SandSnap v2.0: *Bigger, Better, Stronger, Faster*

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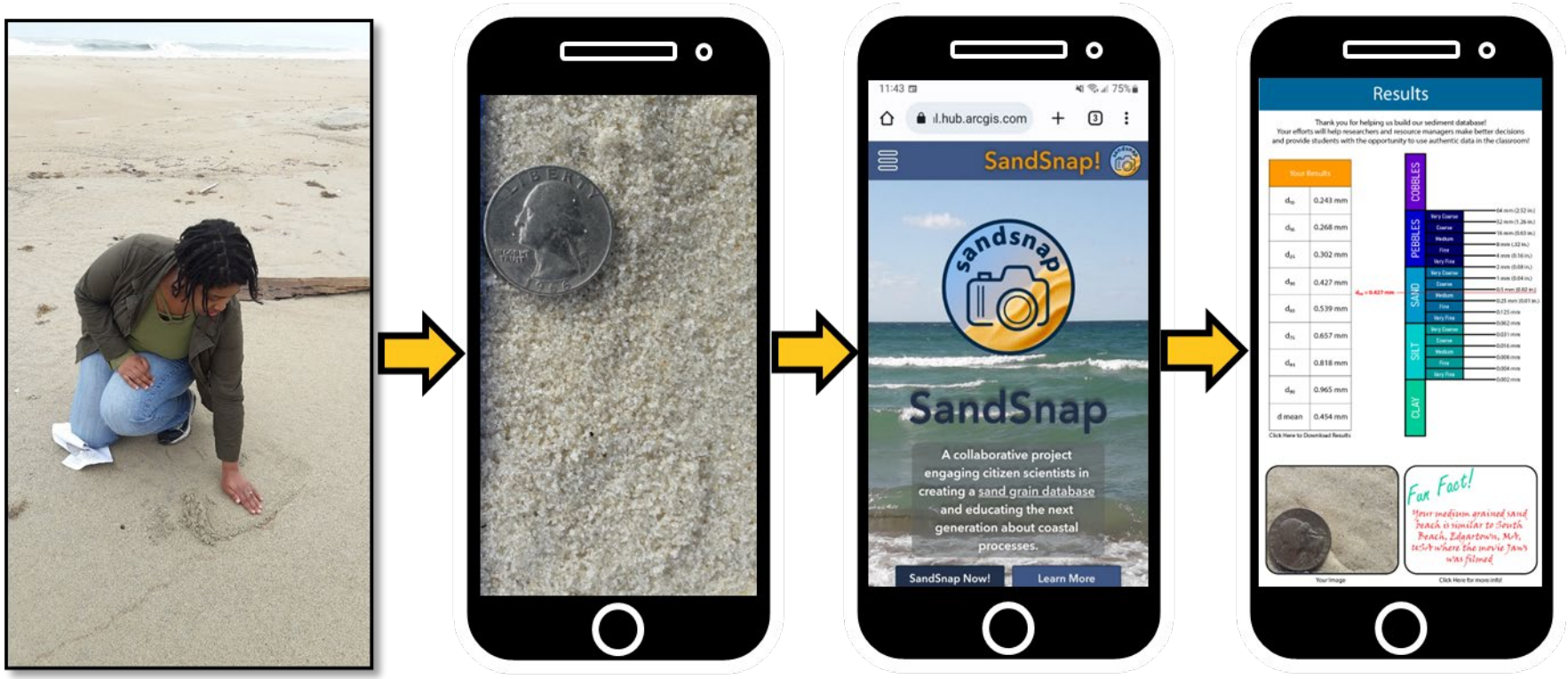
US Army Corps of Engineers®

CHL COASTAL & HYDRAULICS LABORATORY

SandSnap

Scan Me!

- Interactive web app. sandsnap-erdcchl.hub.arcgis.com
- Citizen scientists collect beach sand images.
- App uploads to GovCloud.
- Processed with two AI/ML algorithms.
- Measures grainsize distribution.



Why SandSnap?

- **Build nationwide beach grainsize database.**
  - **Doesn't currently exist.**
  - **Grainsize largest uncertainty source in morphology models.**
  - **This limits coastal resilience and opportunities for BU of dredged sediment.**
  - **Chief's memo – 70% BU by 2030.**
- **Save money.**
  - **Crowdsourcing sediment data collection saves $500/sample -> estimated value creation of $1M/year.**

SandSnap V2.0

- QoL upgrades to SandSnap site/admin console.
- Minor changes to instructions/submission forms.
- Major upgrades under the hood.
  - Updated coin detection model.
  - Updated grain size model.
  - Updated image processing.
  - Greatly improved speed/accuracy.
  - Improved error handling.
- Updated filters and features coming to v2.1 in FY24.

SandSnap Now!

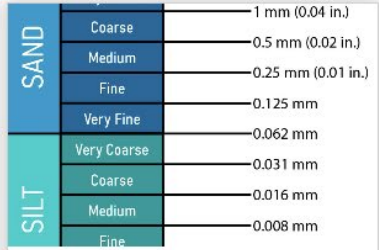
Your efforts will help researchers and resource managers make better decision and provide students with the opportunity to use authentic data in the classroom.

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.

Click here to find a recently submitted SandSnap

Live Demo of Update Web App

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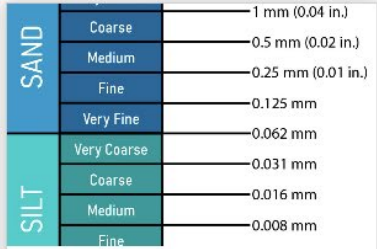

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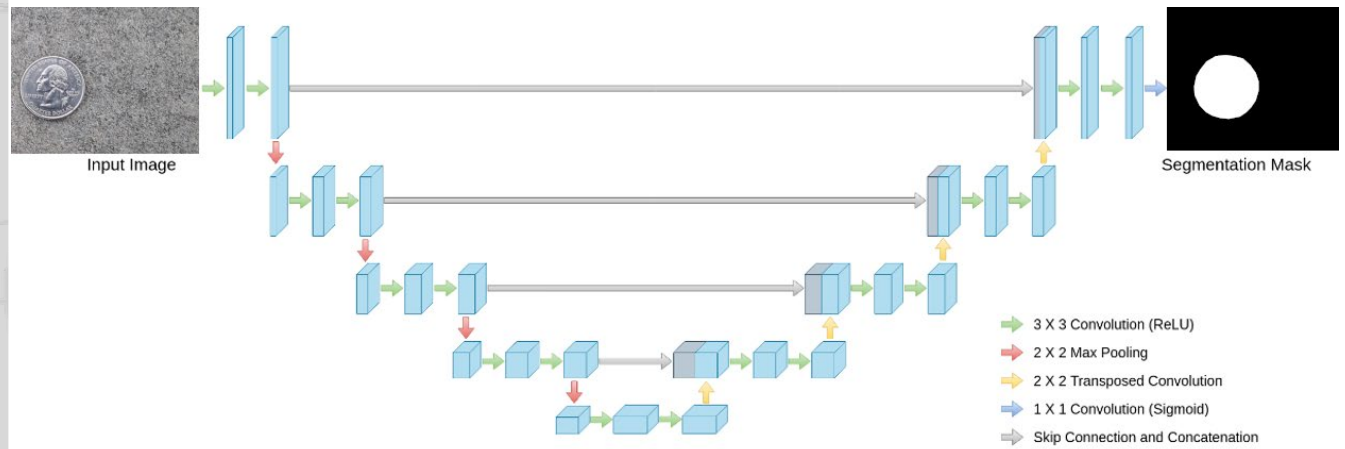
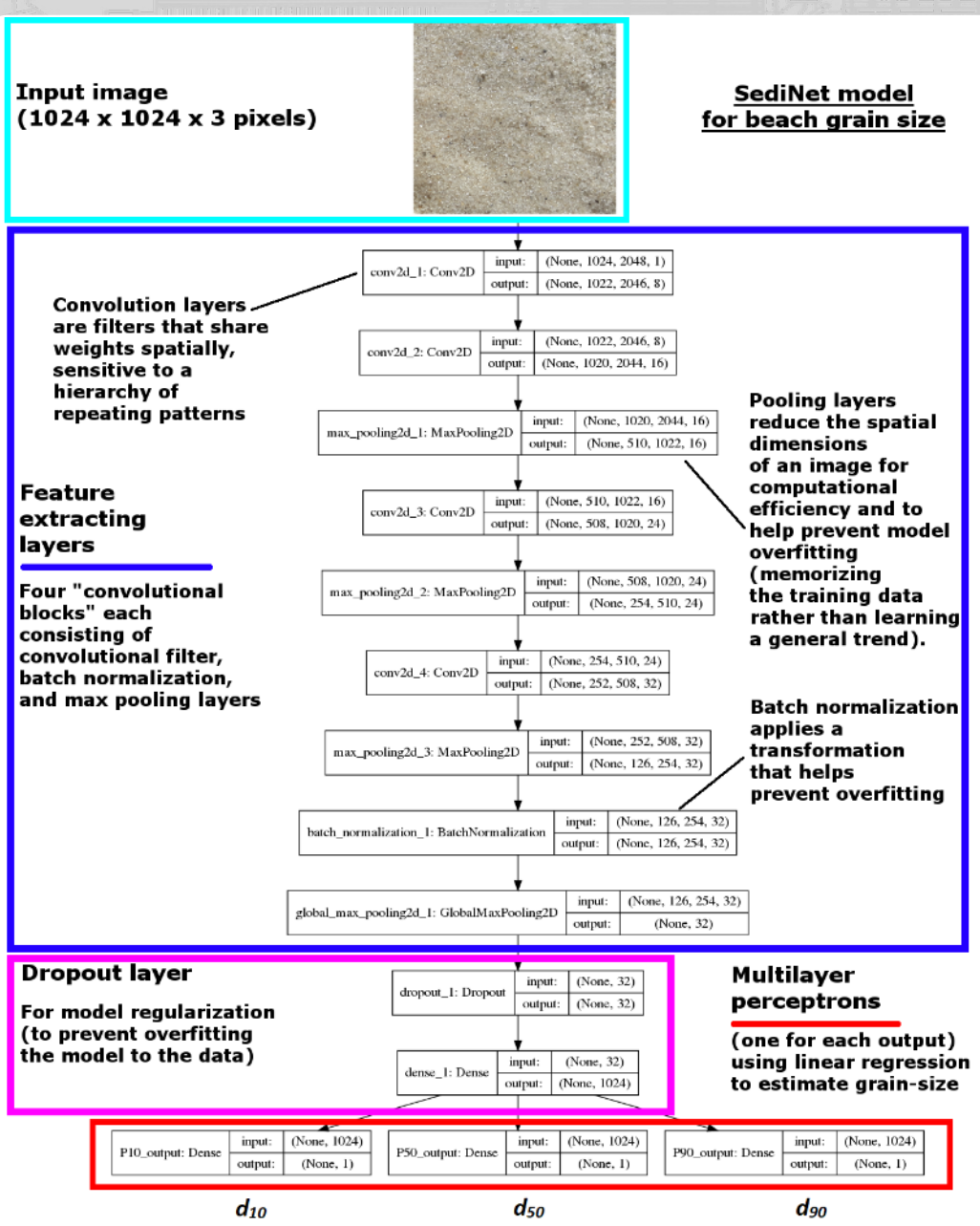
Machine Learning: Coin Detection

- Detect coin pixels versus sand pixels.
  - U-Net (Ronneberger et al. 2015).
  - Fully convolution neural network.
- ~~Individual models tended to underestimate portions of coins.~~
  - ~~Combination of results from 5 distinct models~~
- One coin model to rule them all.
  - Trained with many more nickels, pennies, dimes.



- RANSAC model on "coin pixels" to estimate diameter/centroid.
- Functions:
  - Where is the coin.
  - How large is it in pixels – for mm/px.
  - ~~Divide parent images up into 1024 x 1024 pixel coinless sub-images.~~
  - Searches for most "in-focus" 1024 x 1024 sub-image.
  - ~70% speed increase.

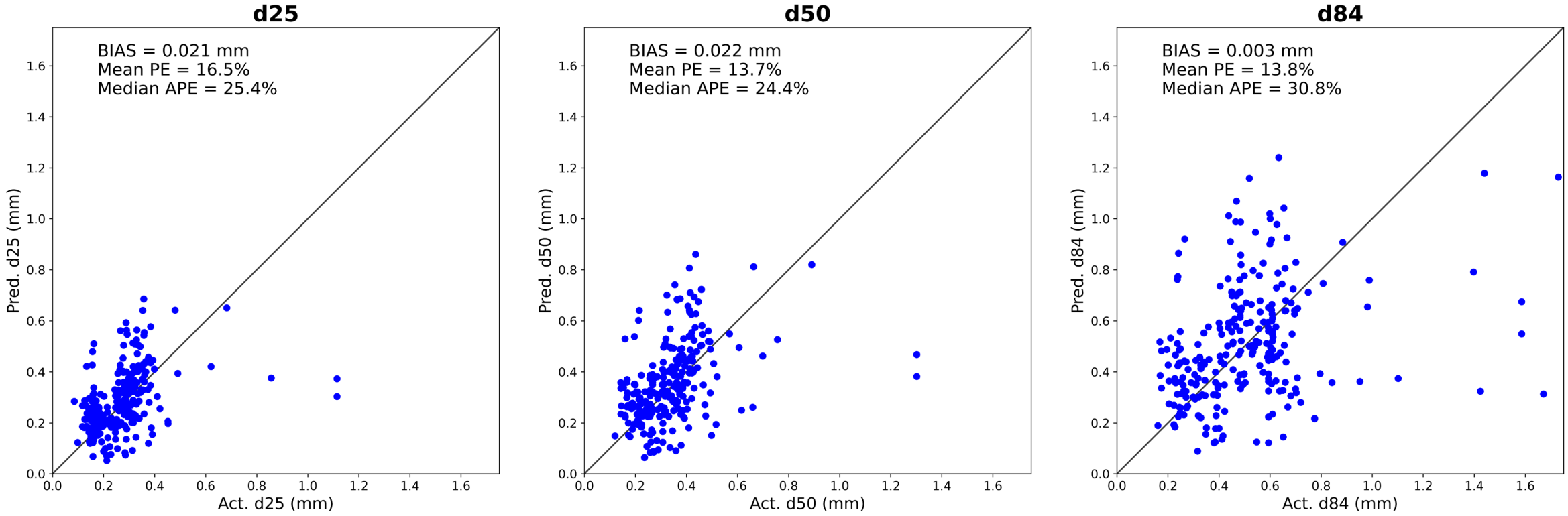
Machine Learning: SediNet



- **SediNet (Buscombe 2020):**
  - **Deep Learning Model**
  - **Convolutional Neural Network with multiple processing layers**
  - **Estimates grain size information from imagery**
  - **https://github.com/MARDAScience/SediNet**
  - **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% d_{50} error from *in situ* test images**~~
- **Up to 266 sets of sand samples + images used to train**

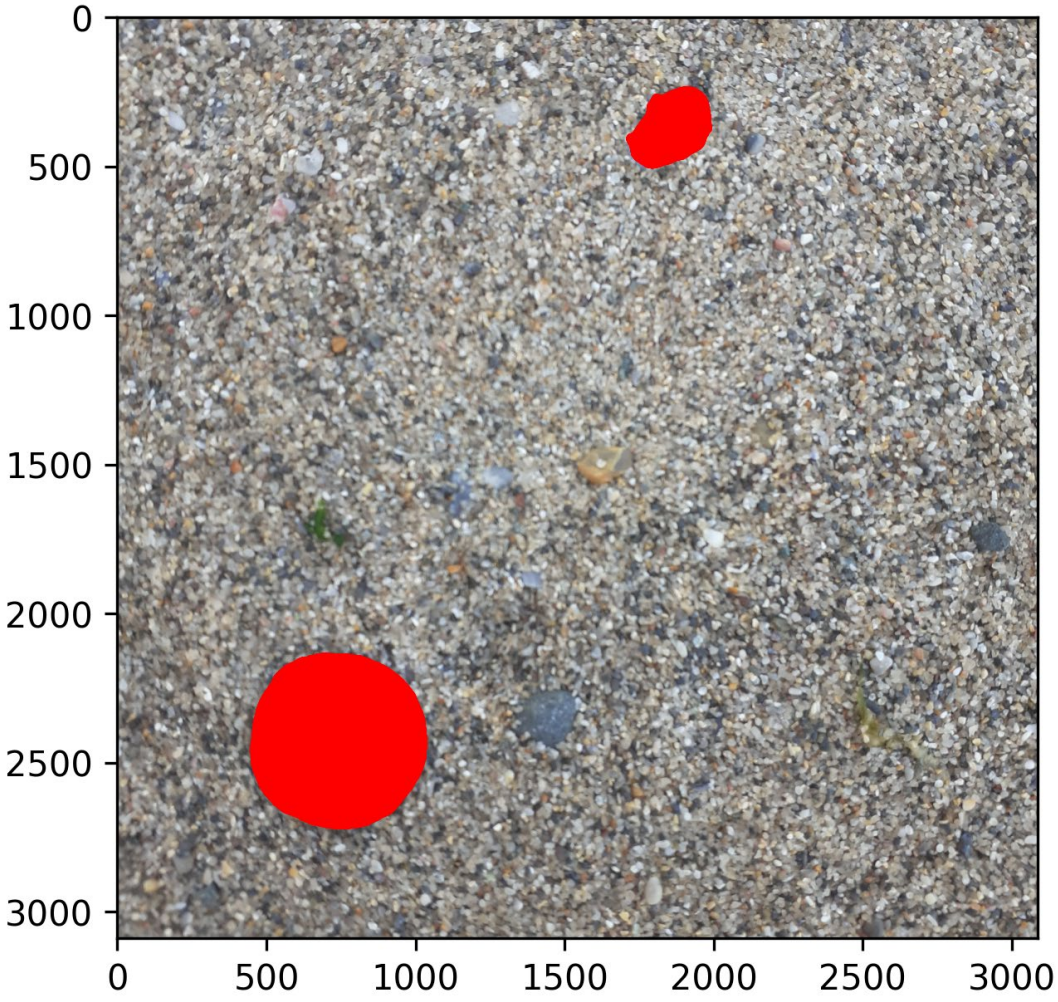
SandSnap V2.0 Error

- **Total accuracy**
- **266 images w/ physical samples:**



Improved Error Handling

- **V1.0 was not handling the errors we knew about correctly.**
- **Got smarter with interfacing with OP-J devs.**
- **Seen more possible errors.**
  - **Parent image too small.**
  - **Coin too close to center of frame.**
- **Passing through more info to admin console.**
  - **# coin pixels detected.**
  - **mm/px values.**
- ***Ongoing.***

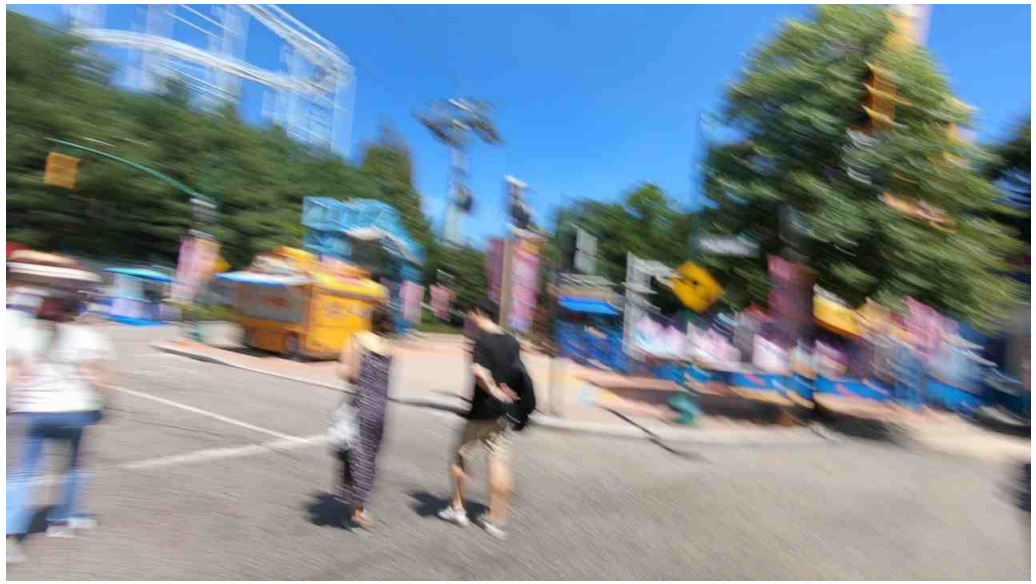


New Stuff for V2.1

- ORISE Student – Jacob Stasiewicz from UNC-Wilmington.
- Pick better filter values for errors we know about.
  - Collect *deliberately bad* SandSnaps.
- Filter/correct for shadows.
- Filter/correct for foreign objects.
- Deblur images (NAFNET).
- Test adding non-US coins.

Good vs. Bad SandSnaps

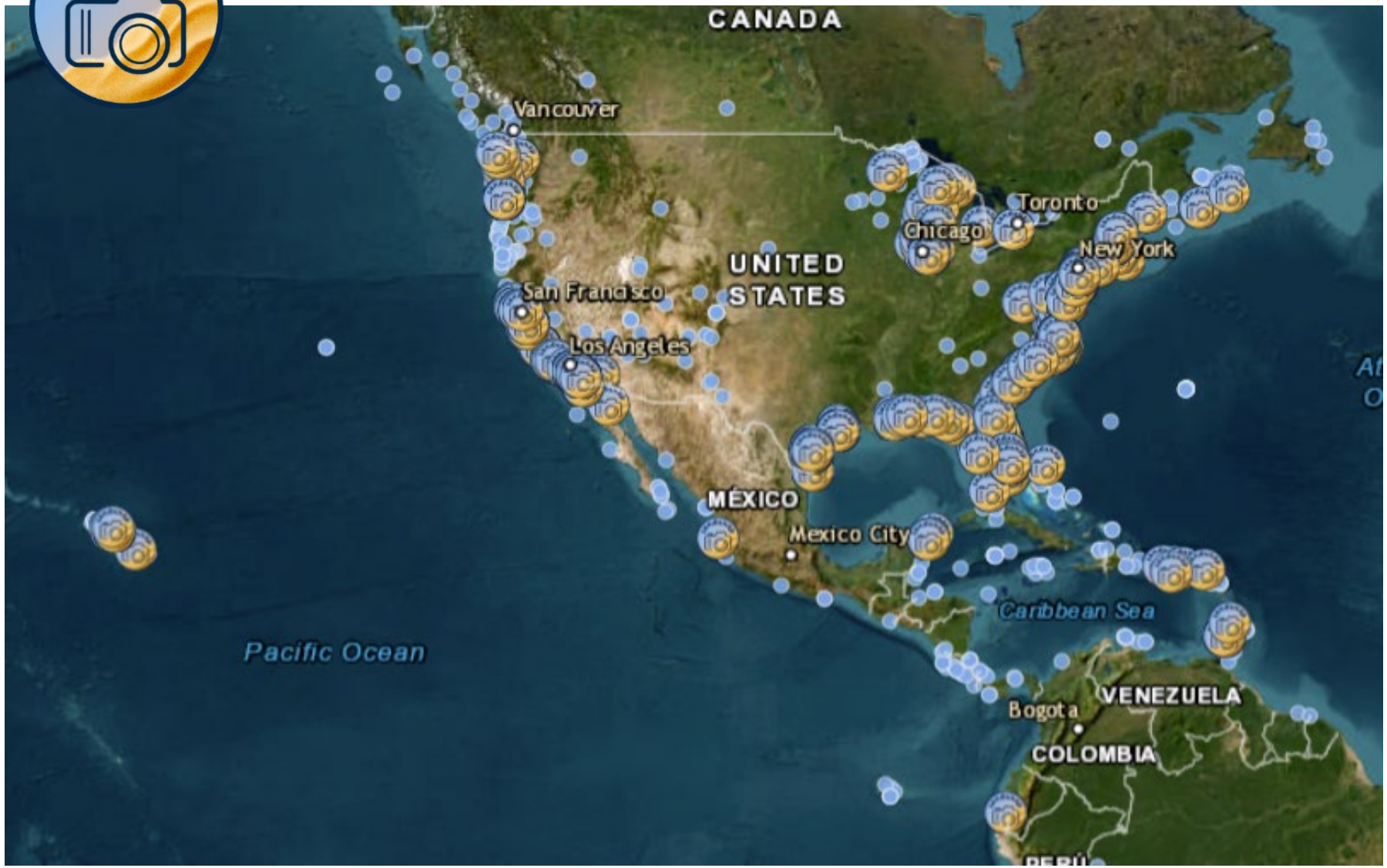
Deblur with NAFNET



- Works awesome on demo images.
- Demo images are 48 KB.
- Average SandSnap is > 4 MB.
- Crashed my Linux machine GPU immediately (24 GB of GPU RAM)

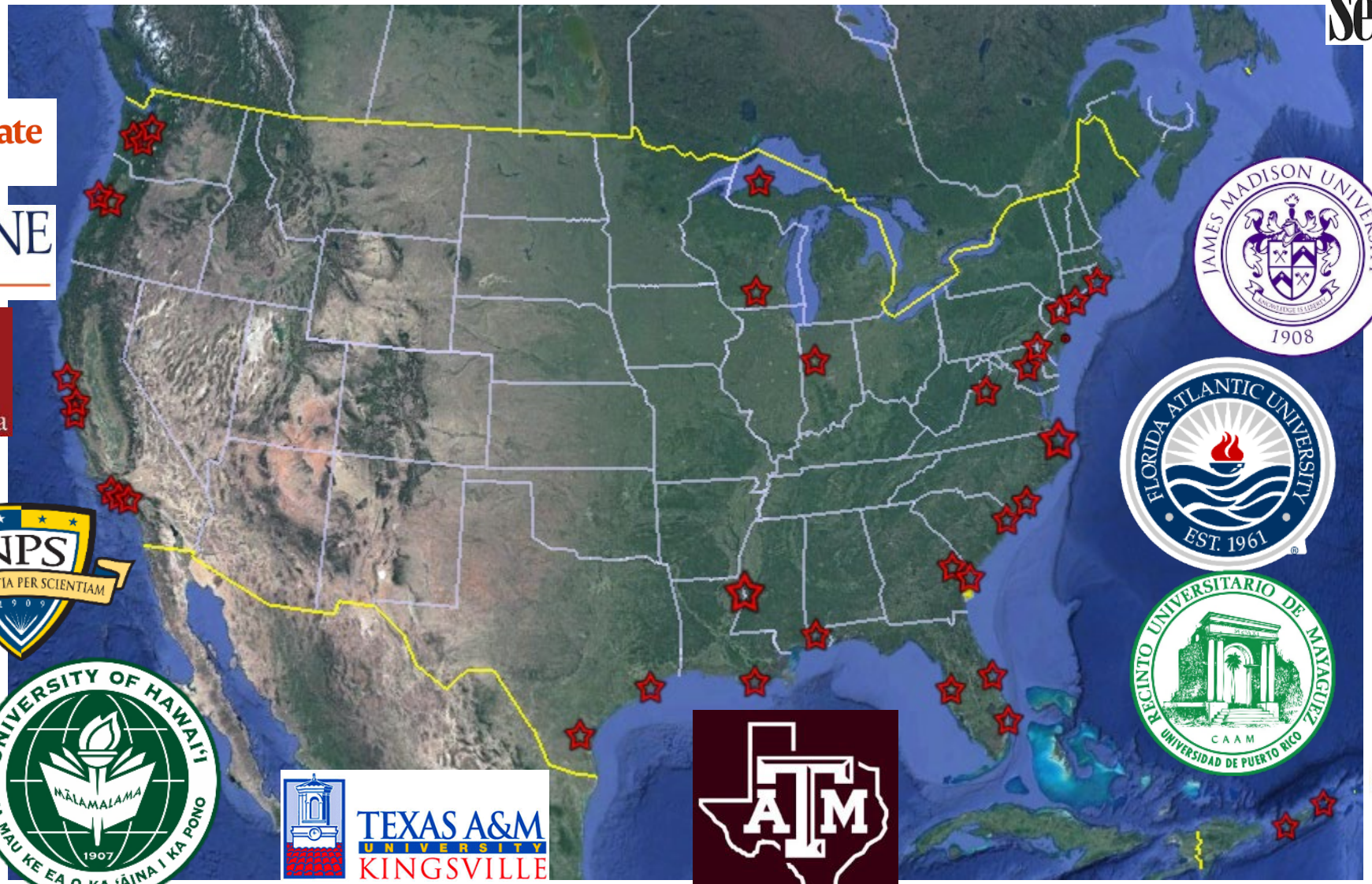
SandSnap Database

= Data point



- ~1300 images
- Bunch of international ones.
- Ecuador
- Australia
- Ghana
- Pakistan
- Denmark
- UK
- Italy

Collaborations



Summary

- **SandSnap V2.0 is online.**
- **Backprocessing complete.**
- **Ready to rock on JP (*finally*) in Collab w/ Nick Cohn and AEOLIS Team.**
- **Improved filtering coming in FY24 w/ V2.1.**

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