PREDICTING INDIVIDUAL CORAL COLONY GROWTH RECRUITMENT & MORTALITY USING NASA NEMO-NET

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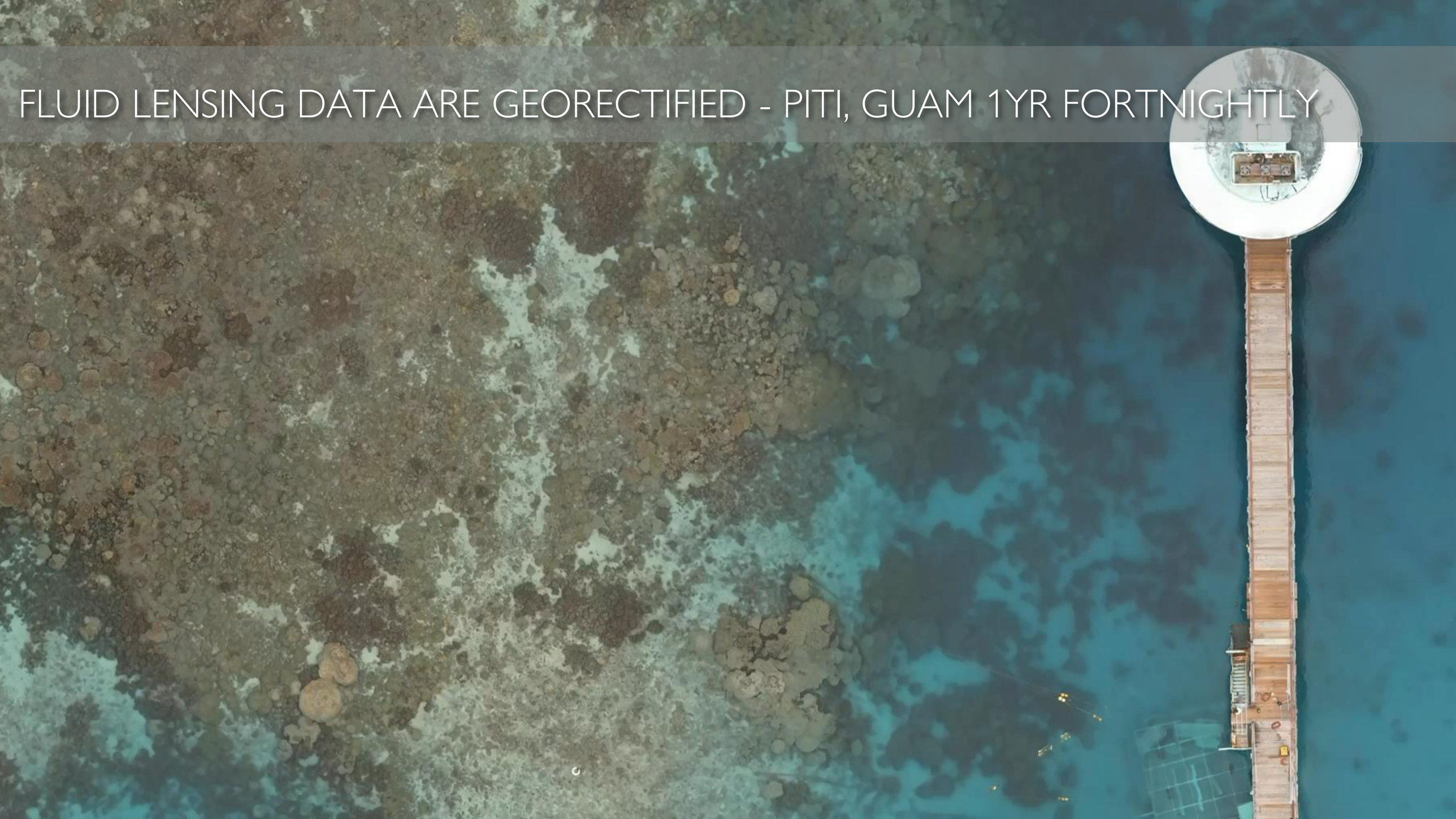
NOAH PIKIELNY, ISAIAH WANG, JAKOB BROWN, NAYONIKA CHOUDHURY
SAM PURKIS (PI) , UNIVERSITY OF MIAMI
NOAA - TOM OLIVER (CO-PI), COURTNEY COUCH (CO-PI)

FLUID LENSING - TUMON BAY, GUAM

Guam Fluid Lensing Campaign

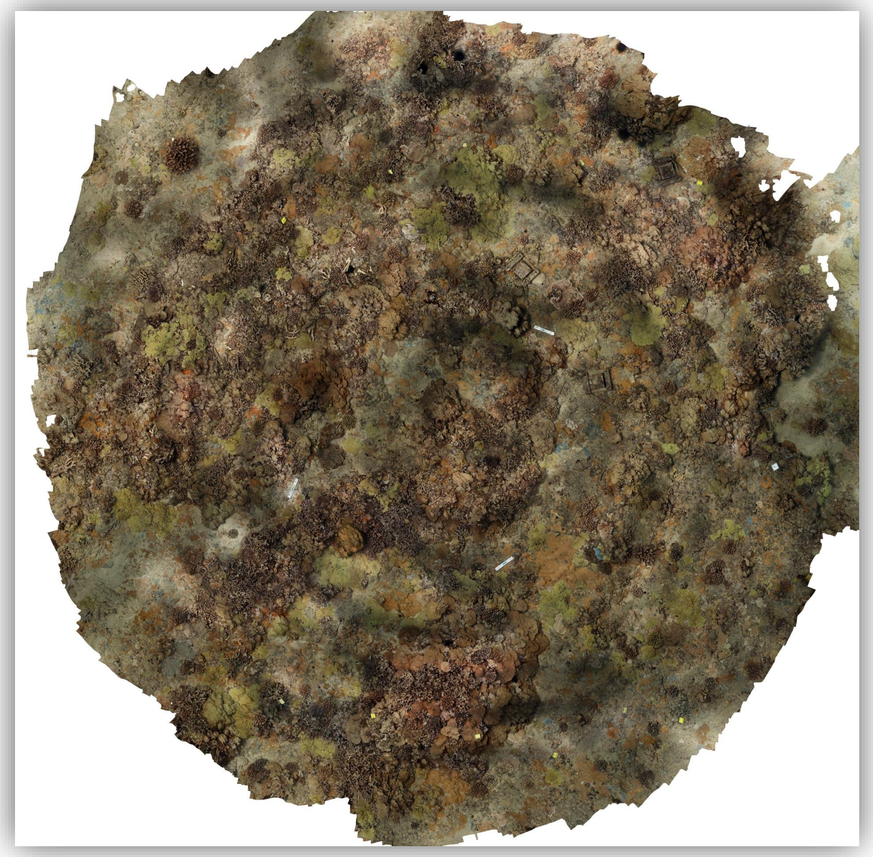
NASA
NEMO
NET
HTTP://NEMONET.INFO

FLUID LENSING DATA ARE GEORECTIFIED - PITI, GUAM 1YR FORTNIGHTLY

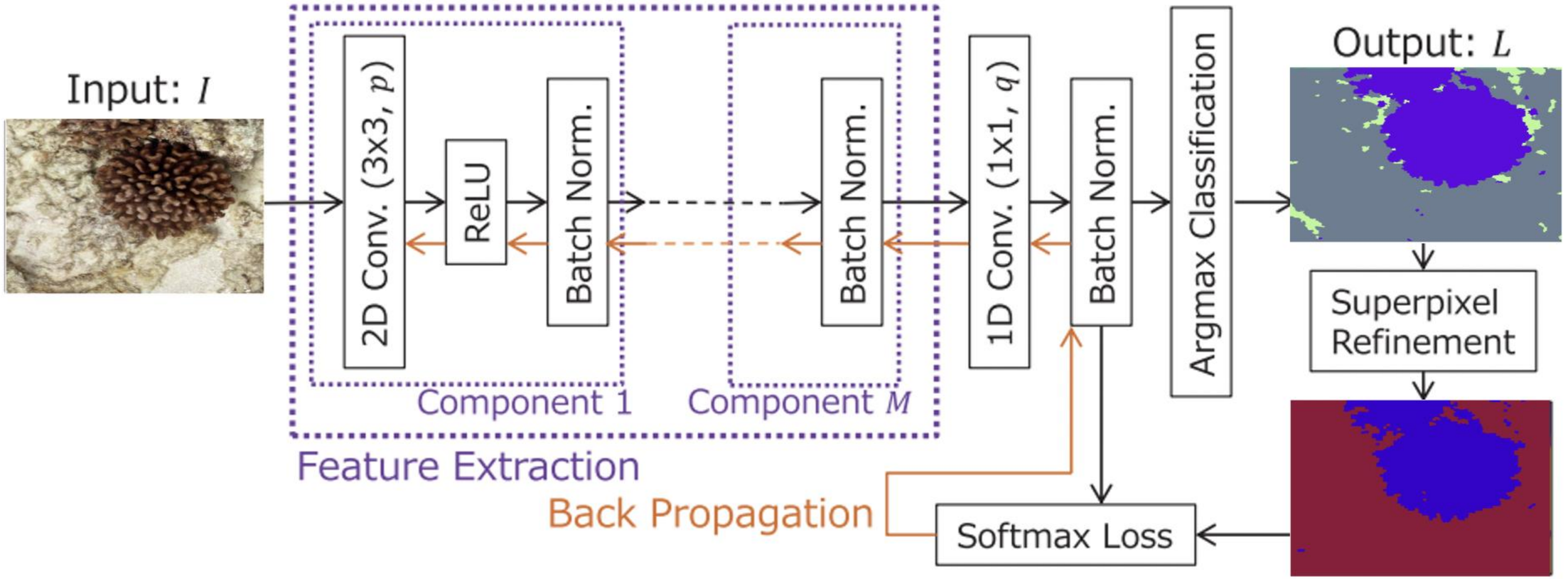


SAMPLE TIME SERIES PROVIDED BY NOAA - MISALIGNED AND HETEROGENEOUS

2018



2021

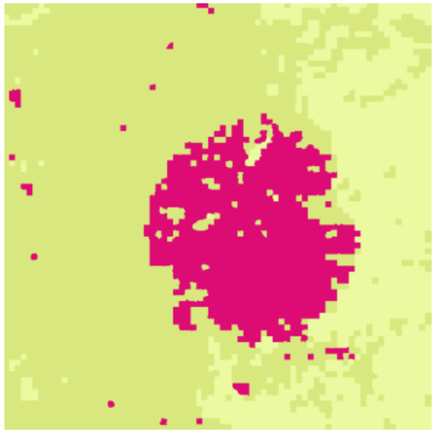
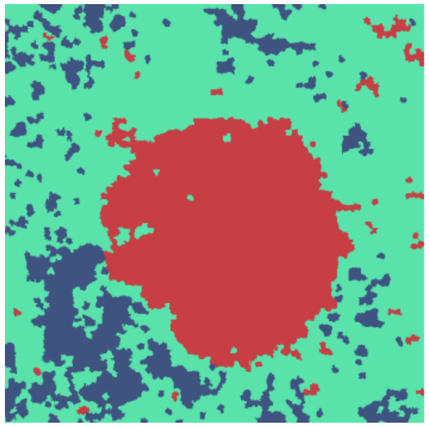
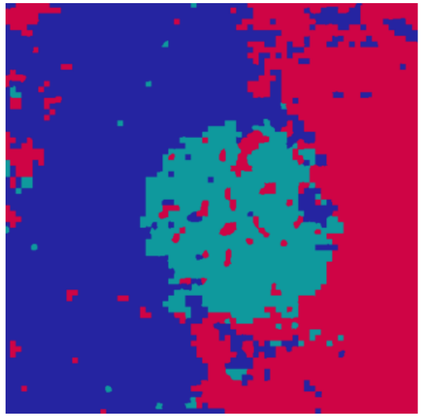
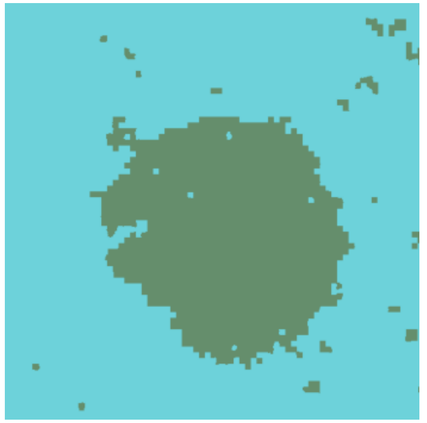


New NeMO-Net Model developed for PICOGRAM

HYPERPARAMETER TUNING ON NOAA EXAMPLE

Original Patches

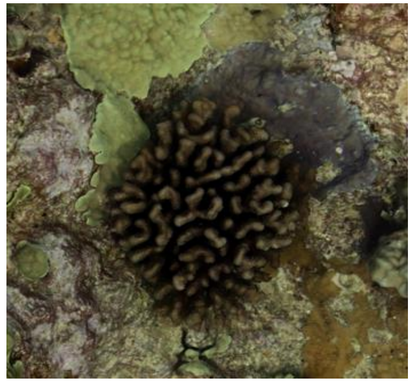
Segmentation Results

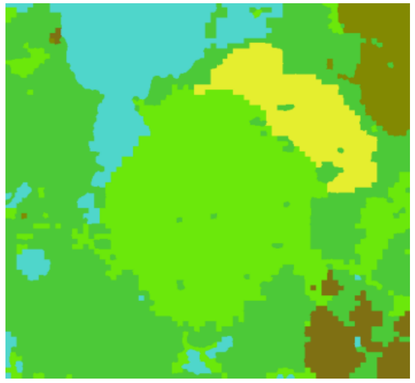





Mask

Smoothing

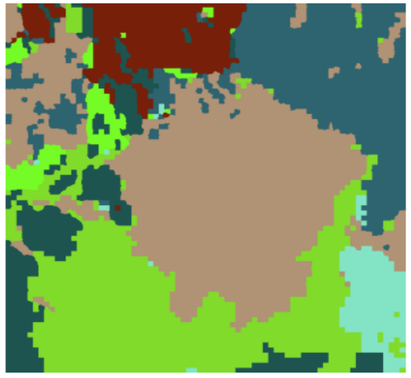
2018



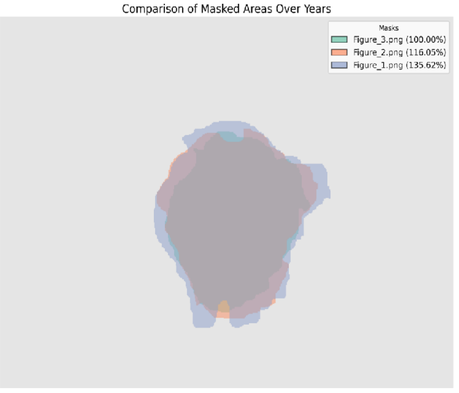


2020

2021



‘GRAM’ Measurement

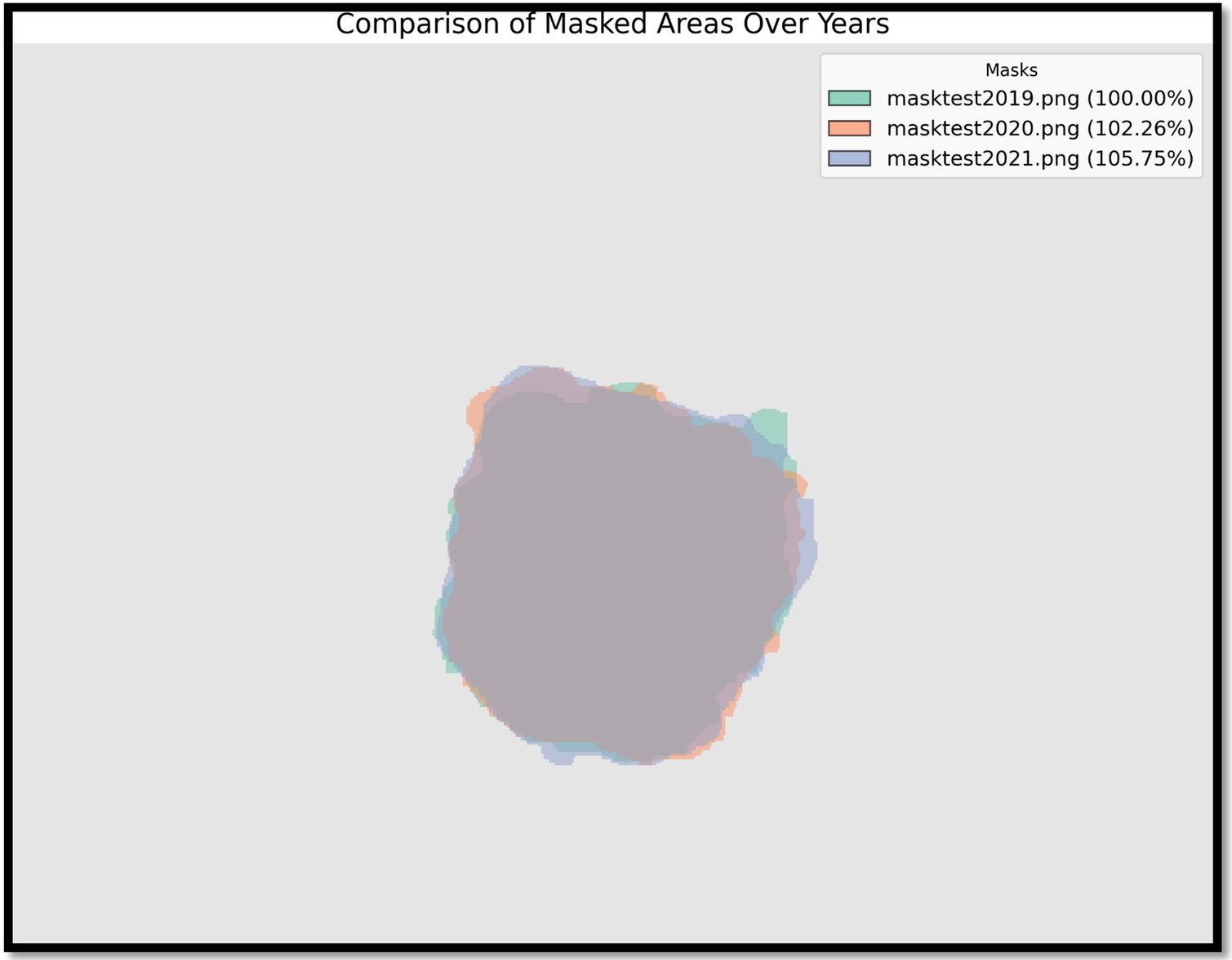


INDIVIDUAL CORAL COLONY CHANGE DETECTION

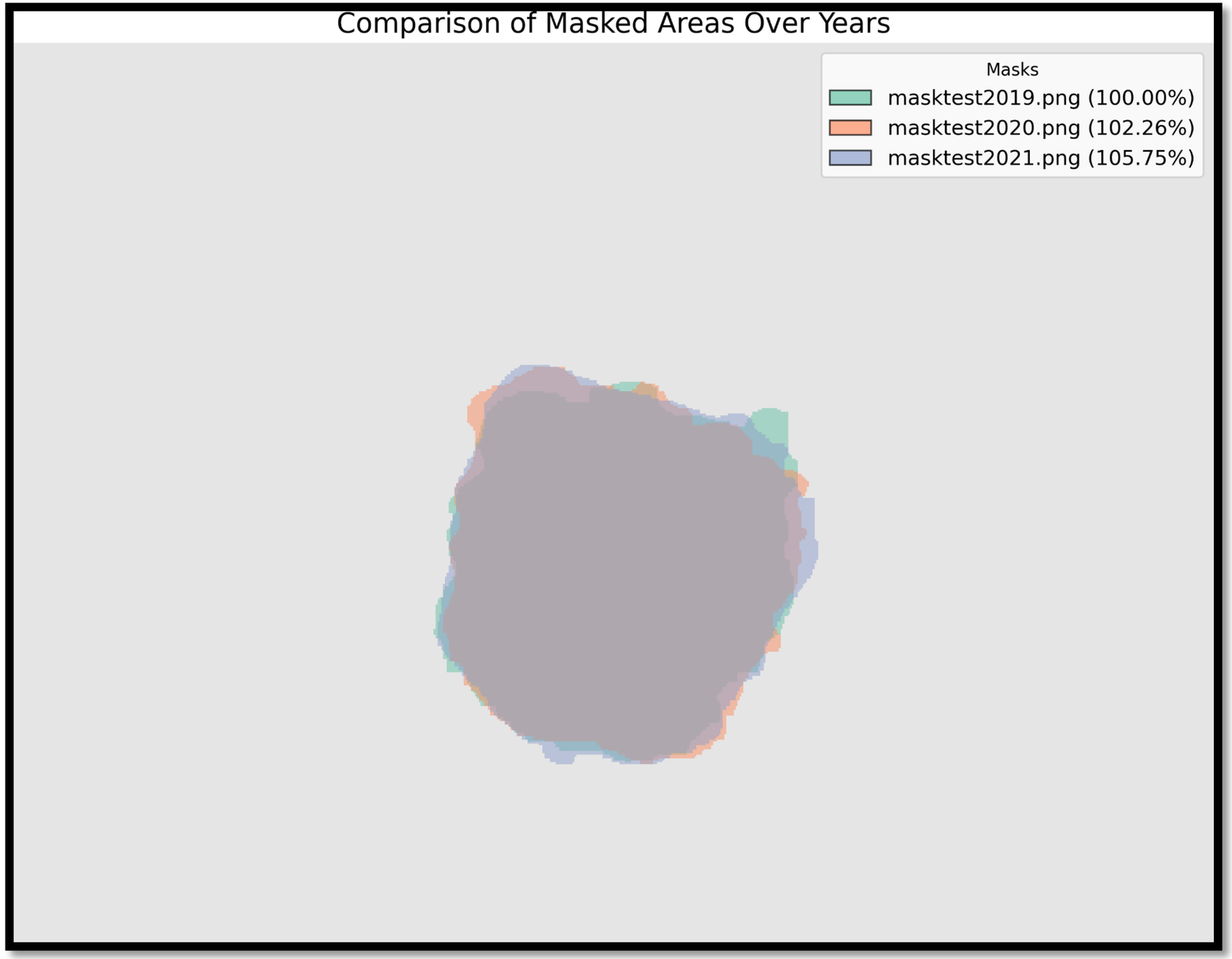
2019

2020

2021



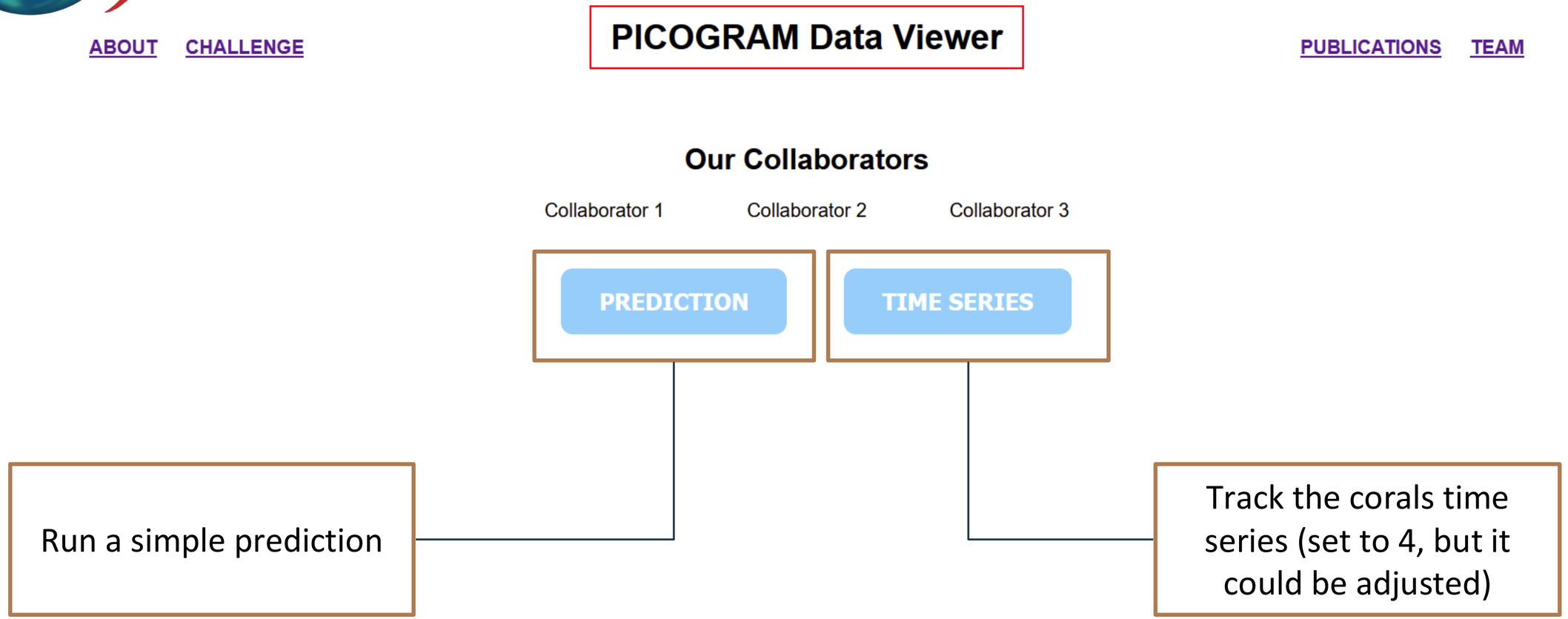
INDIVIDUAL CORAL COLONY CHANGE DETECTION



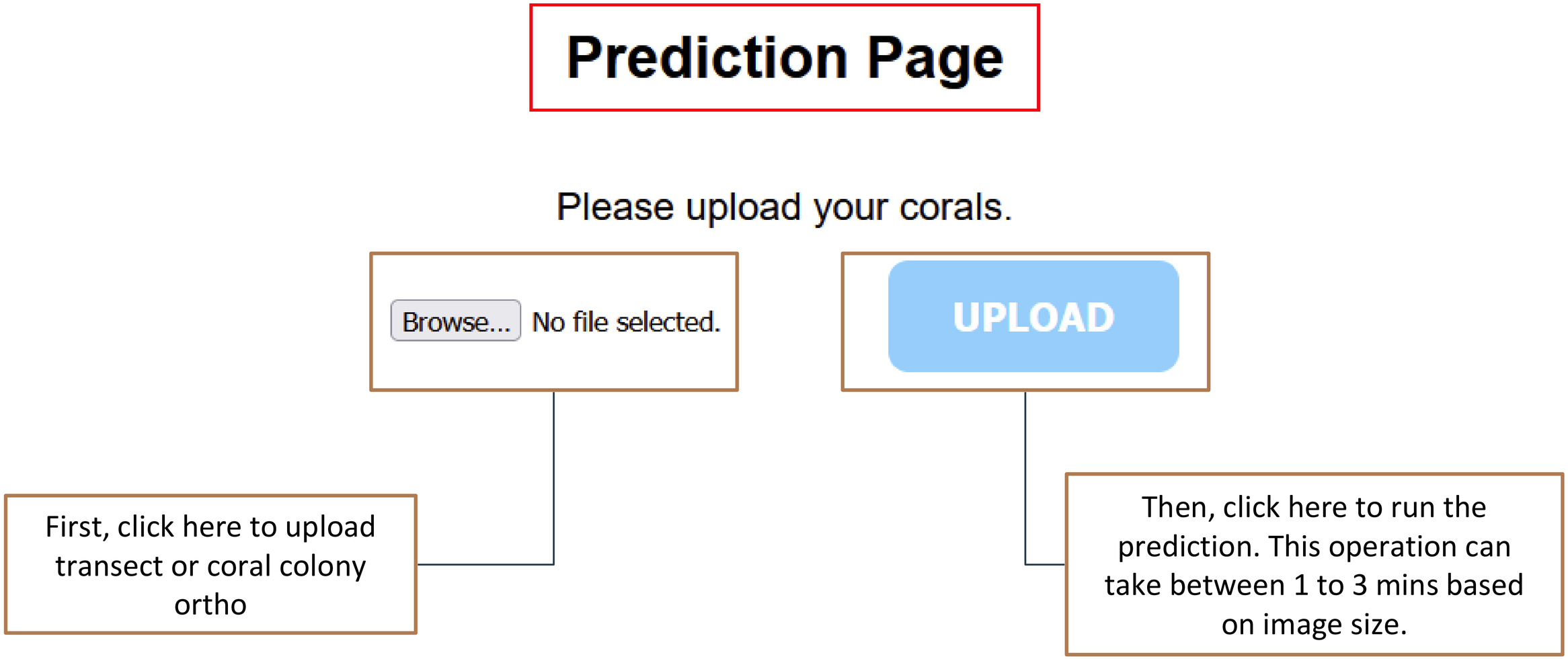
~2.5% increase in planform area per year from 2019 to 2021

Homepage

HTTP://NEMONET.INFO/PICOGRAM

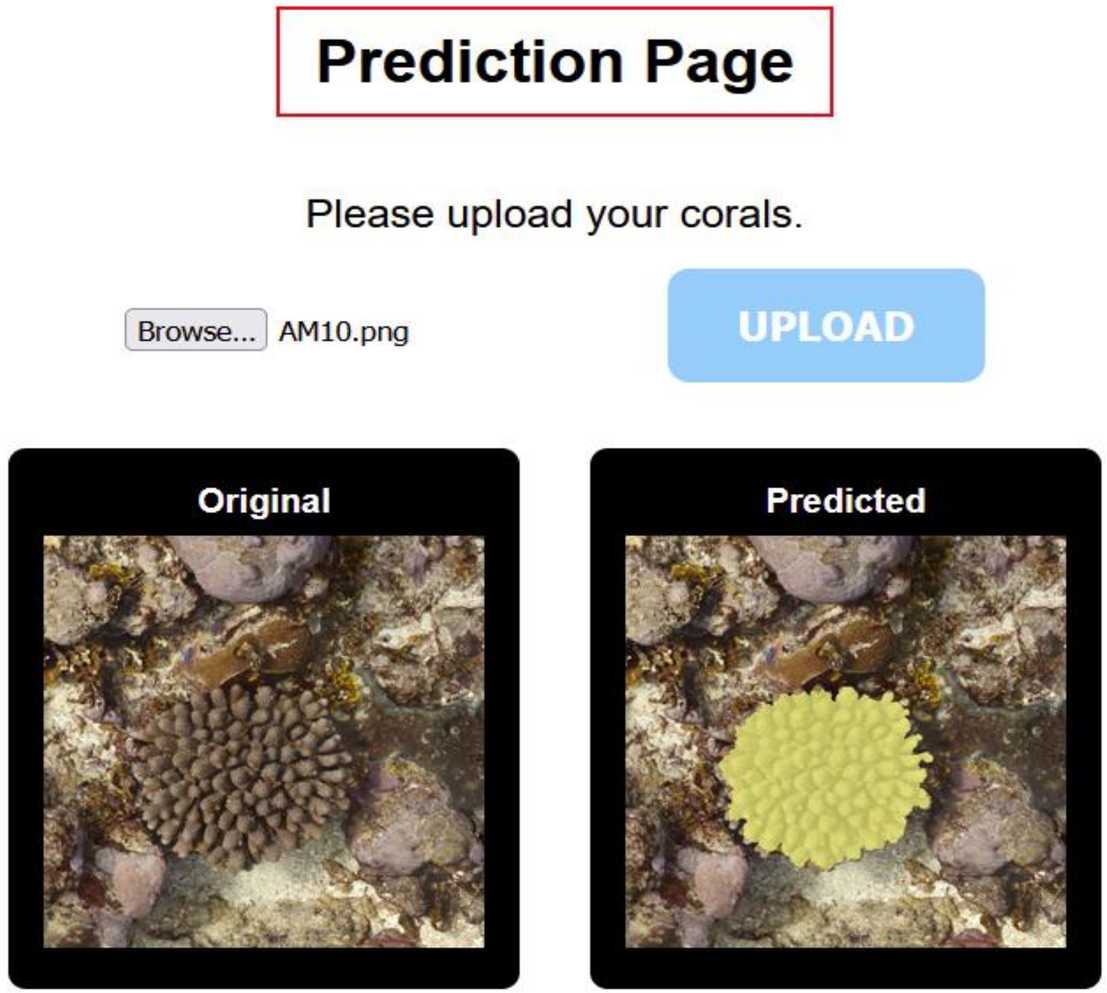


Prediction Page



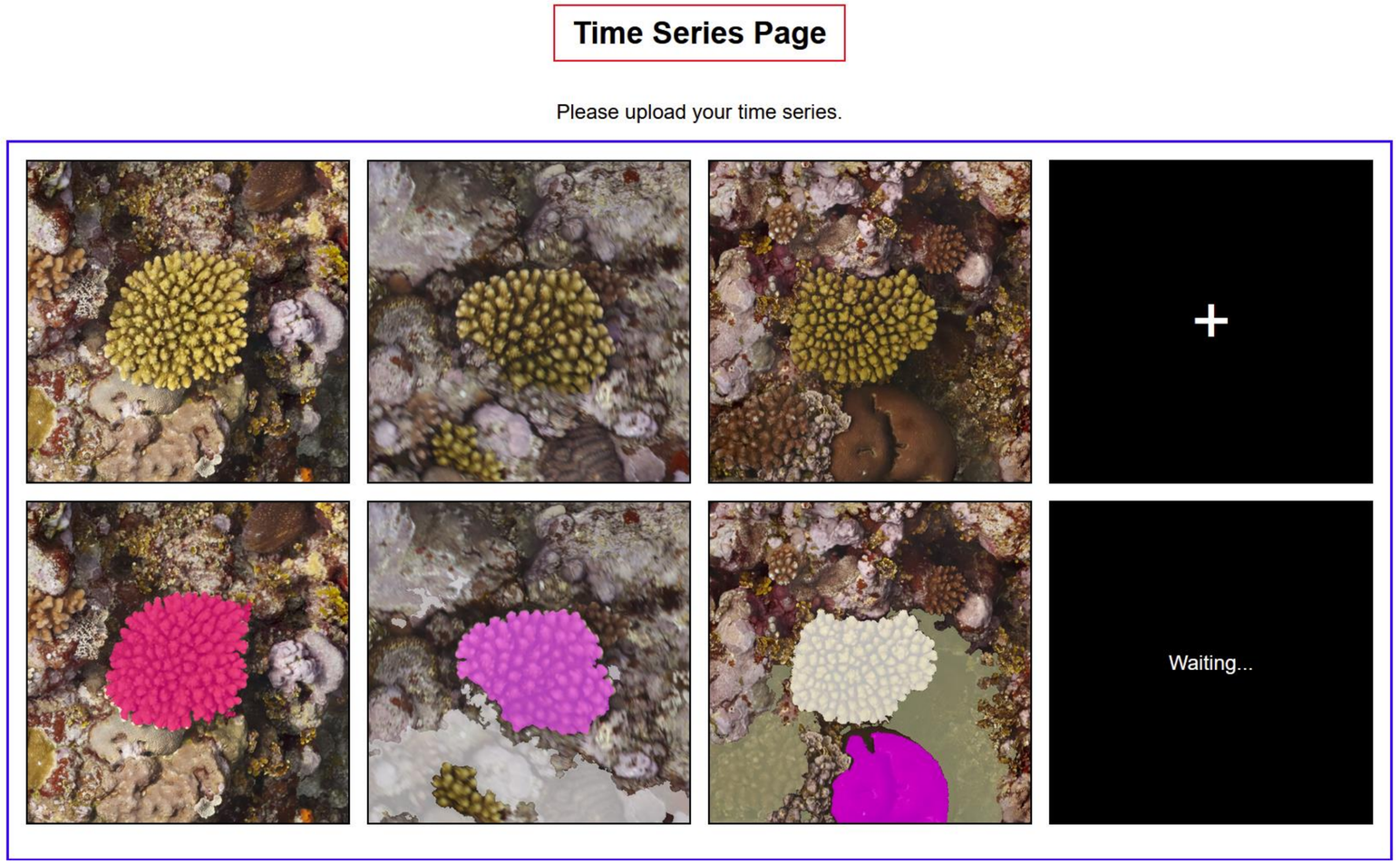
Prediction Page output

After the model finishes the segmentation, the results will be displayed automatically.

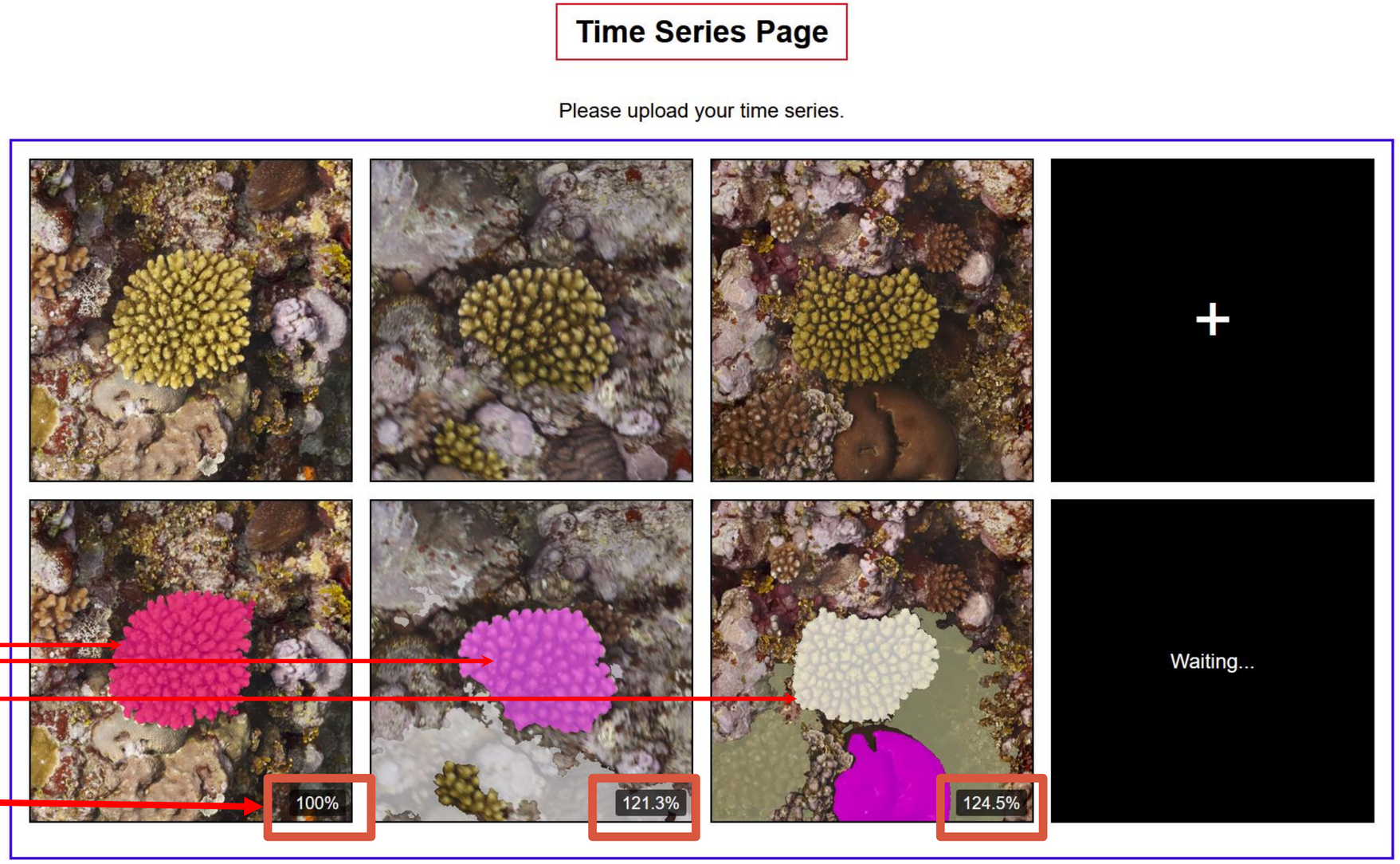


Time Series Page Output

After the model finishes the segmentation, the results will be displayed automatically.



Time Series Page Output



Afterward, the results are displayed by our model. The next step is to select the coral we want to track over time by clicking on it.

In real time, size is calculated and displayed according to reference.

NOAA FISHERIES

PIFSC/ESD/ARP

PICOGRAM Tests & Model Comparisons

20250228

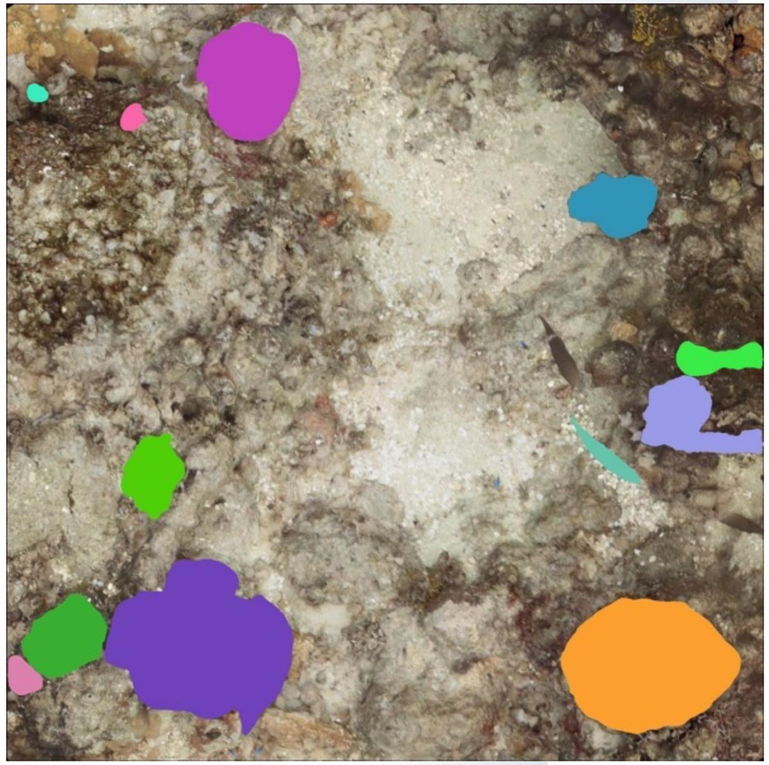
Thomas Oliver - NOAA Federal
<Thomas.Oliver@noaa.gov>

Michael Akridge - NOAA Affiliate
<michael.akridge@noaa.gov>

Ground Truth

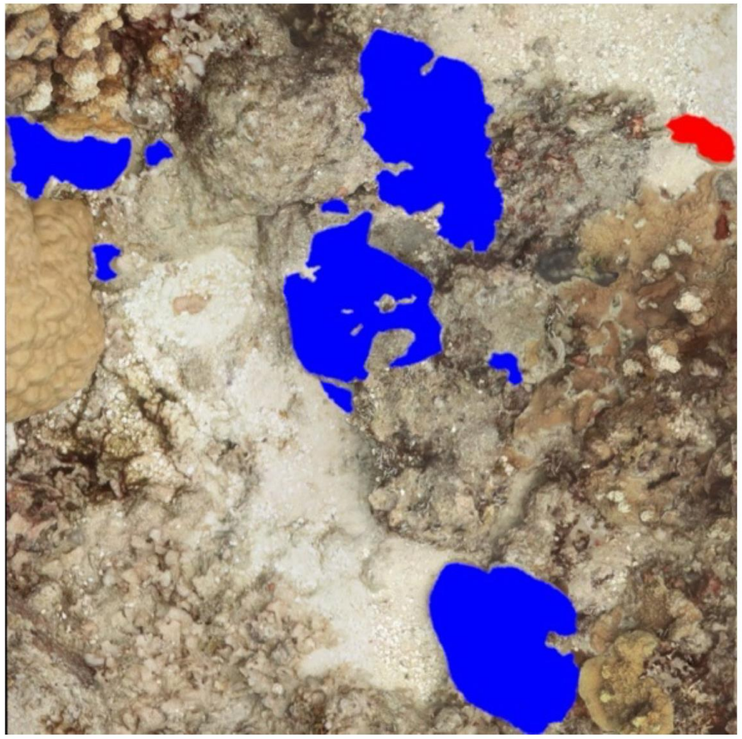
PICOGRAM 1.0

PICOGRAM 2.0

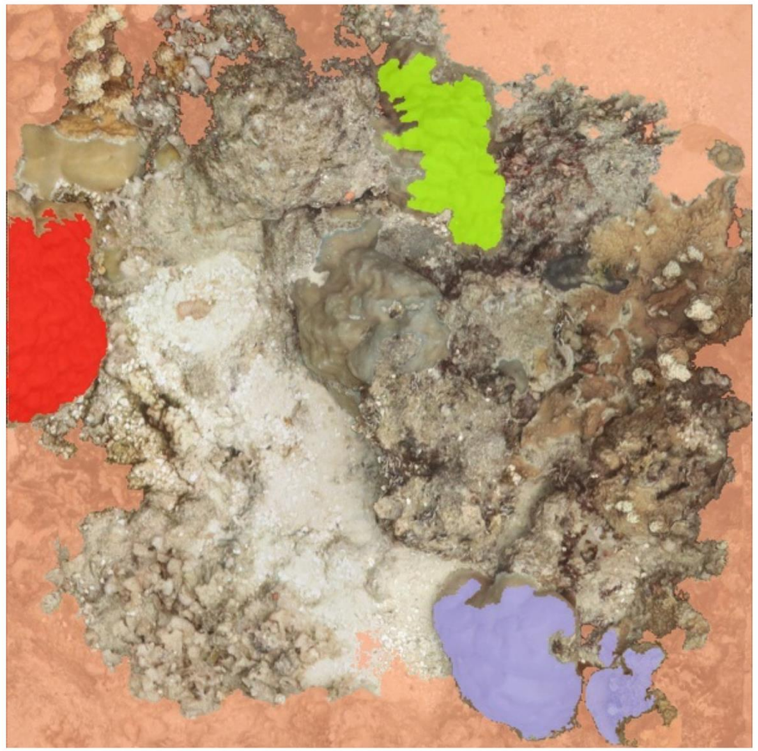


NOAA FISHERIES

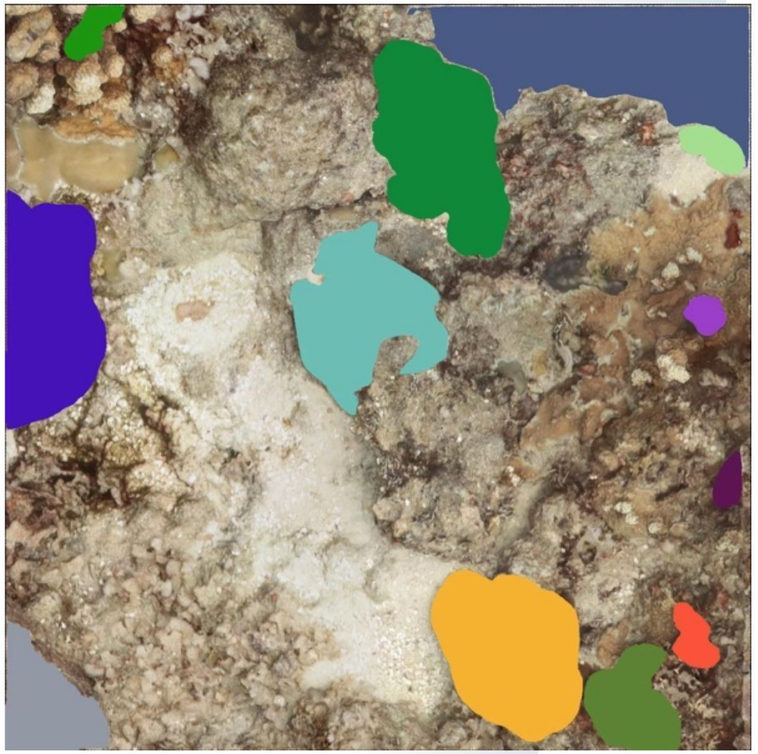
Ground Truth



PICOGRAM 1.0

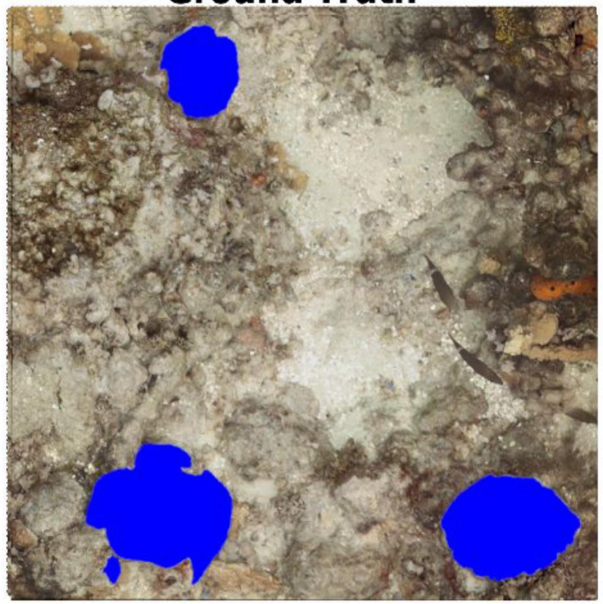


PICOGRAM 2.0



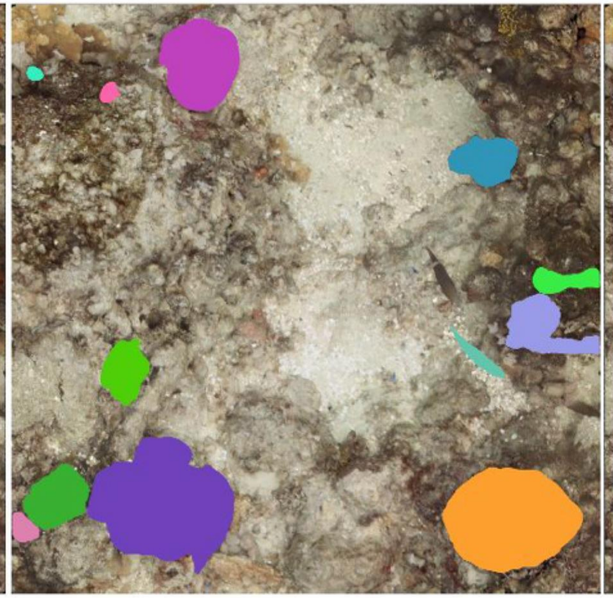
NOAA FISHERIES

GUA_015_2022_Q1_ortho
Ground Truth

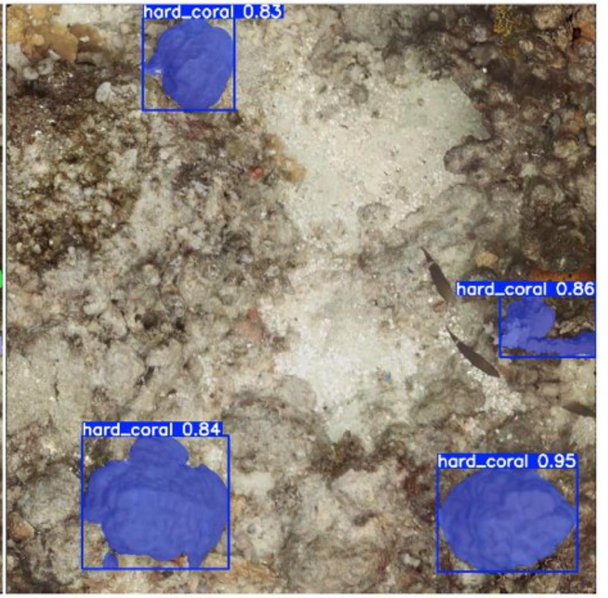


PICOGRAM 1.0

PICOGRAM 2.0



Custom YOLO11 Model



CoralSCOP Model

Segment Anything Model (SAM) 1

SAM 2 -TEST 1

SAM 2 - TEST 2

PRESS RELEASE

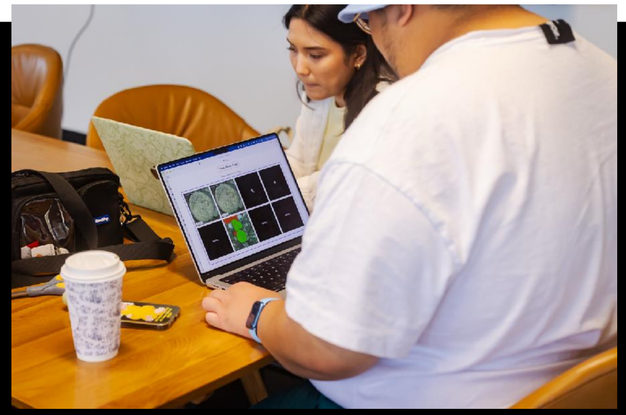
FOR IMMEDIATE RELEASE

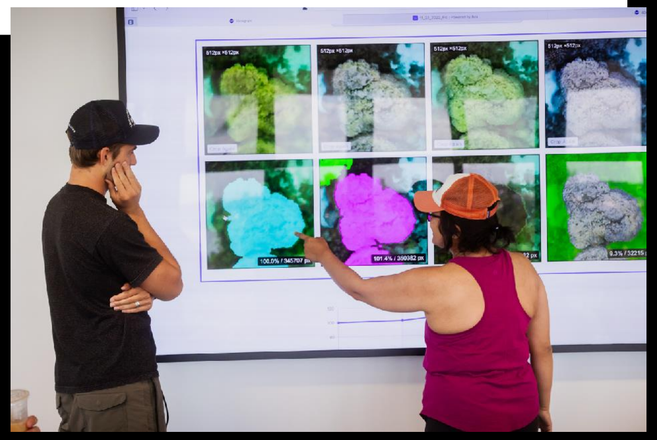
UNIVERSITY OF GUAM
UNIBETSEDÅT GUÅHAN

University of Guam and University of Miami Partnership Use Guam Datasets to Monitor Coral Reef Changes using new NeMO-Net & PICOGRAM Tools

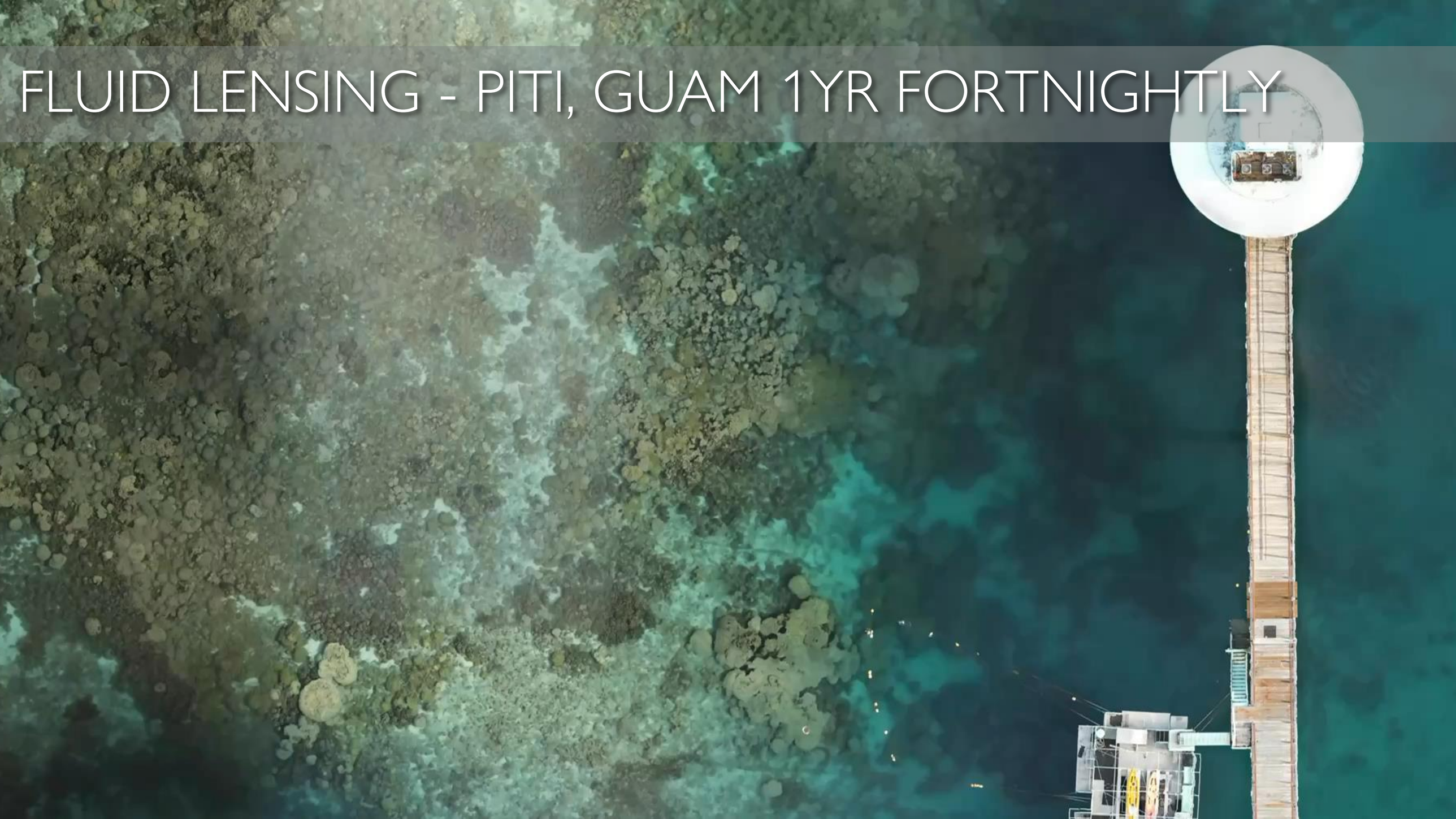
Beneath the surface of the Earth's oceans, coral reefs are undergoing significant changes. Transformations like coral bleaching are visible to the naked eye, while others like coral growth and mortality occur at the centimeter scale and would be much more difficult to measure over time. As these biodiverse and economically vital marine ecosystems face ongoing threats such as rising sea temperatures and human interference, researchers from the University of Guam (UOG) and the University of Miami's Rosenstiel School are working together to explore various solutions that could advance coral reef monitoring and mapping through machine learning tools.

One collaboration is the *Prediction of Individual Coral Growth, Recruitment, and Mortality* (PICOGRAM) program, a computer-based tool in development by NASA & NOAA that uses machine learning to track coral colony size over extended time periods, supported by NASA's Ecological Forecasting Program and led by PI Prof. Sam Purkis at the University of Miami in partnership with NOAA.

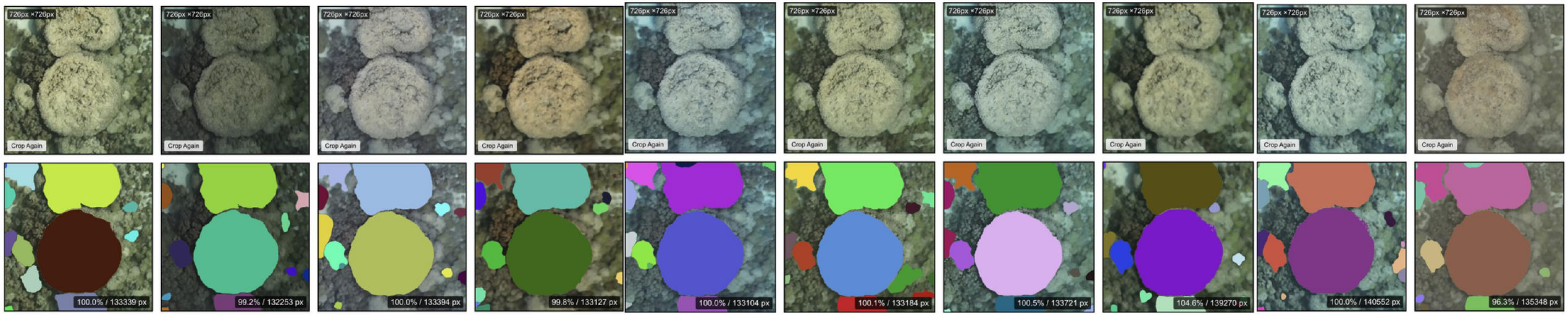


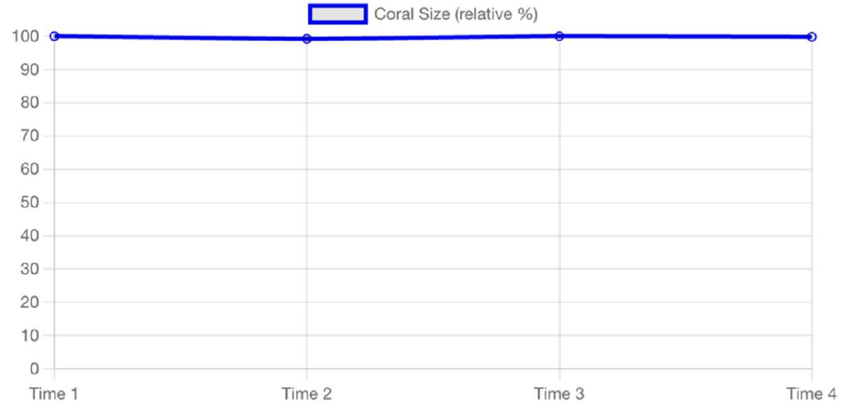


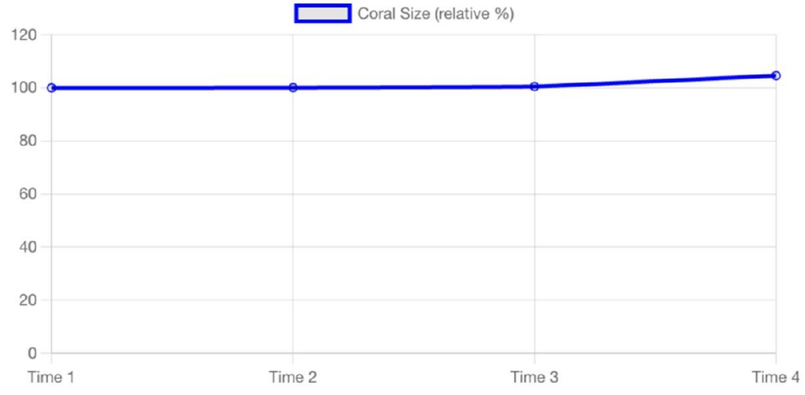
FLUID LENSING - PITI, GUAM 1YR FORTNIGHTLY



PICOGRAM COLONY CHANGES OVER 1 YR - AUTOMATICALLY DETECTED AND MEASURED







Dates: 7/19/22, 8/30/22, 11/22/22, 12/20/22, 1/17/23, 2/28/23, 3/13/23, 4/26/23, 5/21/23, 6/5/23

UNIVERSITY OF MIAMI
ROSENSTIEL SCHOOL OF MARINE, ATMOSPHERIC, AND EARTH SCIENCE
AIRCRAFT CENTER for EARTH STUDIES

End-User Survey: NASA NeMO-Net, Fluid Lensing, NeMO-Net Data Viewer, & PICOGRAM

As part of our NASA-funded projects, we are collecting feedback from end users to better understand how project tools and data products are utilized in practice. Your insights will assist us in evaluating impact, enhancing future iterations, and ensuring long-term sustainability of these projects.

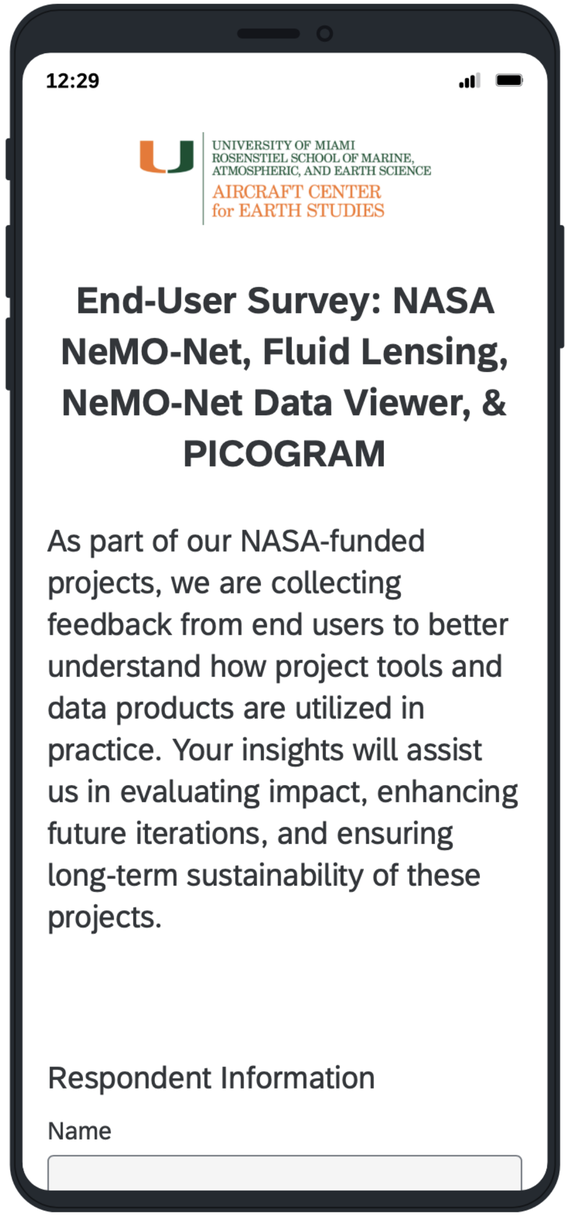
Respondent Information

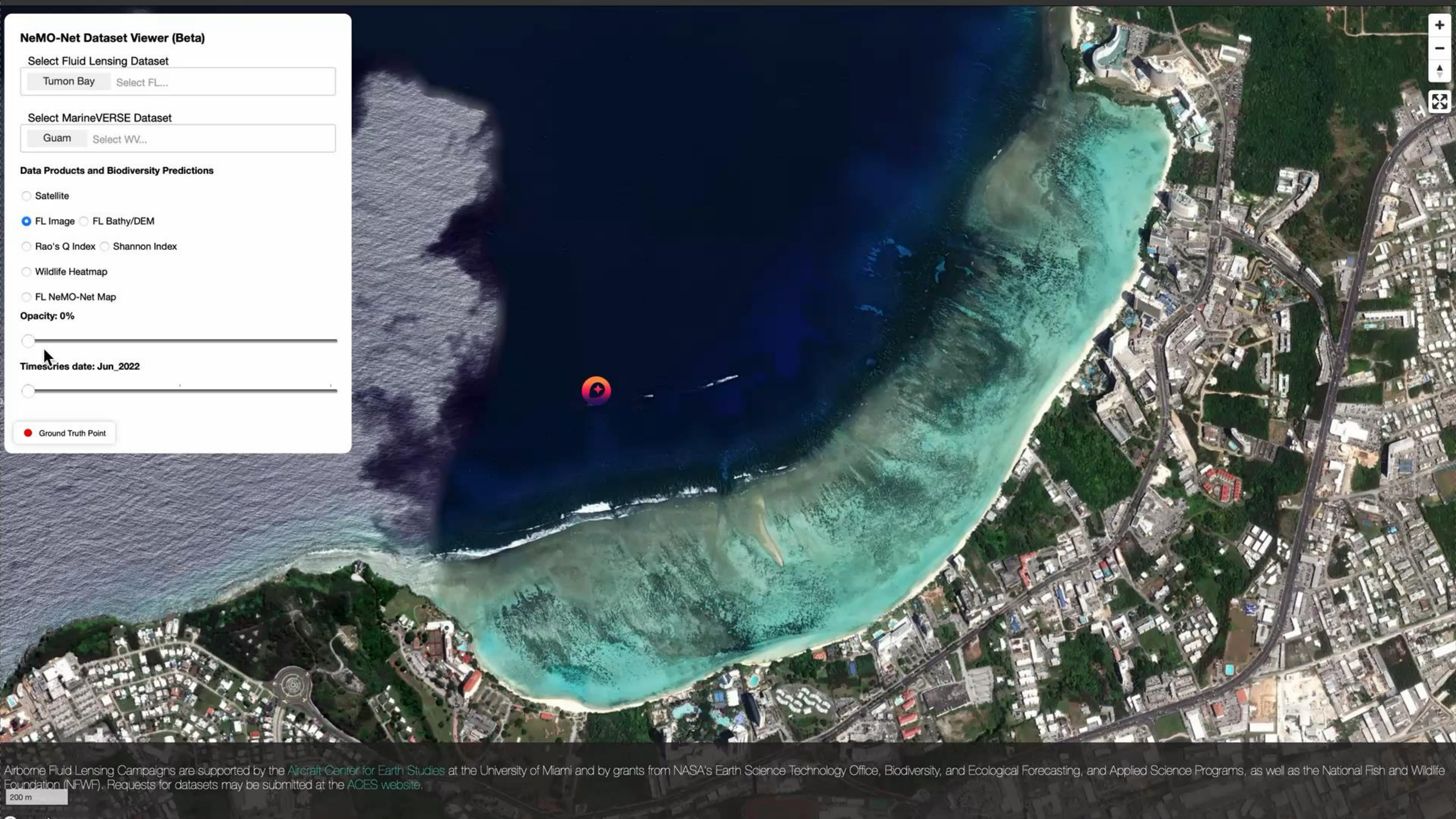
Name

Title

Email

Organization




NeMO-Net Dataset Viewer (Beta)
Select Fluid Lensing Dataset
Tumon Bay
Select FL...
Select MarineVERSE Dataset
Guam
Select WV...
Data Products and Biodiversity Predictions
Satellite
FL Image
FL Bathy/DEM
Rao's Q Index
Shannon Index
Wildlife Heatmap
FL NeMO-Net Map
Opacity: 0%
Timeseries date: Jun_2022
Ground Truth Point
Airborne Fluid Lensing Campaigns are supported by the Aircraft Center for Earth Studies at the University of Miami and by grants from NASA's Earth Science Technology Office, Biodiversity, and Ecological Forecasting, and Applied Science Programs, as well as the National Fish and Wildlife Foundation (NFWF). Requests for datasets may be submitted at the ACES website.
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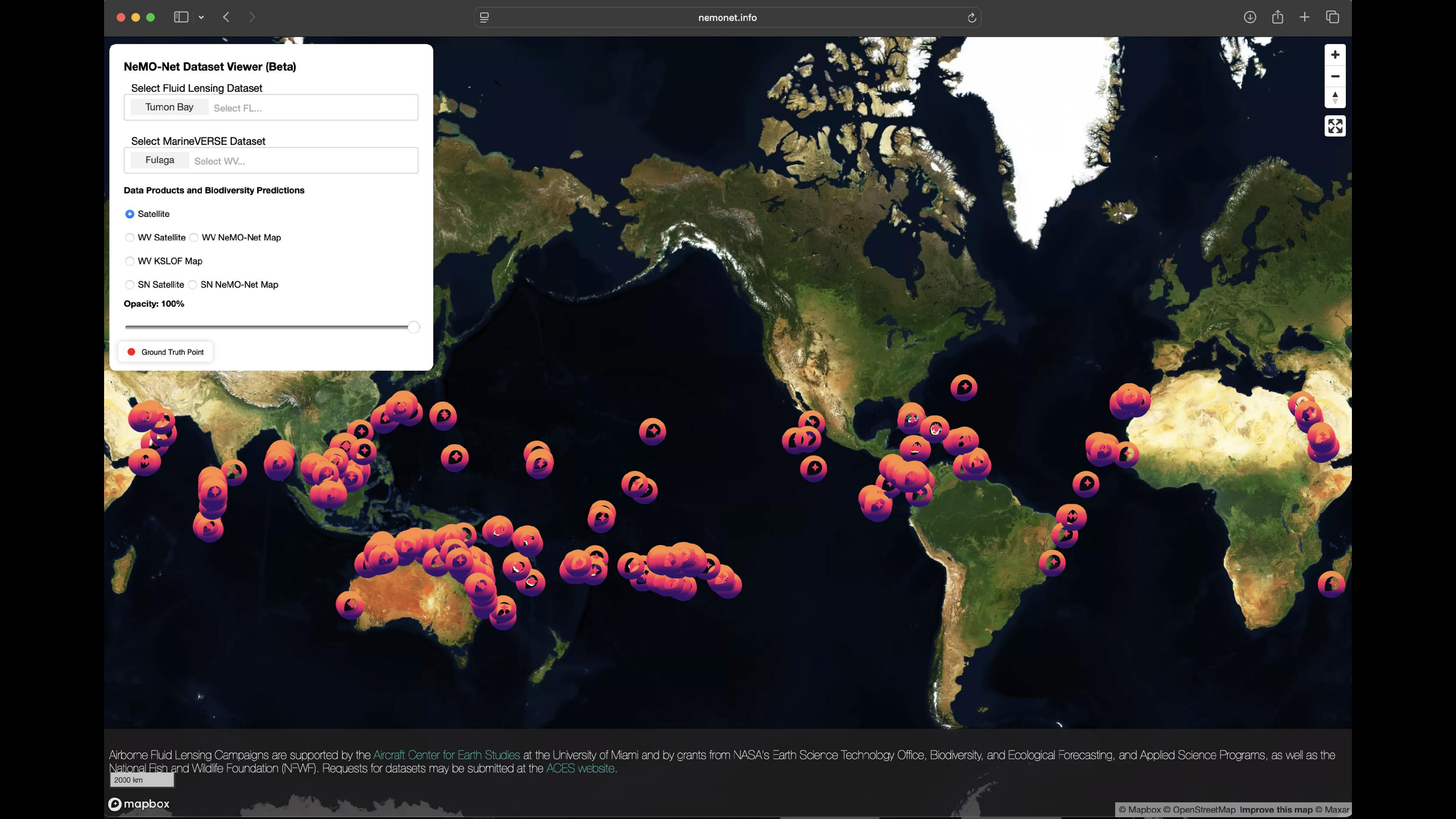
nemonet.info
NeMO-Net Dataset Viewer (Beta)
Select Fluid Lensing Dataset
Tumon Bay
Select FL...
Select MarineVERSE Dataset
Fulaga
Select WV...
Data Products and Biodiversity Predictions
Satellite
WV Satellite
WV NeMO-Net Map
WV KSLOF Map
SN Satellite
SN NeMO-Net Map
Opacity: 100%
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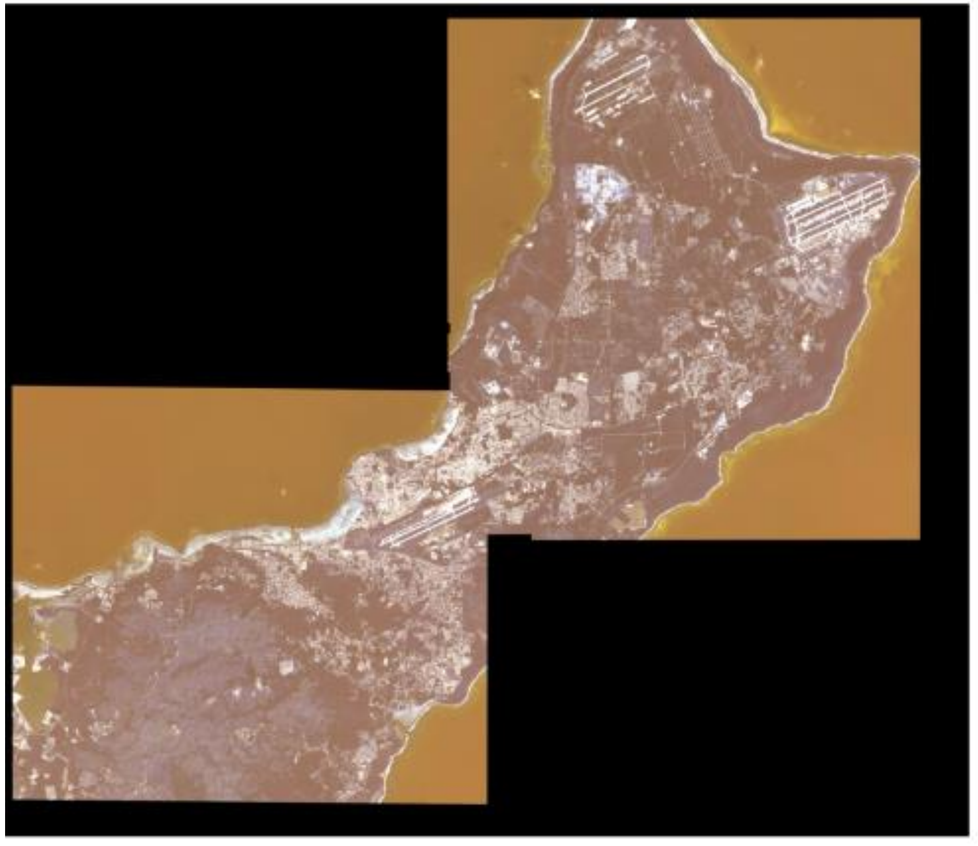
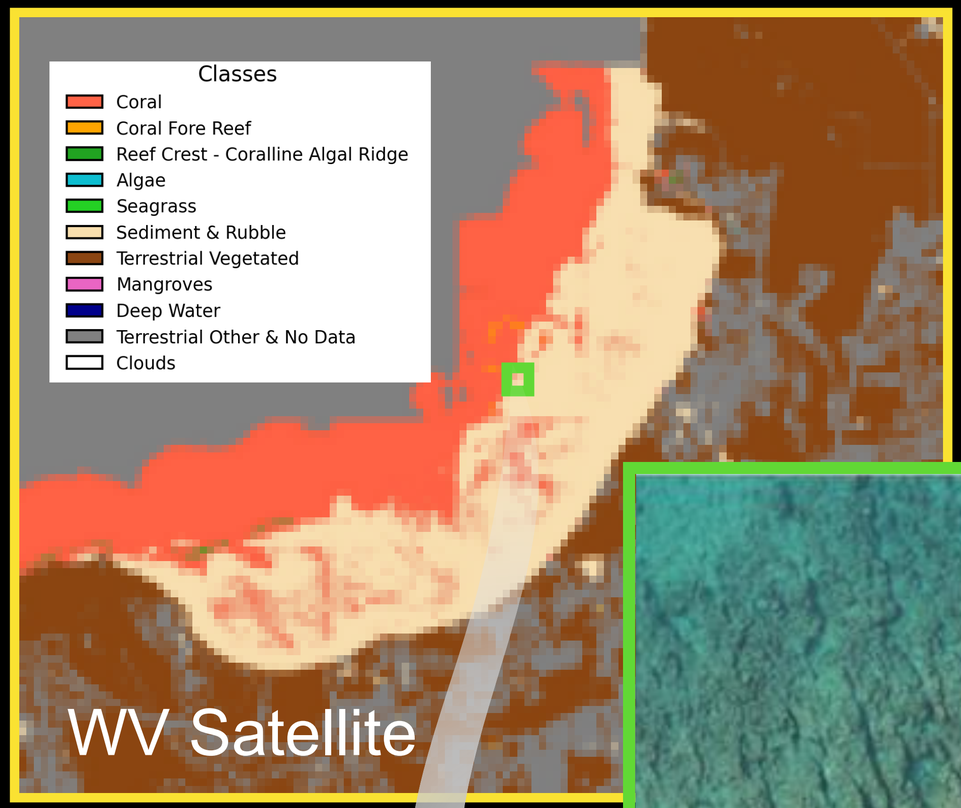
2000 km
mapbox
© Mapbox © OpenStreetMap Improve this map © Maxar



Classes

- Coral
- Coral Fore Reef
- Reef Crest - Coralline Algal Ridge
- Algae
- Seagrass
- Sediment & Rubble
- Terrestrial Vegetated
- Mangroves
- Deep Water
- Terrestrial Other & No Data
- Clouds


Classes
Coral
Coral Fore Reef
Reef Crest - Coralline Algal Ridge
Algae
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Terrestrial Vegetated
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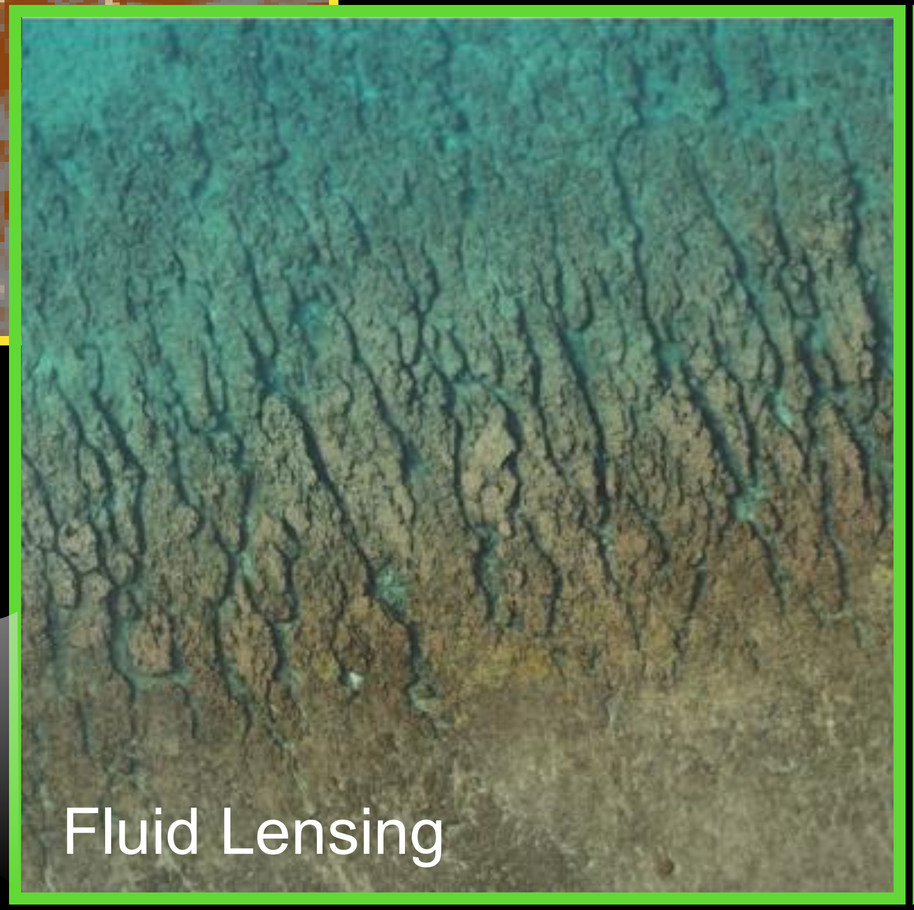
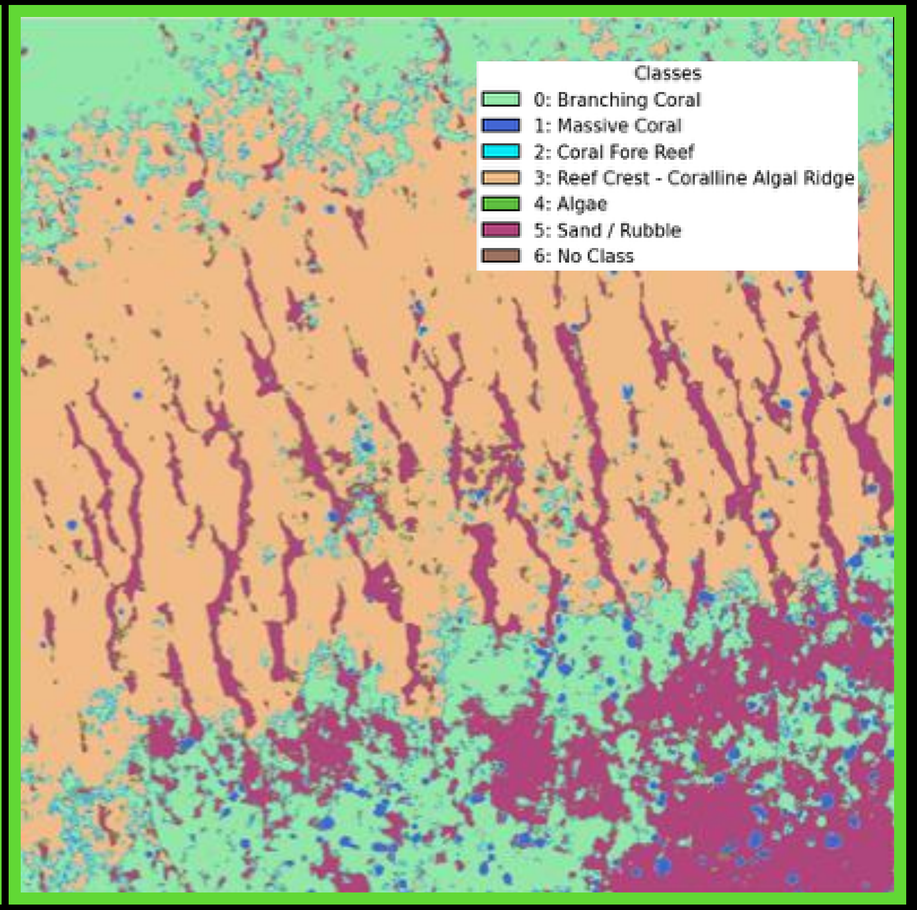
Deep Water
Terrestrial Other & No Data
Clouds
WV Satellite


Fluid Lensing


Classes
0: Branching Coral
1: Massive Coral
2: Coral Fore Reef
3: Reef Crest - Coralline Algal Ridge
4: Algae
5: Sand / Rubble
6: No Class

THANK YOU!

ACES.EARTH.MIAMI.EDU

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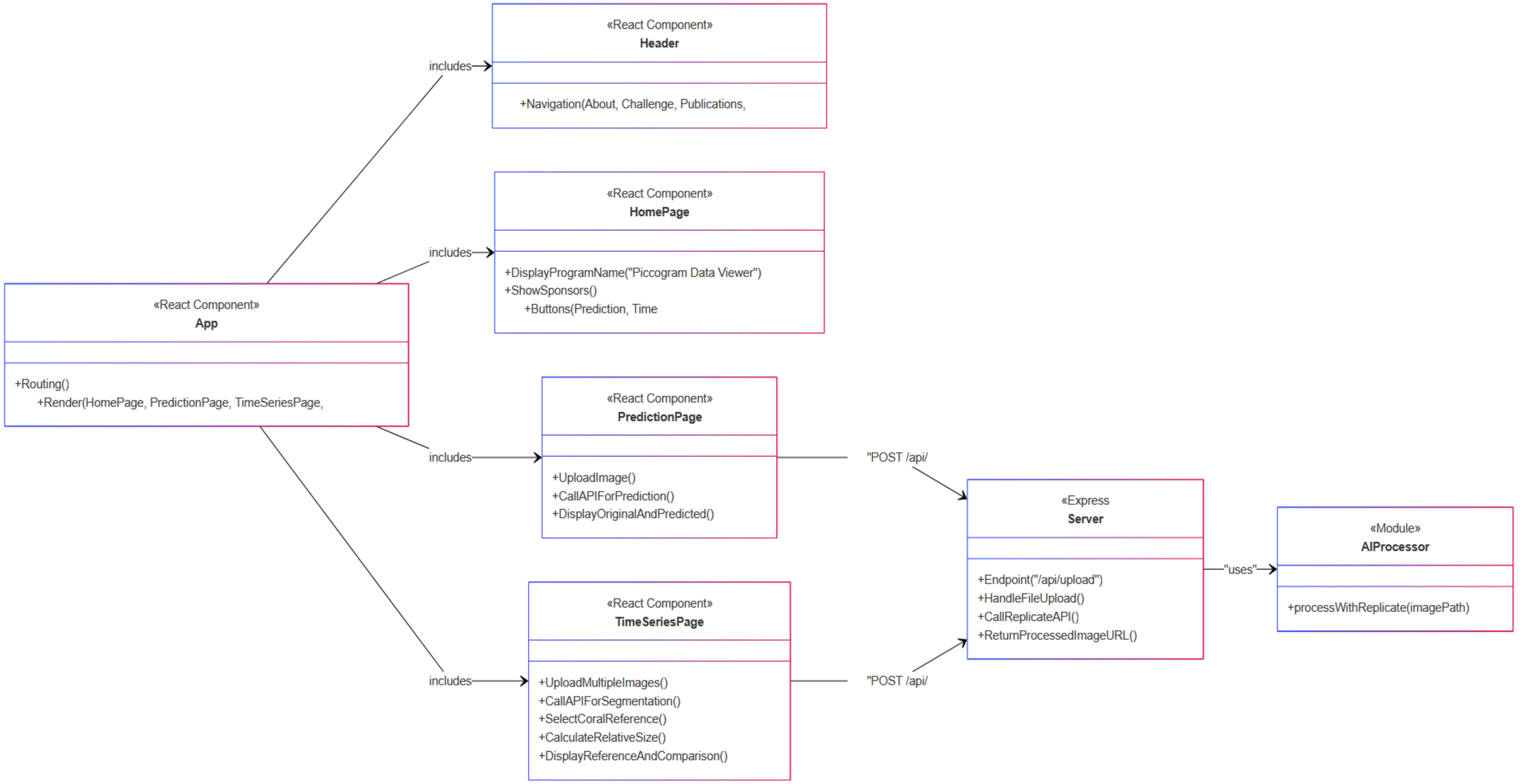
UNIVERSITY OF MIAMI
AIRCRAFT CENTER
for EARTH STUDIES

BACKUP SLIDES

Class Diagram for PICOGRAM Data Viewer

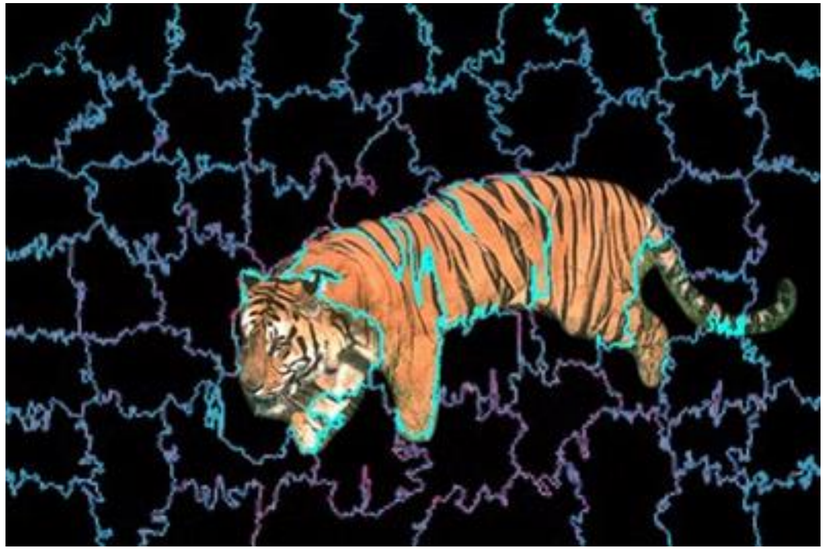


UNSUPERVISED IMAGE SEGMENTATION BY BACK-PROPAGATION

A new approach with NeMO-Net CNN

After applying SLIC (Simple Linear Iterative Clustering) segmentation and setting compactness, the algorithm uses a CNN to extract feature representations directly from the input image without labeled data.

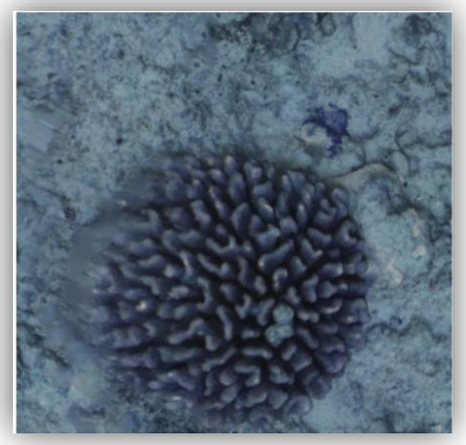
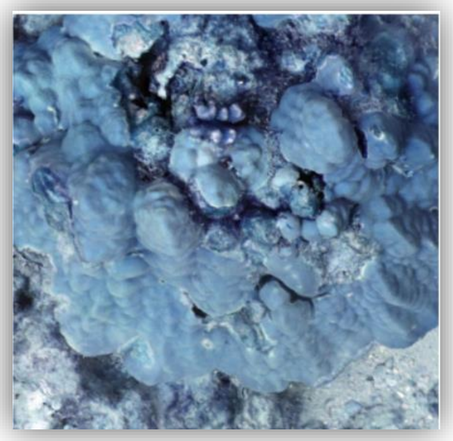
The CNN then assigns initial labels to pixels by selecting the highest activation across its feature maps, creating an initial segmentation map. This leverages the CNN's ability to learn patterns in an unsupervised manner, providing a foundation for iterative label refinement in subsequent steps.



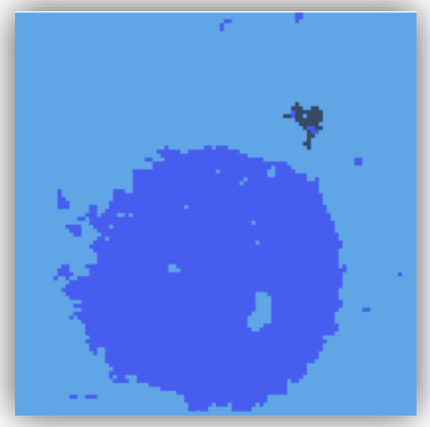
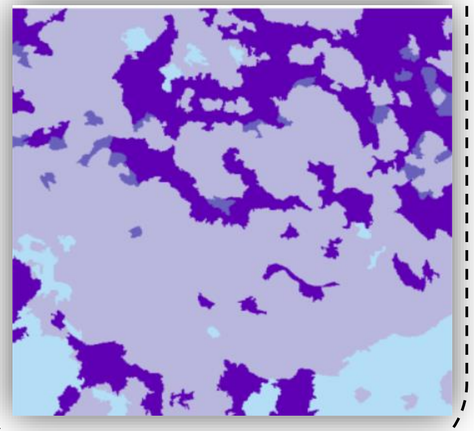
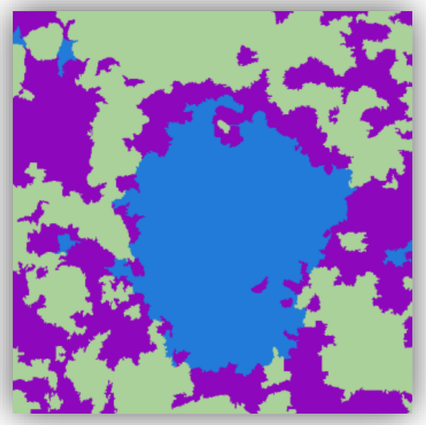
Sample SLIC segmentation

TESTING ON TIME SERIES DATA AND SPECIFIC COLONY TYPES

Original Patches

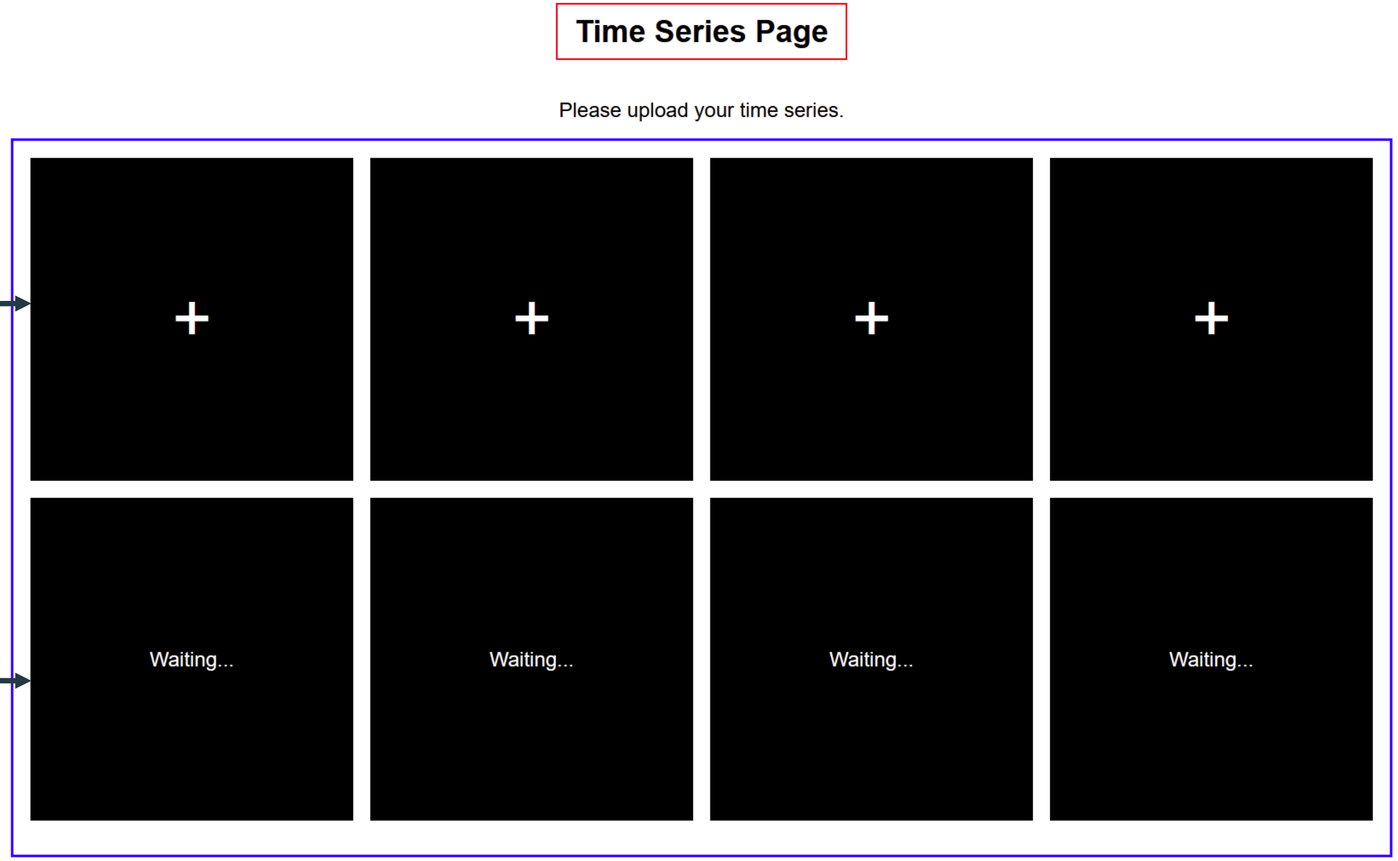
Segmentation Results

Time Series Page

Here, you can start uploading the time series from left to right. Note that the leftmost column is the reference image

Here, the model will start outputting the results AUTOMATICALLY.



PICOGRAM 2.0 vs SAM 2.1 Model Comparisons

NOAA FISHERIES

Ground Truth

SAM 2.1

PICOGRAM 2.0

NOAA FISHERIES