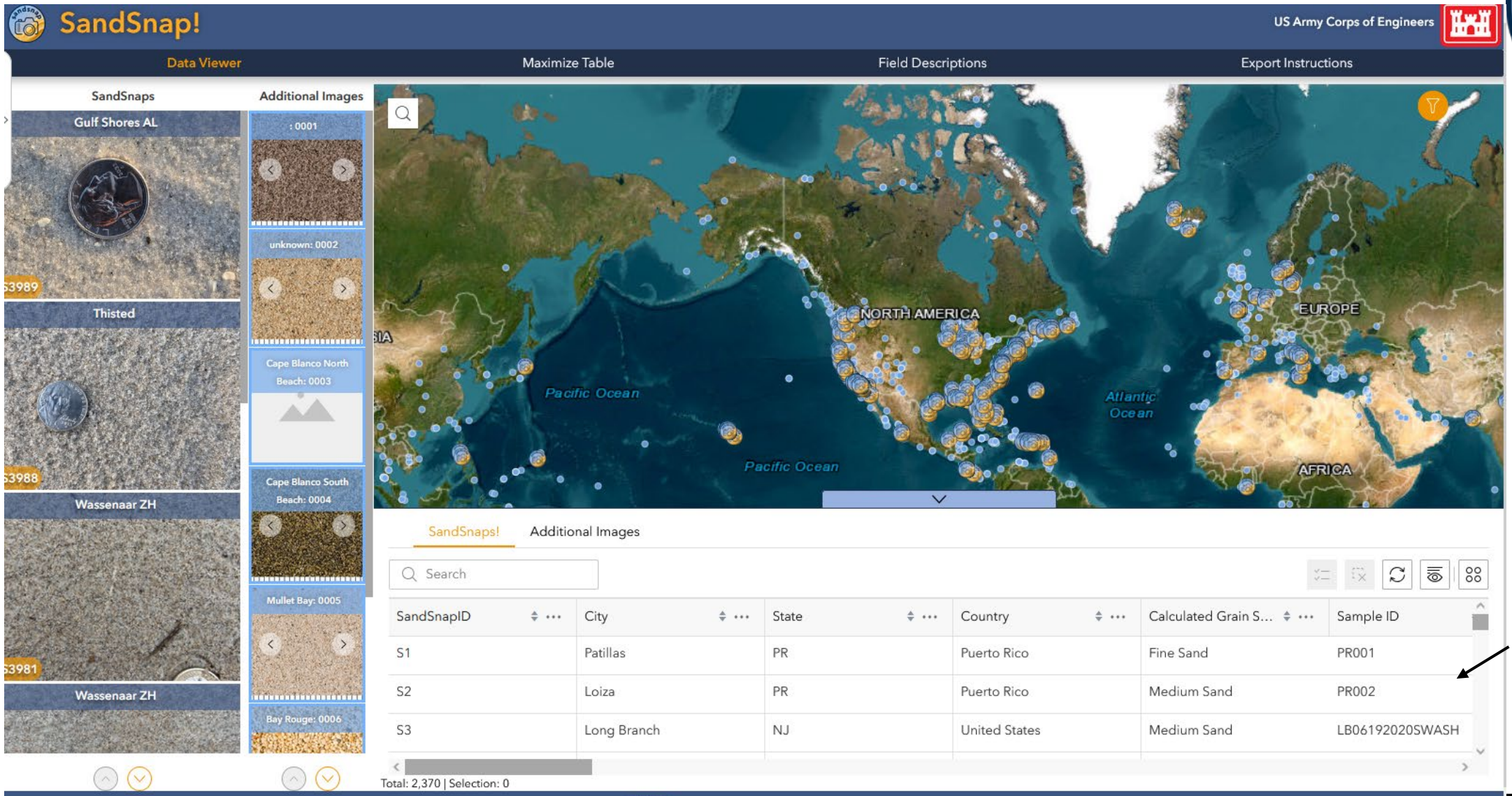
- All selected the cross-shore morphological position

Common Issues





Database

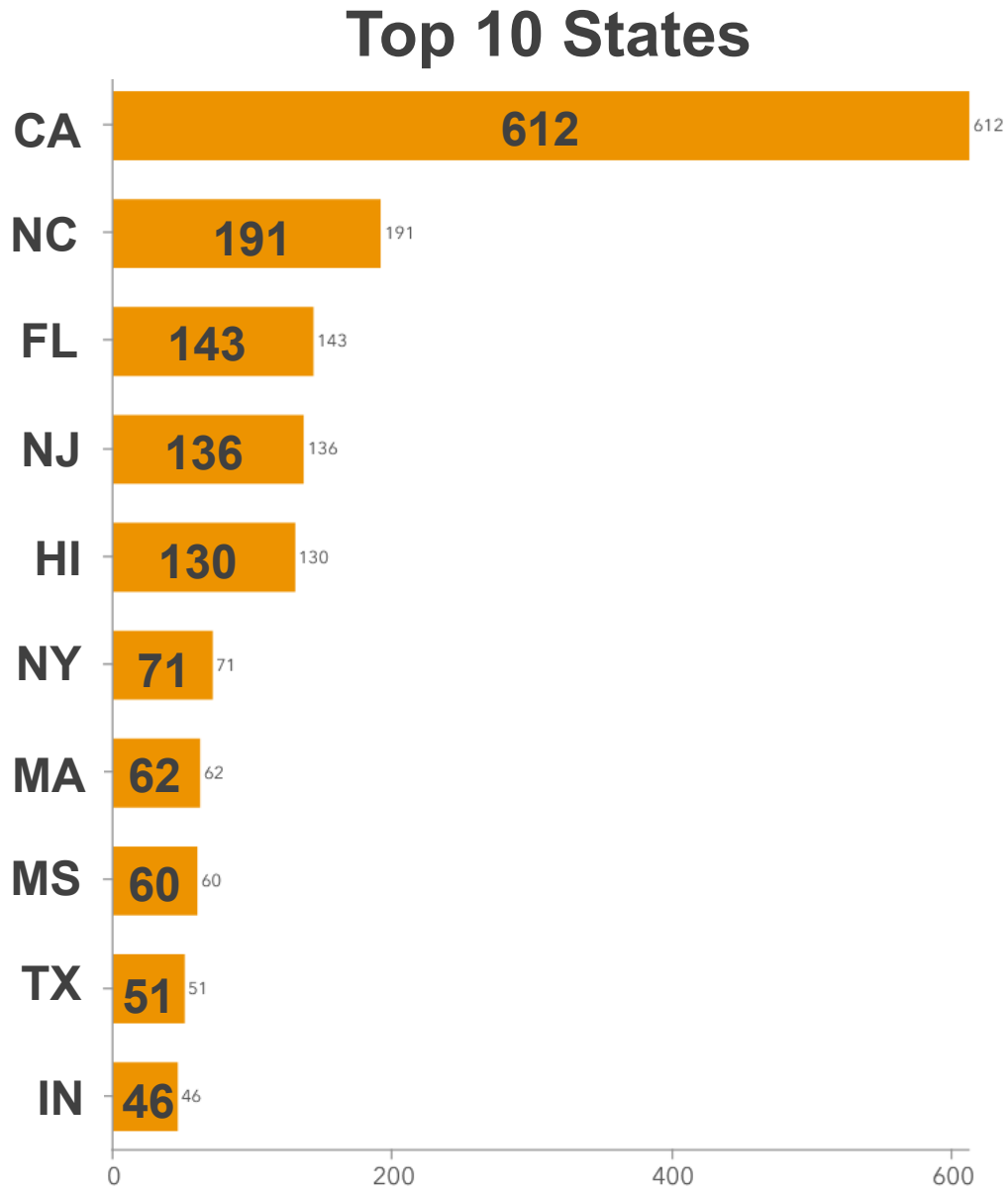


Full Gradation (d_{10}-d_{90})

Database Stats

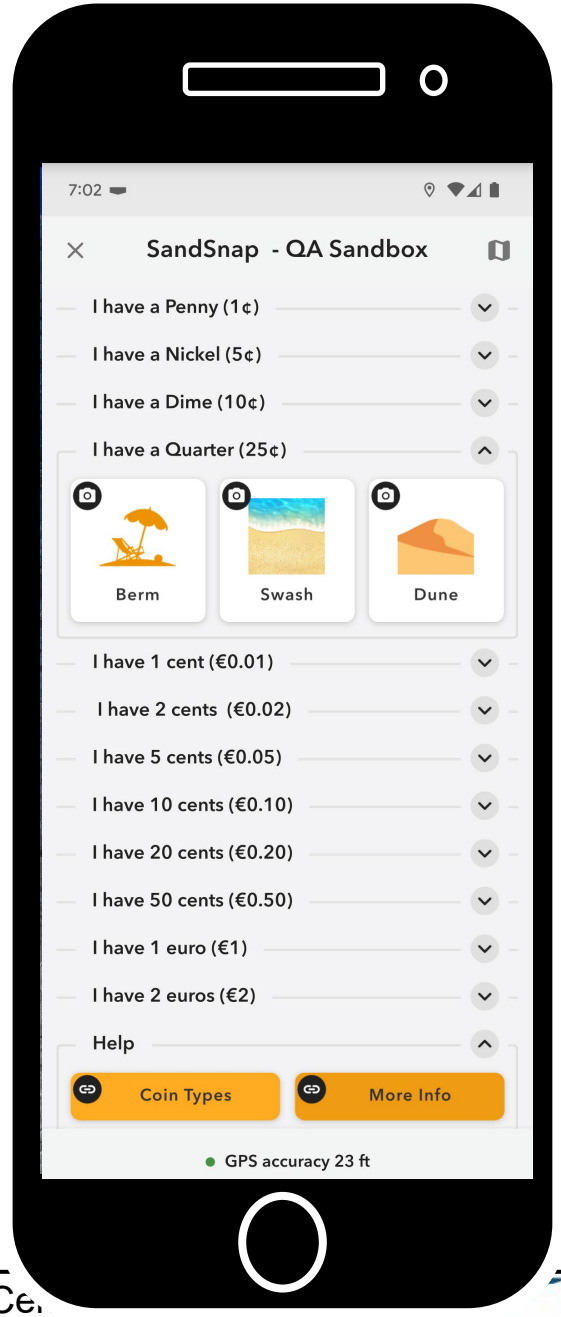
Successful SandSnaps: 2,374
USA SandSnaps: 1,758
Errors: 20%
# of States: 32
# of Countries: 53

(Feb. 3, 2025)



Coming Soon

- Additional Currency Types
  - Euros
  - Canadian
  - Mexican Pesos
  - Other
- Phone App
  - Testing “Quick Capture” App
  - Very useful if there’s no service
- Bulk Upload of Images
- Bulk Download of Images



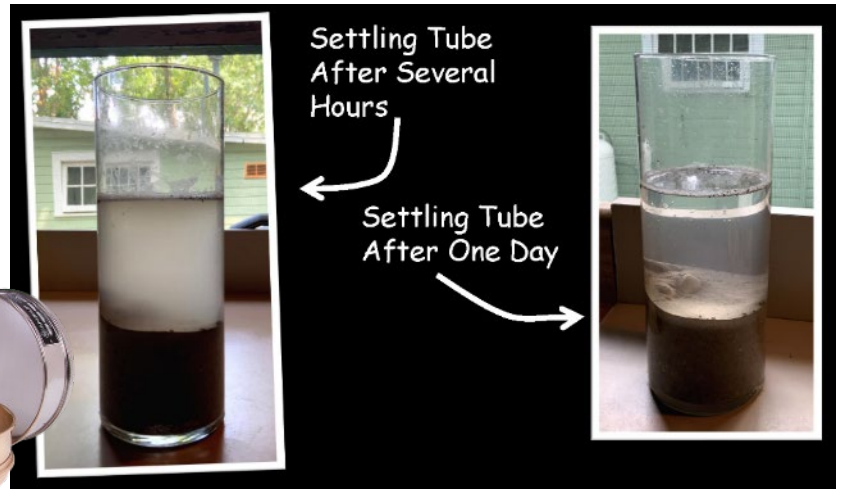
More Coming Soon

<u>Technical Investigations:</u>

- Mixed Sediment Beaches
  - Sand + Gravel, Sand + Shell Hash, Pebbles, Shell Hash
  - Meta's Segment-Anything (Version 2)

- Sediment Shape

Outreach Efforts – K-12



Initiatives:

- Library “Discovery Bags”
- In-person event activities
- Class lesson plans
- Science Fair Projects

STEM Activities:

- “Sorting It Out” – Sieve & Sand Castle
- “That Settles It” – Settling Tube
- “Digging In Deeper” – Petri Dish & Hand Lens
- “It’s a Snap” – SandSnap

Summary

- SandSnap is Continually Improving
- Class Lesson Plans & Science Fair Projects are Ready
- The Database is Growing But WE NEED YOU!

SandSnap@usace.army.mil