SANDSNAP - AMASSING A BEACH GRAIN SIZE DATABASE IN THE UNITED STATES

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INTRODUCTION
U.S. beaches are data rich environments with readily accessible topographic and hydrodynamic data, but a national database of beach grain size information does not exist. Unfortunately, grain size is often poorly parameterized, particularly for geographically large studies, because it is unfeasible to collect beach grain size information on a large, multi-state or national scale with traditional methods. As a result, sediment size often has the largest uncertainty of the input parameters for sediment transport modeling (Soulsby, 1997).

METHODOLGY
"SandSnap" is a research initiative to amass the first nationwide beach sand grain size database with the help of citizen scientists using their smart phones. Citizen scientist community members contribute to the database by taking a picture of sand at a beach with a U.S. coin in the frame for scaling, uploading the image and filling out the form on the SandSnap web application (www.sandsnap-erdcchl.hub.arcgis.com), and recording the sample location with the smart phone's built-in GPS. The images are analyzed with an open-source deep learning convolutional neural network trained to estimate beach grain size (SediNet – Buscombe 2020) running on cloud computing resources. The results are returned to the user within two minutes along with a fun fact about a famous beach with similar grain size to incentivize further participation. All image submissions and extracted grain size data are easily accessible and available for download on the SandSnap web application.

The model is retrained regularly using gradation measurements from physical samples collected concurrently with the phone images by nearly 30 universities and state agencies. The mean absolute error for the median grain size was less than 15% for the latest trained model. However individual images may contain more error depending on other aleatory factors (e.g., blurriness, obliqueness, shadows). The accuracy of the model results is expected to improve as the amount of training data increases.

DISCUSSION
The interactive web application was released in March 2022, and the usefulness of the database will grow with increased participation. This grain size database can be used to capture the critical spatial and temporal sediment gradation variation on beaches (McFall et al., 2020). This information will ultimately lead to improved beach life cycle and uncertainty analysis, an increased sediment gradation range for beach compatibility to increase the beneficial use of dredged sediment, and substantial improvements in coastal numerical modeling capability.

A demonstration of the SandSnap web application and highlighted outreach activities will be presented. One outreach activity is the "SandSnap Discovery Bags" that are being piloted at two sites in New York. These bags can be checked out at libraries in coastal communities and are filled with equipment to do four exciting scientific beach activities for children, including SandSnap. This furthers SandSnap's goals of educating the public about coastal sciences, inspiring the next generation of coastal scientists and engineers, and amassing a spatially and temporally robust sand beach grain size database.

REFERENCES
Buscombe (2020): SediNet: A configurable deep learning model for mixed qualitative and quantitative optical granulometry. Earth Surf. Proc. & Land., 45(3):638-651.
McFall et al. (2020): Technical Feasibility of creating a beach grain size database with citizen scientists. EDRD/CHL CHETN-IV-125.
Soulsby (1997): Dynamics of Marine Sands, Thomas Telford Publications.

Figure 1 - Map of existing SandSnap locations noted with large round logos in the continental United States.