



UNIVERSITY OF THE
AEGEAN



Experience and lessons learned from monitoring the marine litter on the shore with the Coastal Marine Litter Observatory (CMLO)

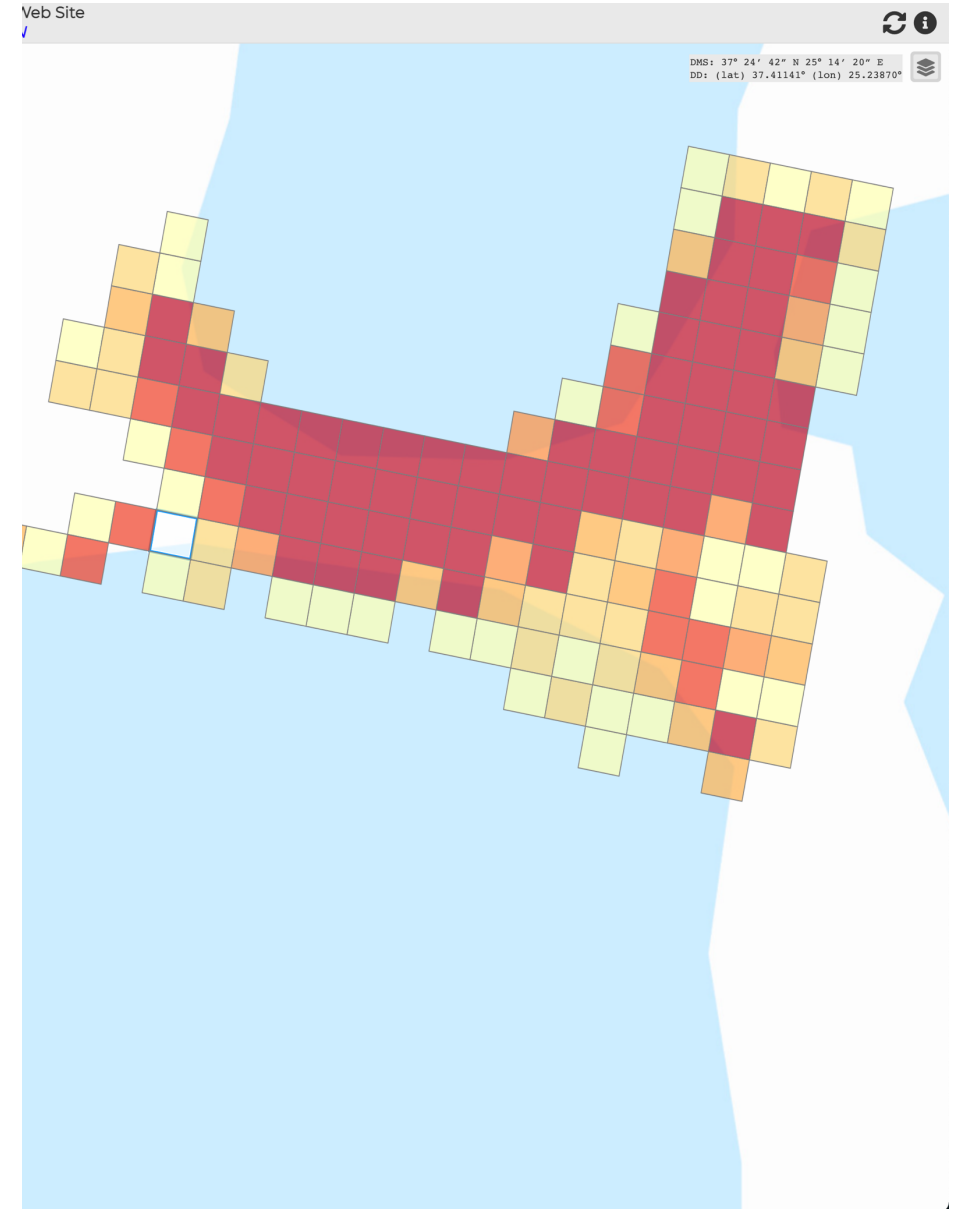
K. Topouzelis, A. Papakonstantinou, D. Simos, A. Moustakas

Coastal Marine Litter Observatory (CMLO)

- Marine Litter Density Mapping in the coastal areas in a harmonized method
- Drone RGB images as input data
- Marine Litter accumulation visualized as density maps
- Automatic reporting through an open geospatial portal
- System functionalities connecting results with raw images (detected plastics)
- Supporting decisions and policies e.g. EU (MSFD - (D10C1) and UN (SDG14.1.1b)



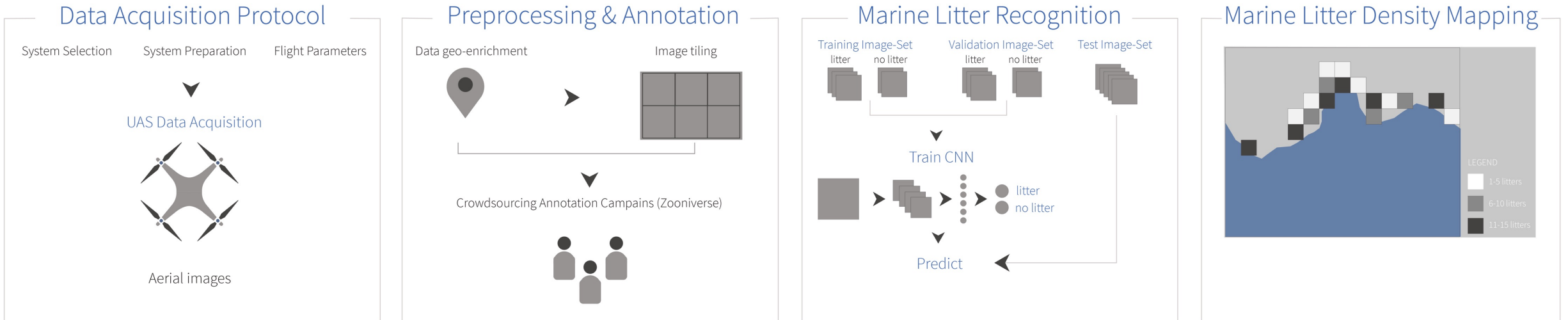
Global Partnership
on Plastic Pollution
and Marine Litter



Coastal Marine Litter Observatory (CMLO)

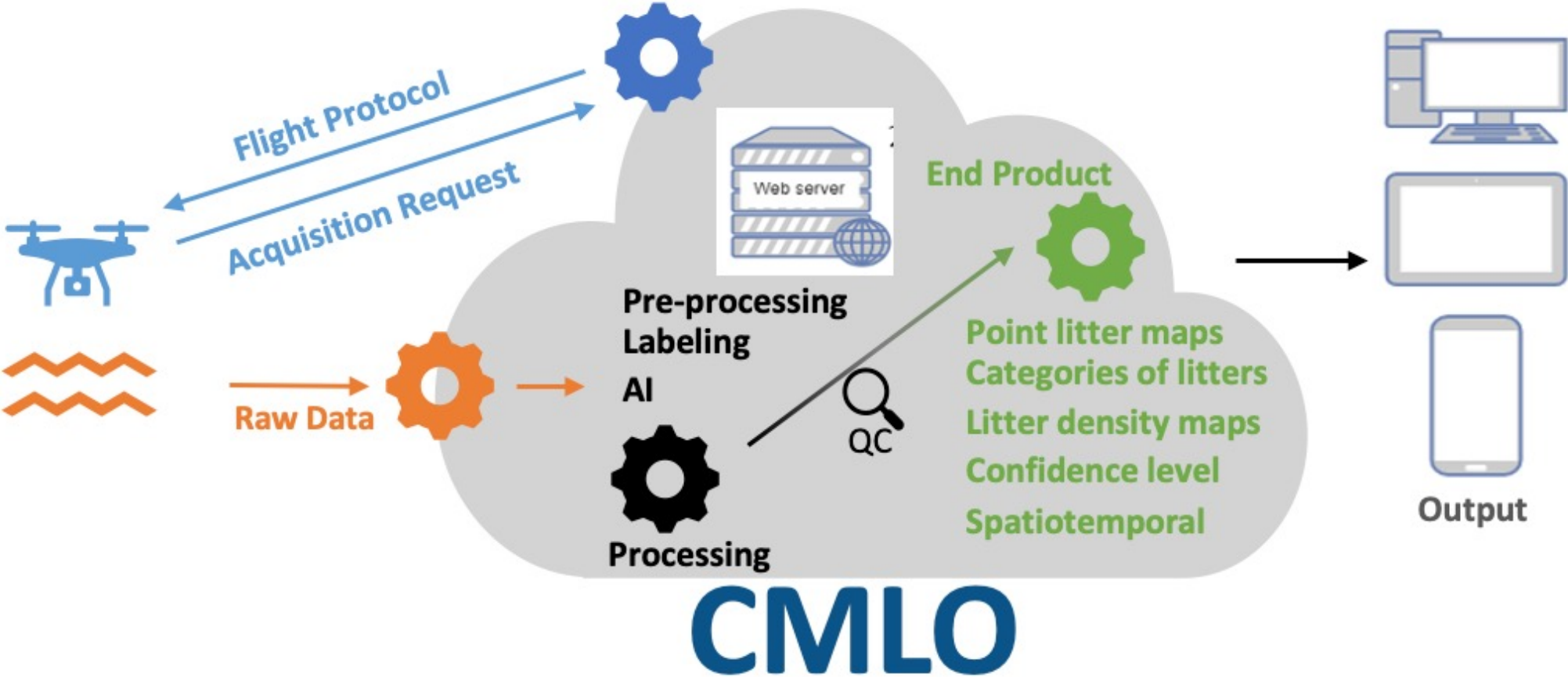
Marine Litter Density Mapping in the coastal areas:

UAS data acquisition protocol combined with deep learning techniques for the automatic detection and mapping of litter concentrations in the coastal zone



Papakonstantinou, A.; Batsaris, M.; Spondylidis, S.; Topouzelis, K. (2021). *A Citizen Science Unmanned Aerial System Data Acquisition Protocol and Deep Learning Techniques for the Automatic Detection and Mapping of Marine Litter Concentrations in the Coastal Zone.* *Drones* 2021, 5, 6. DOI: [10.3390/drones5010006](https://doi.org/10.3390/drones5010006)

Coastal Marine Litter Observatory (CMLO)

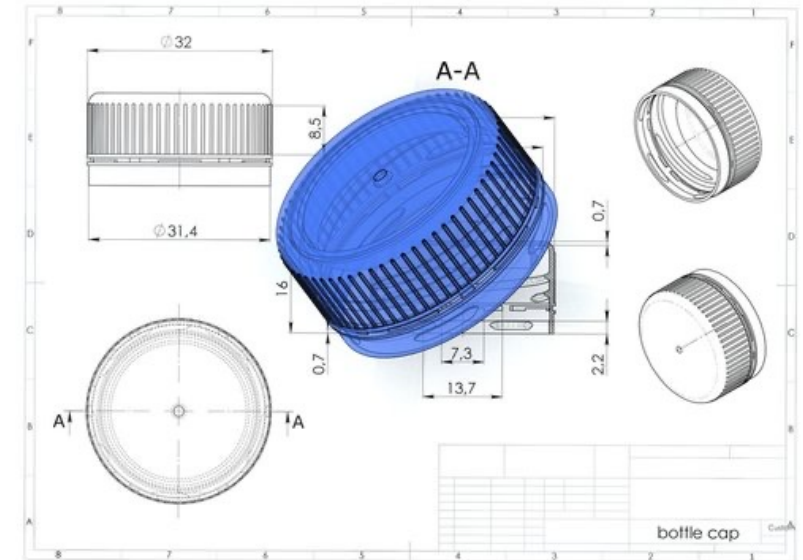


Coastal Marine Litter Observatory (CMLO)

ML Proposed Main Categories & Size

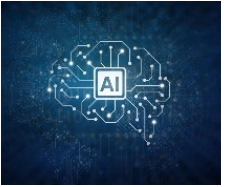
1	SYNTHETIC POLYMER MATERIALS (PLASTICS)
2	RUBBER MATERIALS
3	CLOTH-TEXTILE MATERIALS
4	PAPER - CARDBOARD MATERIALS
5	WOODEN MATERIALS
6	METALLIC MATERIALS
7	GLASS- CERAMICS MATERIALS

- GSD = 1cm or **0,5 cm** → 18-20 m Phantom Pro
 - Min Area = $1\text{cm}^2 - 0,25\text{cm}^2$
- Or
- min measurable item dimensions equal a plastic bottle cap in 2 to 4 pixels for consumer grade



Coastal Marine Litter Observatory (CMLO)

Use of Artificial Intelligence Algorithms



Automated detection of marine litter

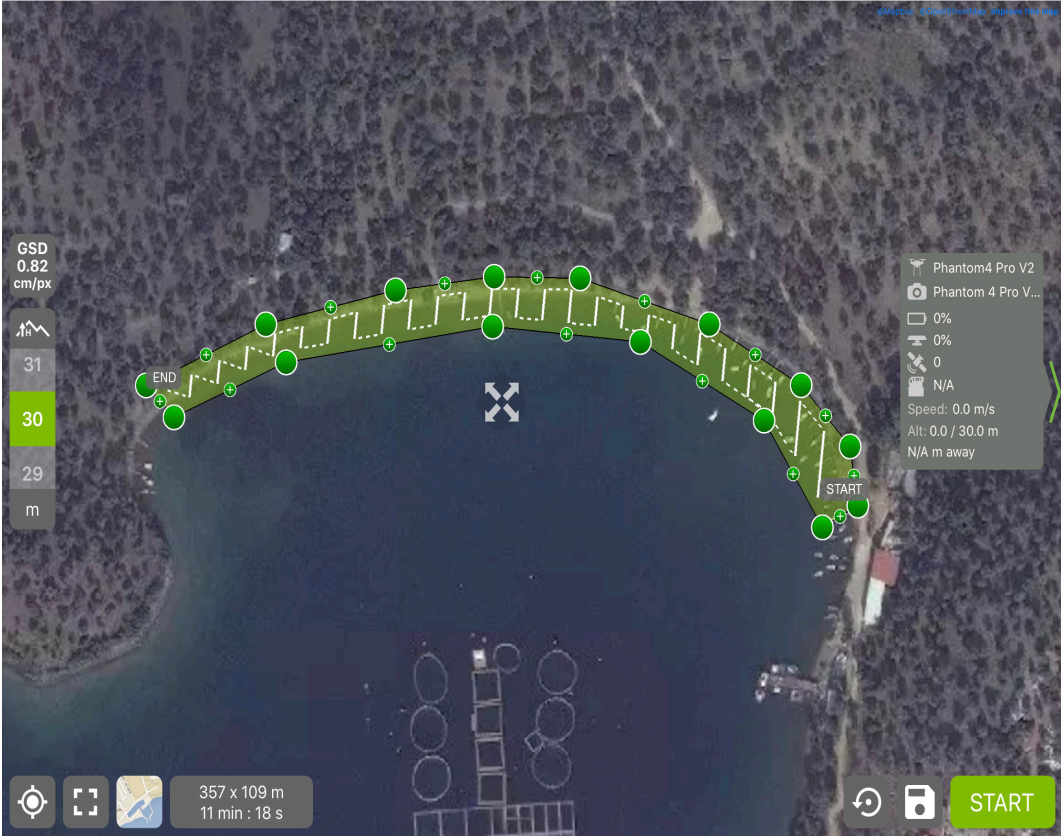


Detection of 7 categories

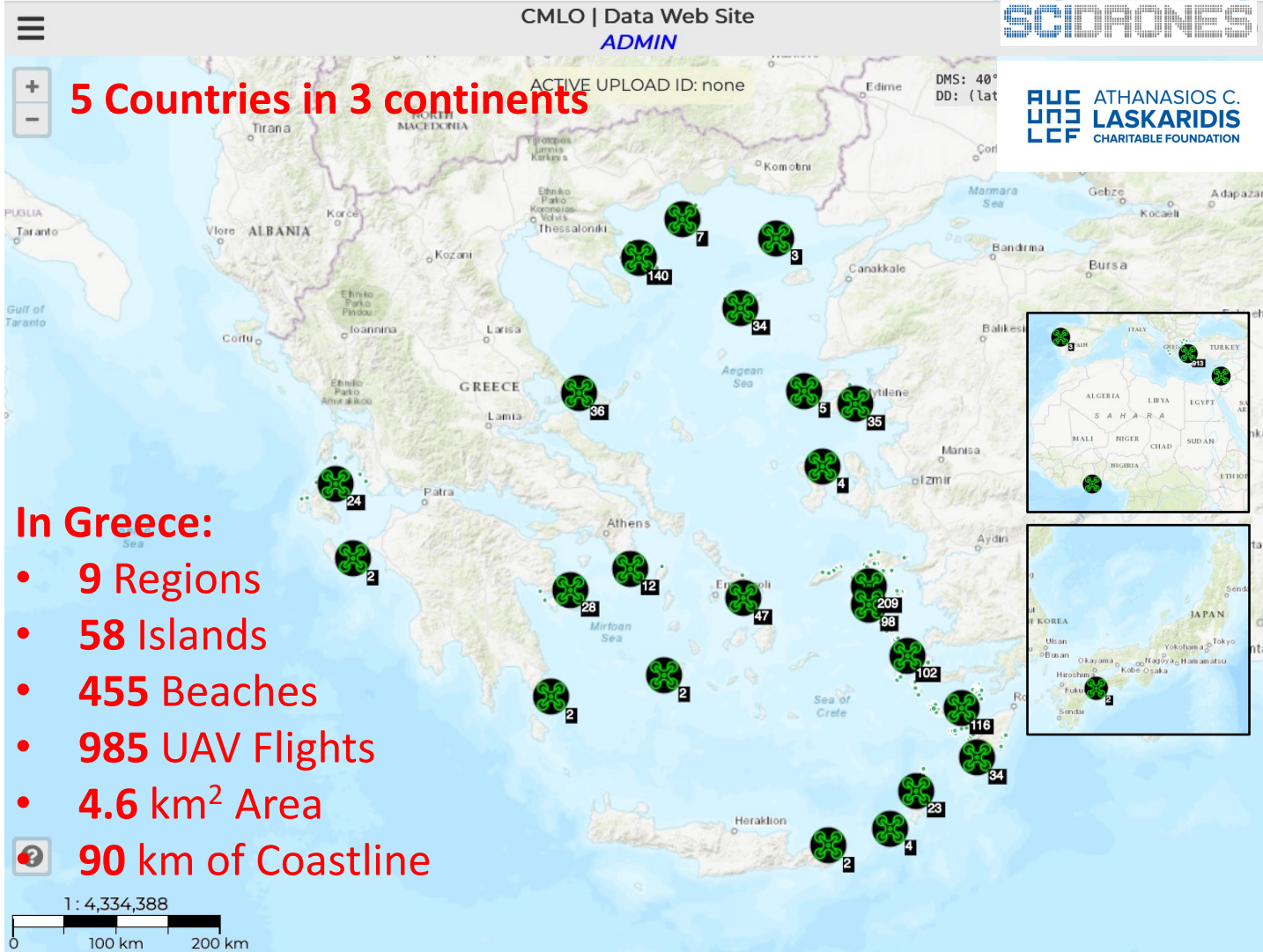


Coastal Marine Litter Observatory (CMLLO)

Standard drone data acquisition protocol



Coastal Marine Litter Observatory (CMLO)



- ◆ **Combination of Drones & AI**
- ◆ **Fully Automated Process**
- ◆ *TRL Level: 9*
- ◆ *Accuracy: ≥ 85%*
- ◆ *Online cloud platform:*
 - ◆ **Mapping of litter positions**
 - ◆ **Monitoring the changes in time & space**
 - ◆ **Pollution time series visualization**

15.220 High resolution aerial photos

428.000 Marine litter items
356.300 Plastic items

22/8/2023

Converts drones' aerial photographs to valuable geospatial information

Coastal Marine Litter Observatory (CMLO)

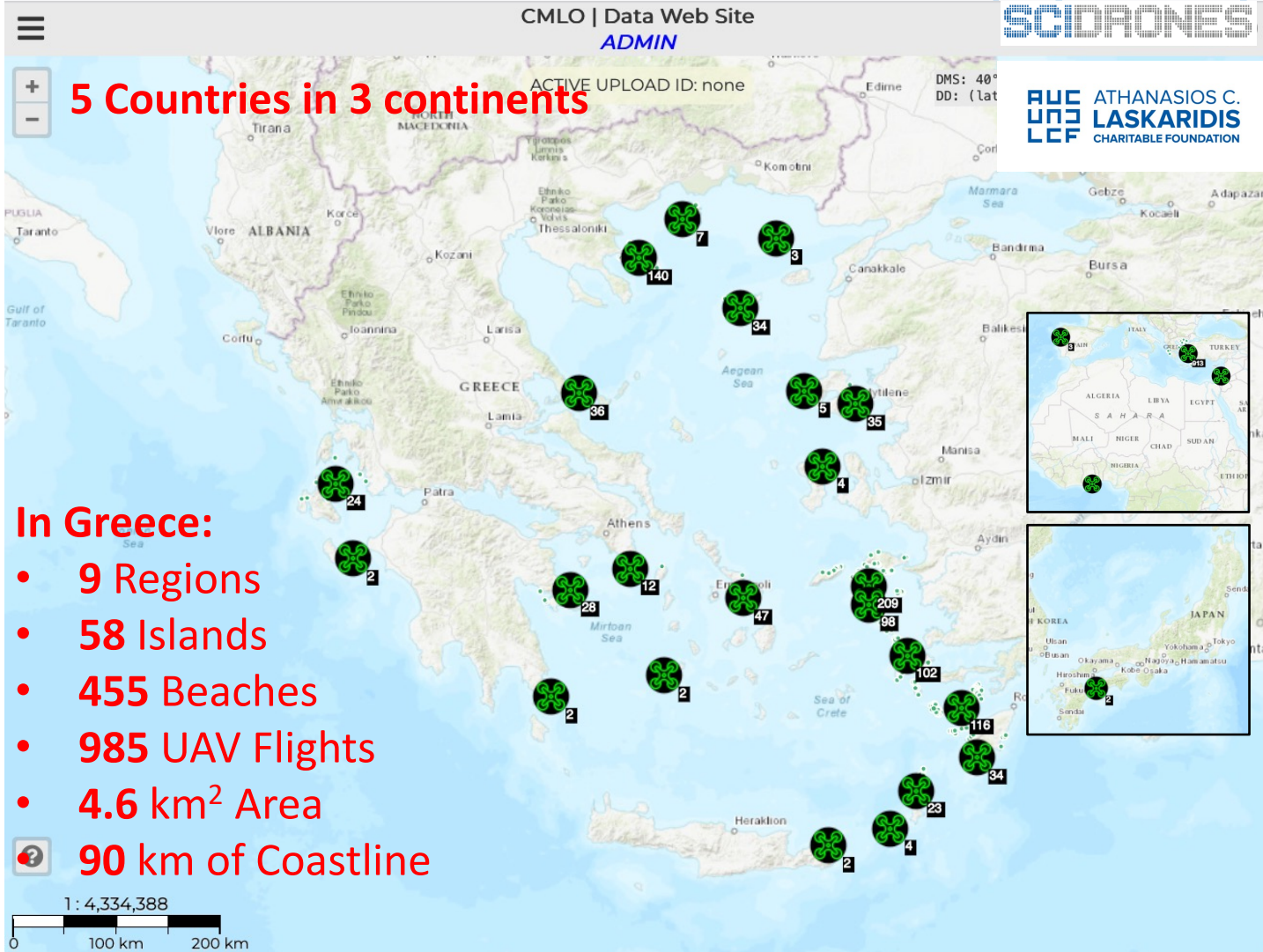


Table 1.1. CMLO training objects

No	Marine Litter Categories	No of Objects
1	Synthetic Polymer Materials (Plastics)	47,649
2	Rubber Materials	759
3	Cloth-Textile Materials	350
4	Paper - Cardboard Materials	1,532
5	Wooden Materials	3,389
6	Metallic Materials	643
7	Glass- Ceramics Materials	261
8	Unknown	561

15.220 High resolution aerial photos

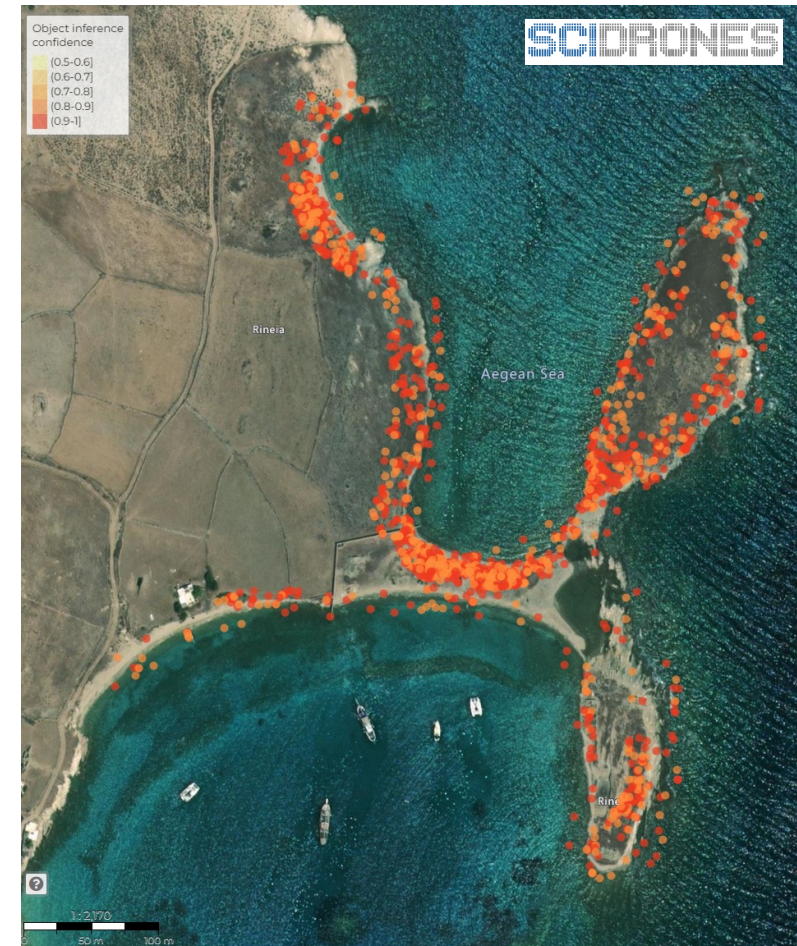
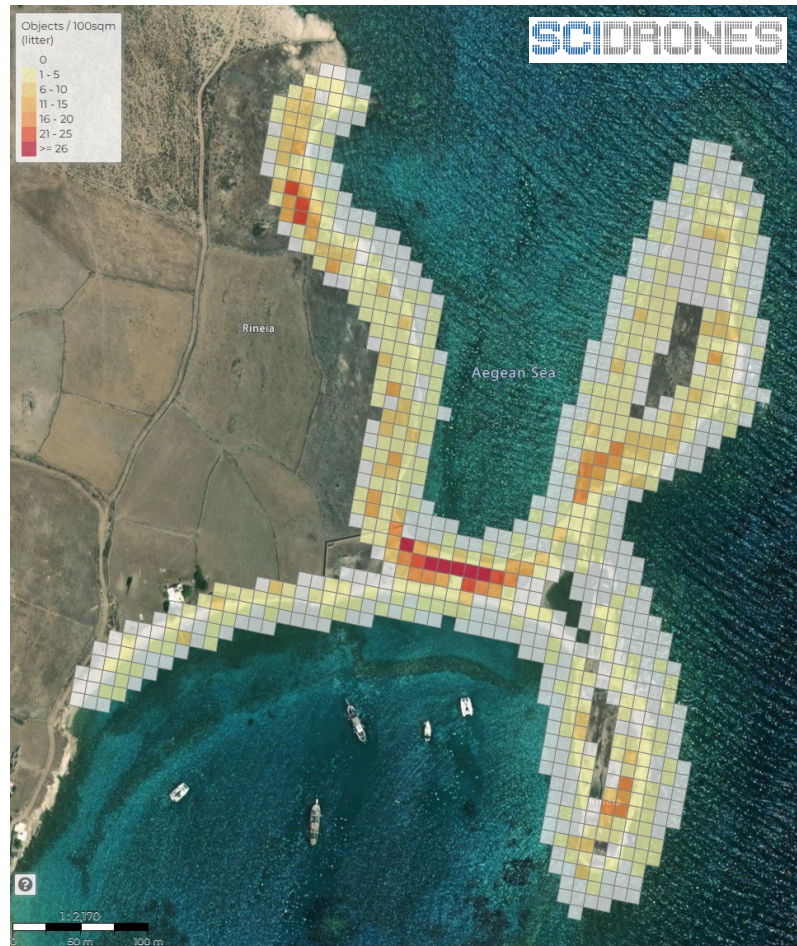
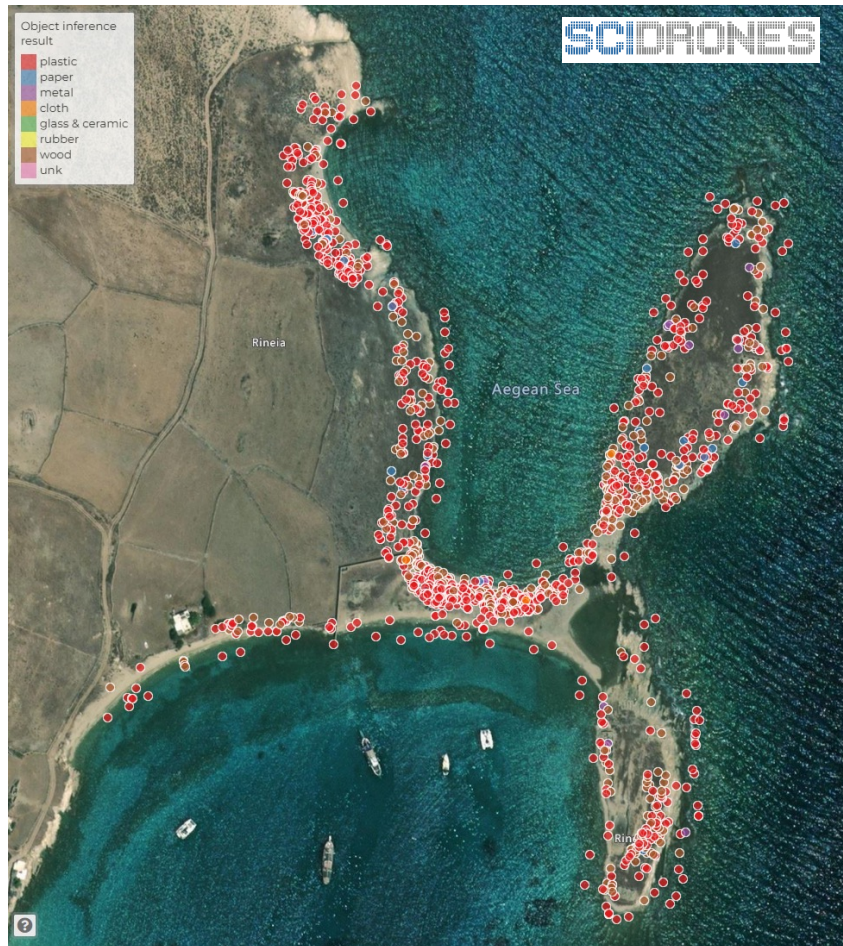
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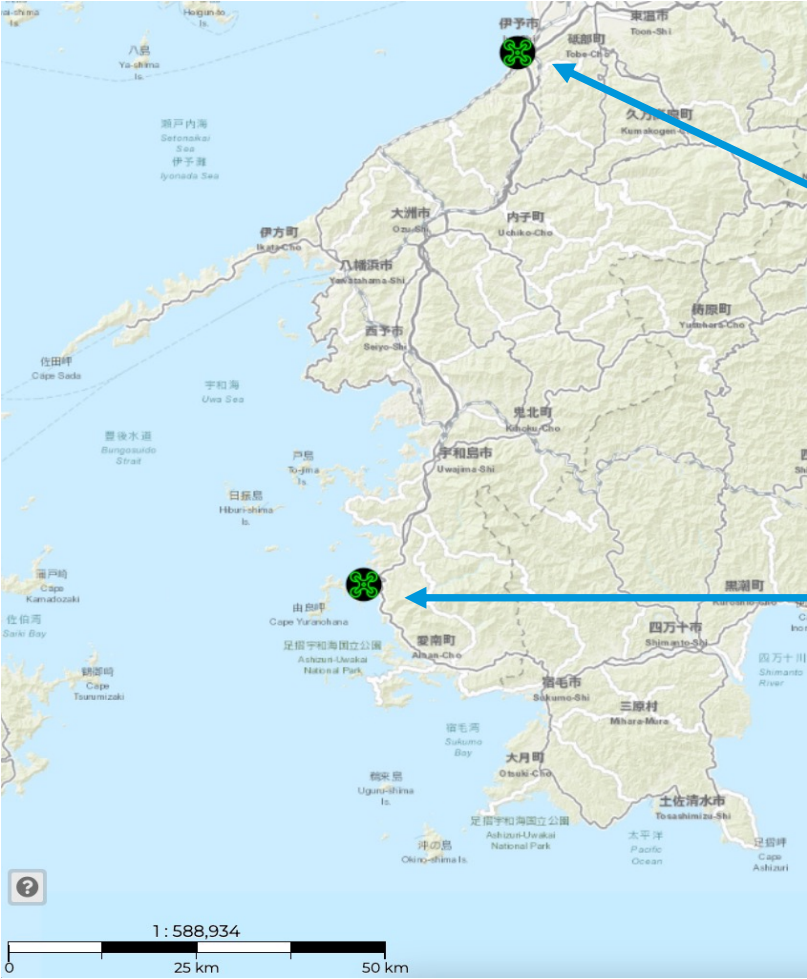
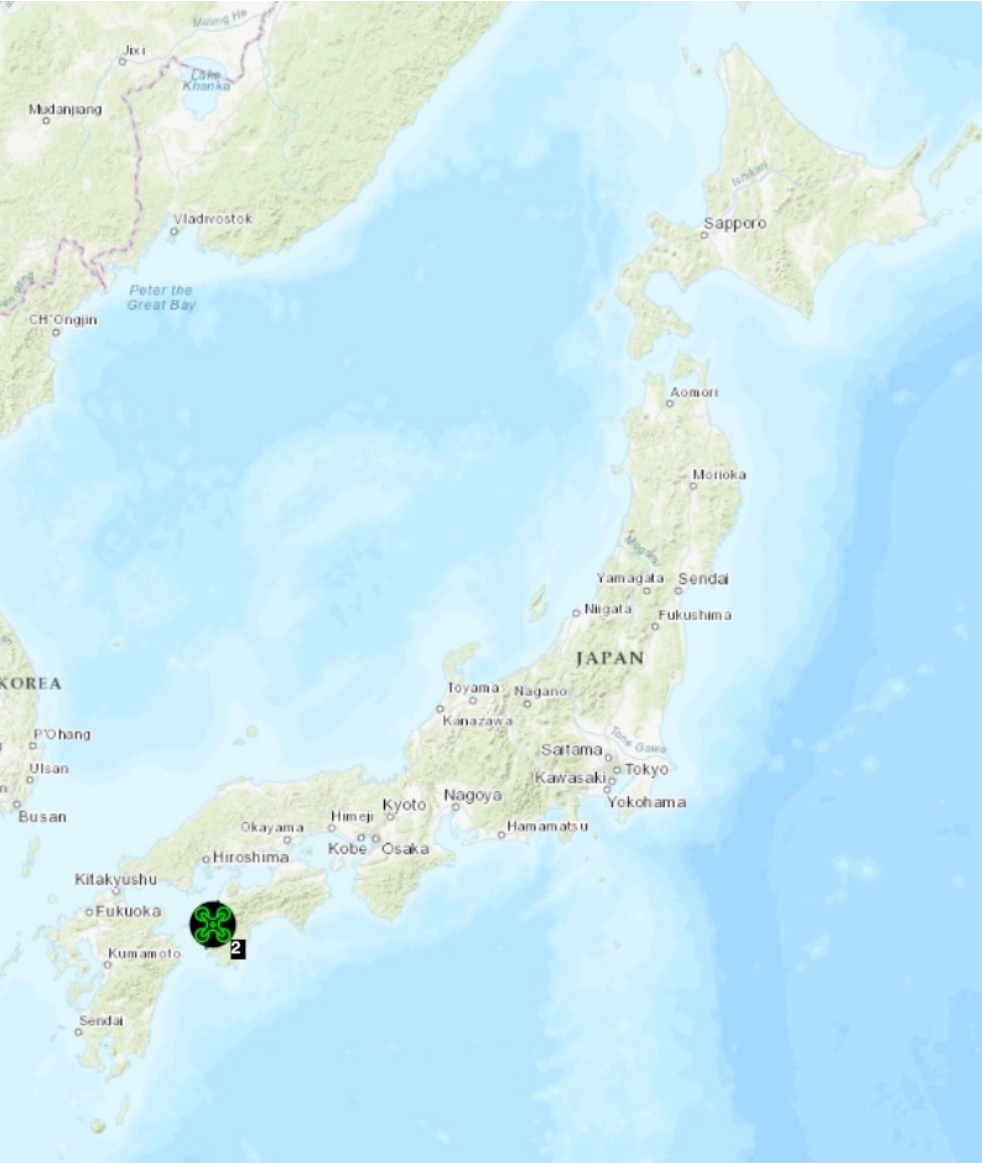
Converts drones' aerial photographs to valuable geospatial information

Coastal Marine Litter Observatory (CMLO)

Maps of marine litter geolocations, types and densities
Advanced Geo-Visualization techniques



Case study: Japan - 2023






Lyo beach

Uwajima beach

Case study: Japan - Uwajima beach

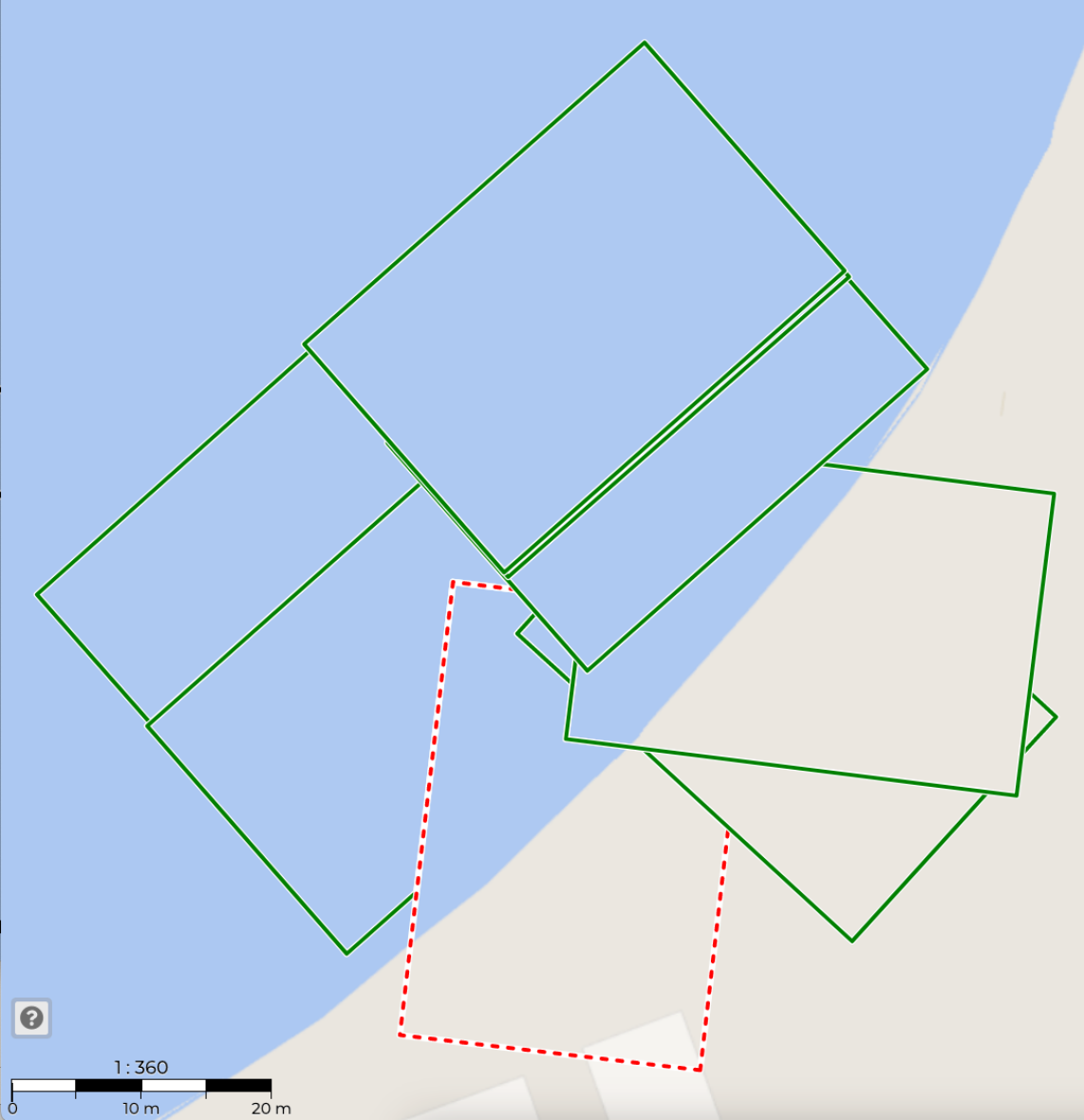
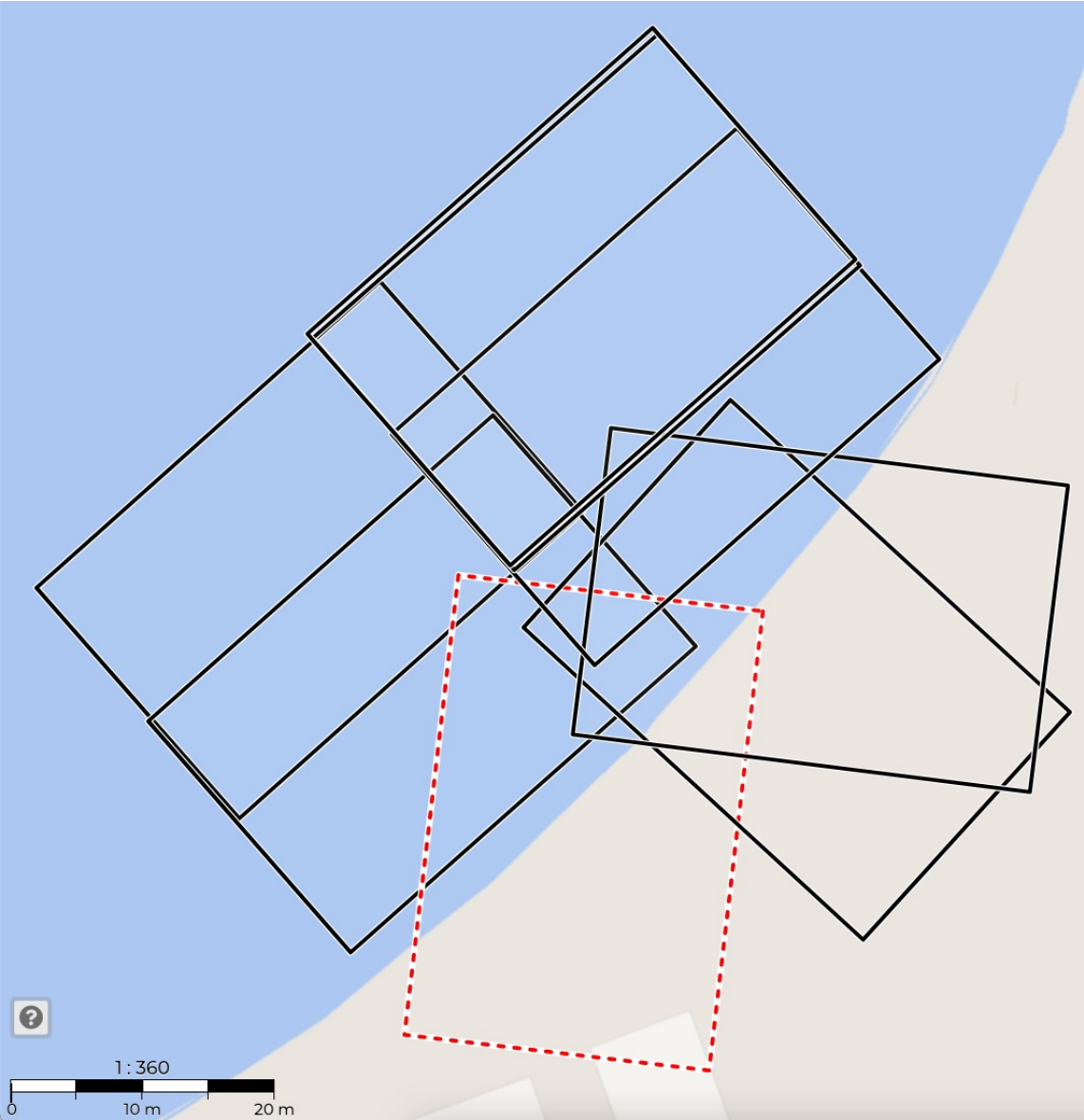
Admin user data

ID	USERNAME	TITLE	DESCRIPTION	ENTITY	DATA DATE	IMAGE COUNT	UPLD GEOM	IMG FOOTPRINT	MAP REPORT	DENSITY MAP
1083	ADMIN	Japan - Kako - uwajima beach	Japan - uwajima beach 09-06-2023	Prof Kako - Japan	2023-07-27	8/1				<input type="checkbox"/>

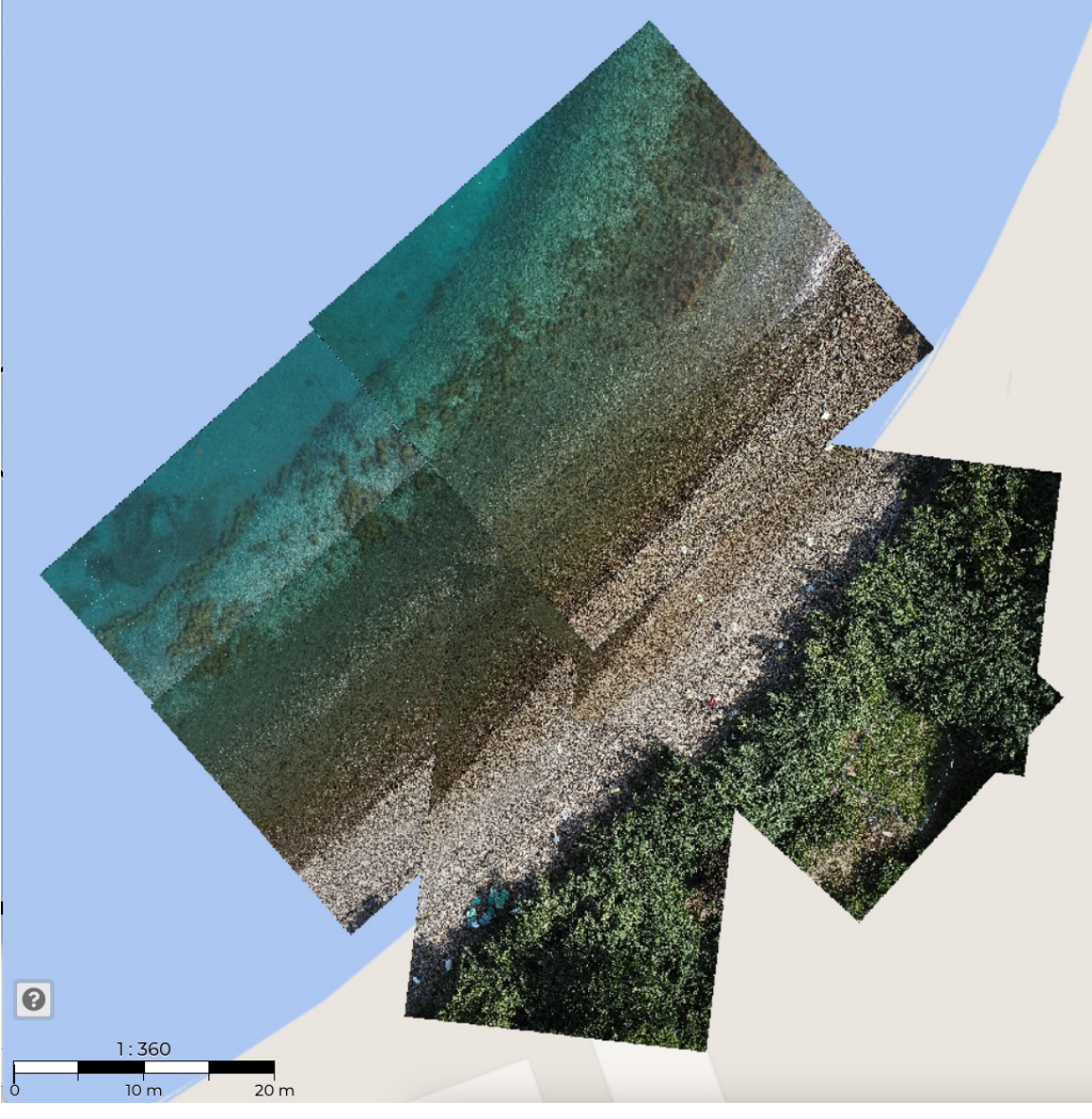
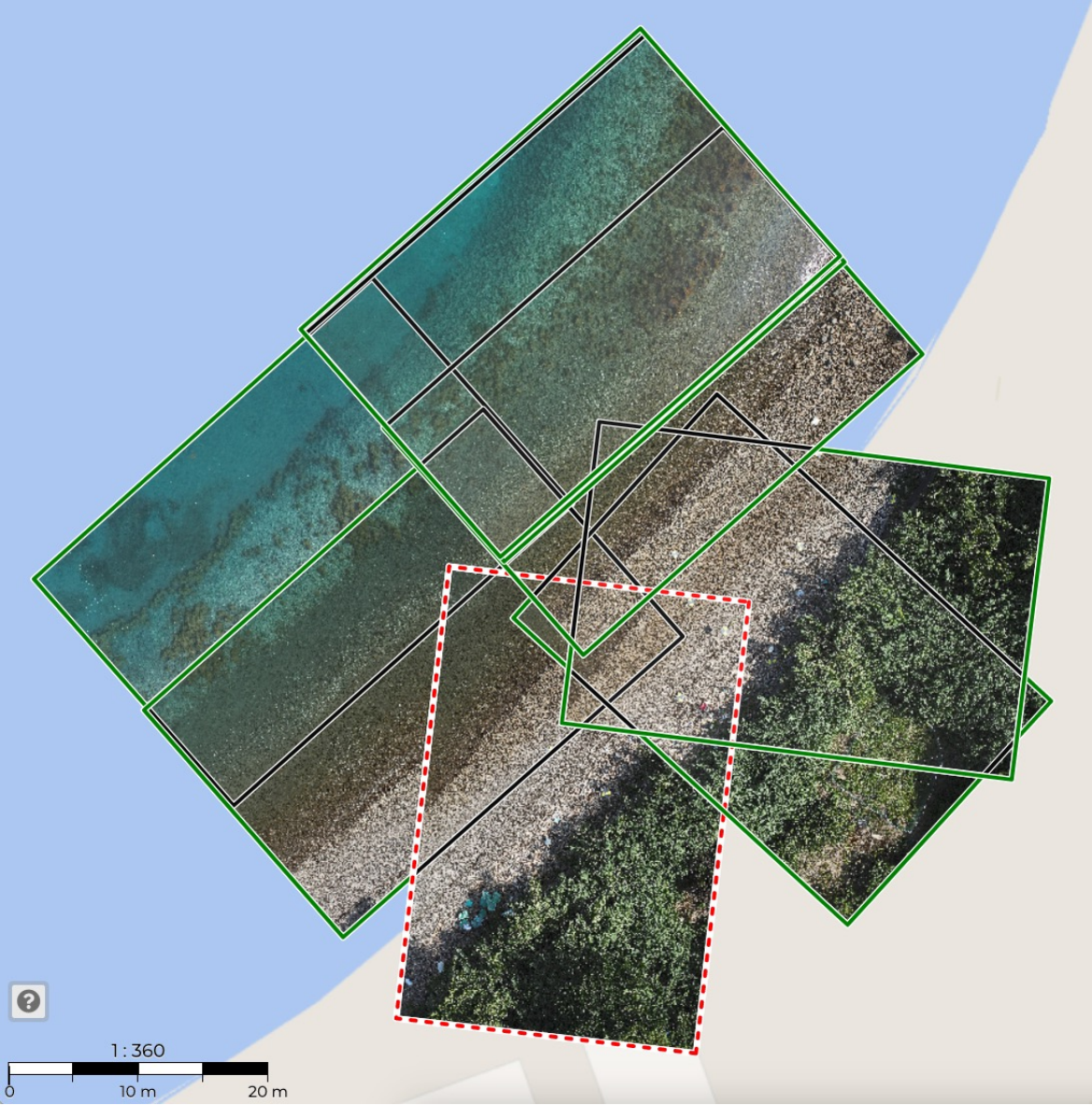
11 photo uploaded – 3 invalid (wrong pitch) – 8 processed



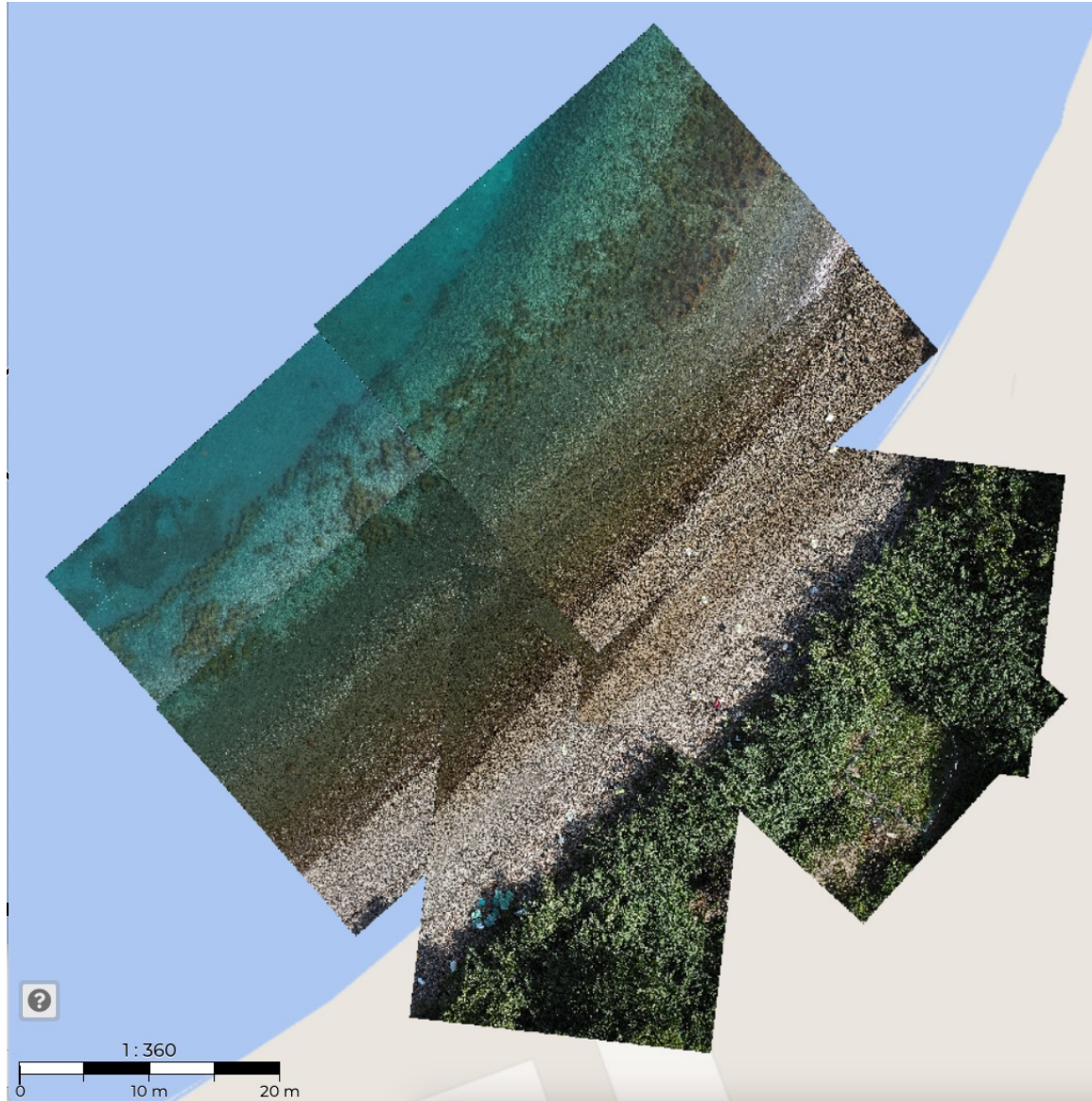
Case study: Japan - Uwajima beach



Case study: Japan - Uwajima beach



Case study: Japan - Uwajima beach



Data filtering

Object inference result filter

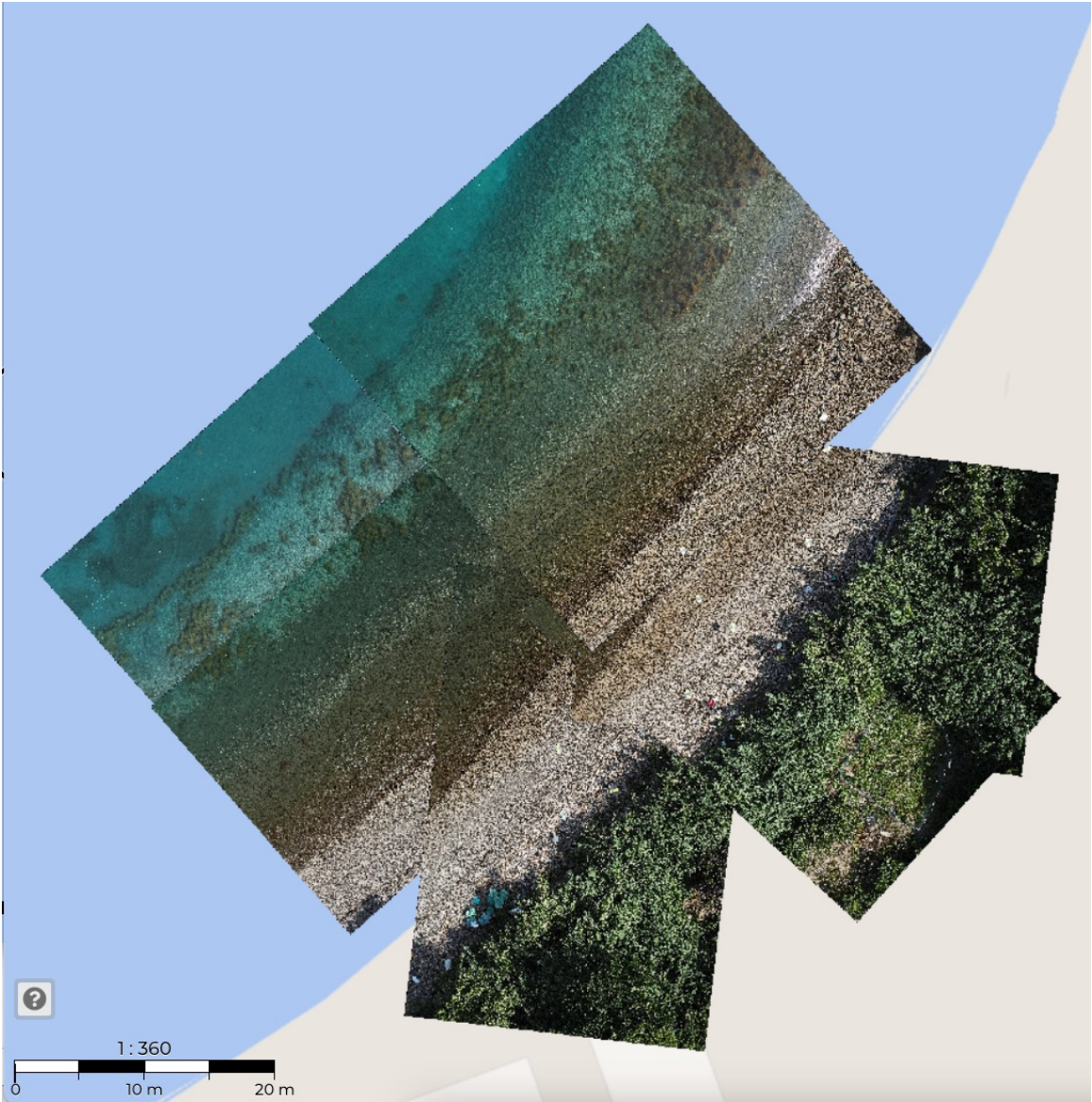
Note: does not affect density map

<input checked="" type="checkbox"/> plastic	<input checked="" type="checkbox"/> paper	<input checked="" type="checkbox"/> metal
<input checked="" type="checkbox"/> cloth	<input checked="" type="checkbox"/> glass/ceramic	
<input checked="" type="checkbox"/> rubber	<input checked="" type="checkbox"/> wood	<input checked="" type="checkbox"/> unknown

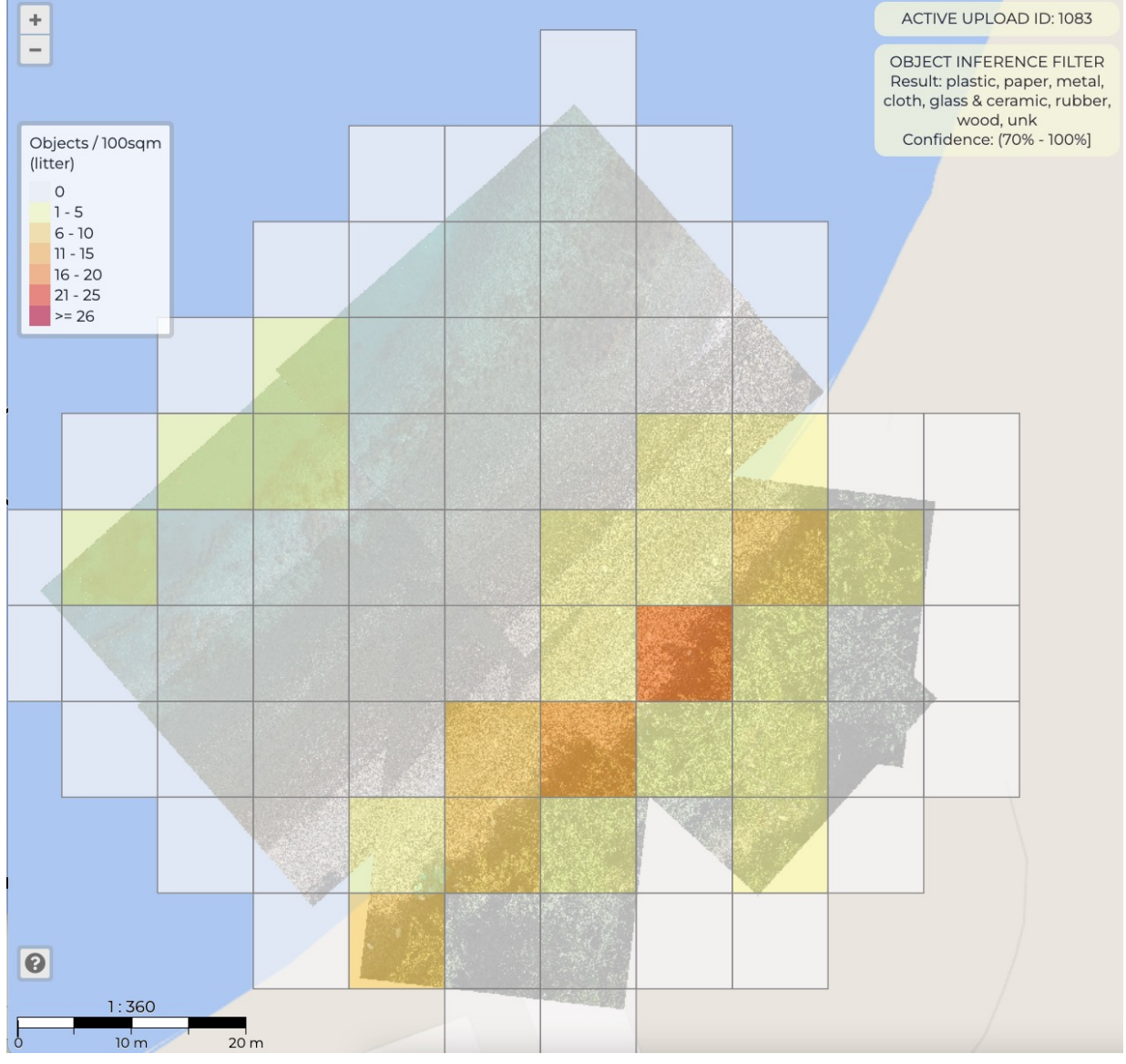
Object inference confidence filter

From 70% To 100%

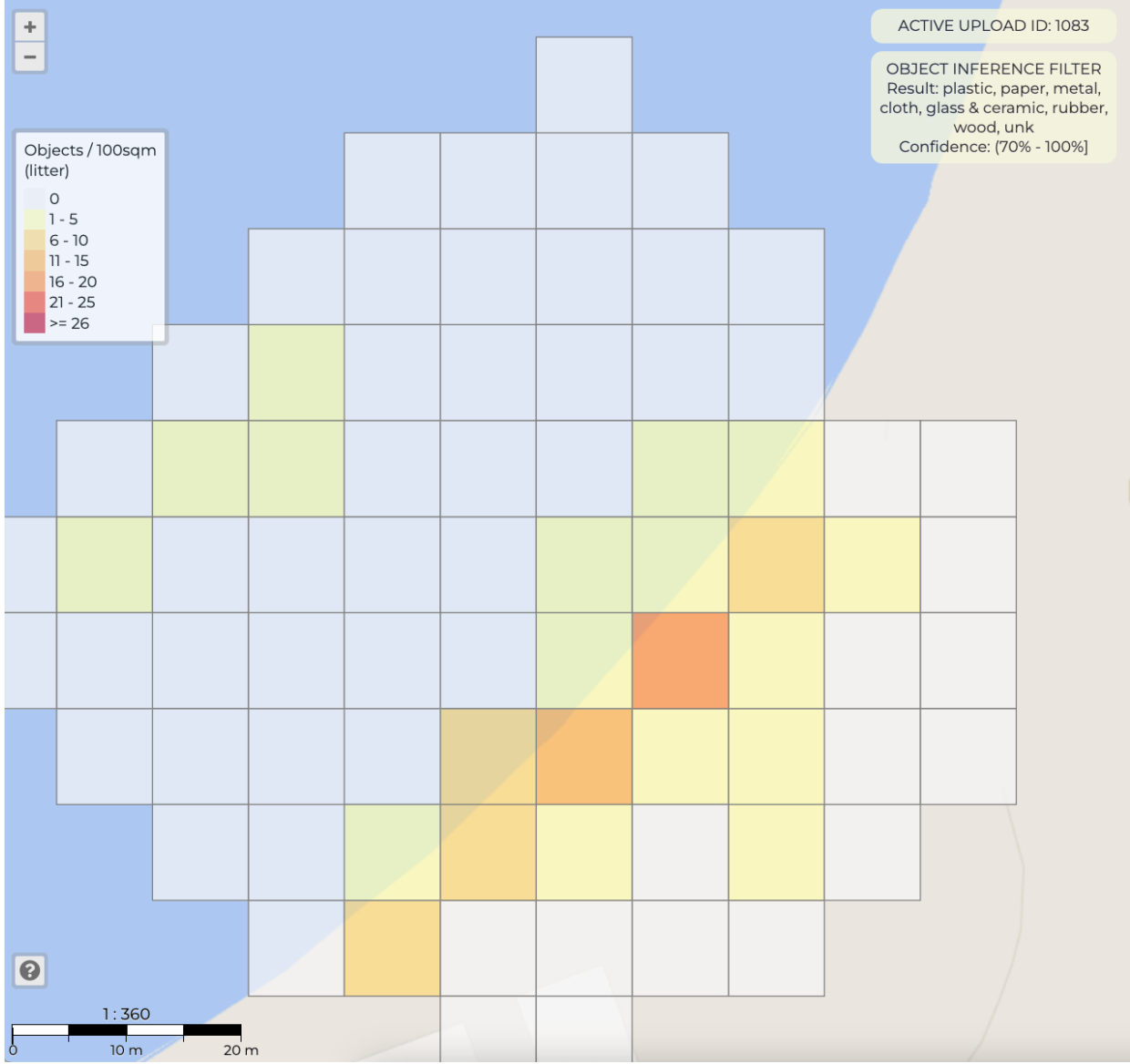
Case study: Japan - Uwajima beach



Case study: Japan - Uwajima beach



Case study: Japan - Uwajima beach



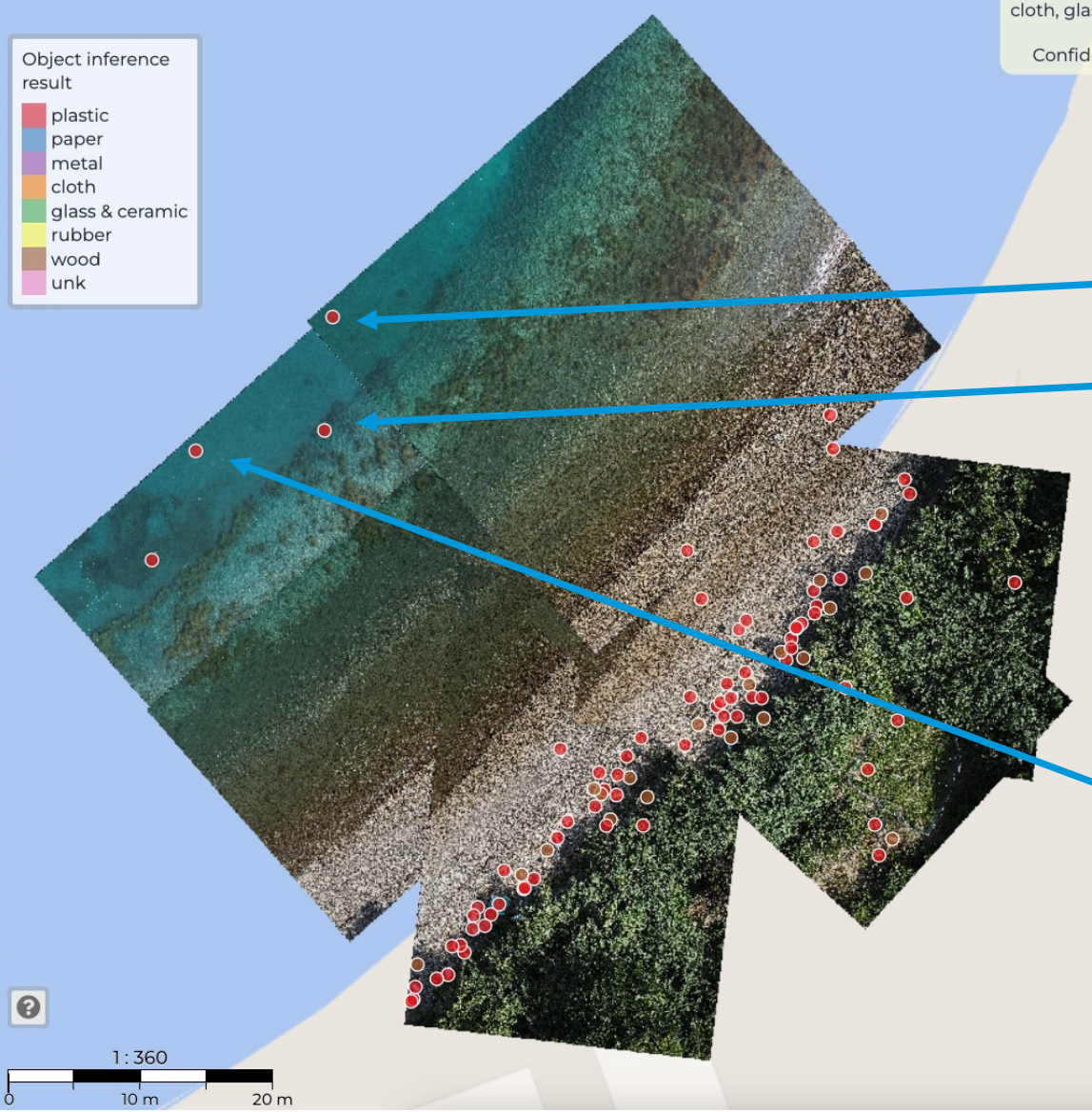
Case study: Japan - Uwajima beach



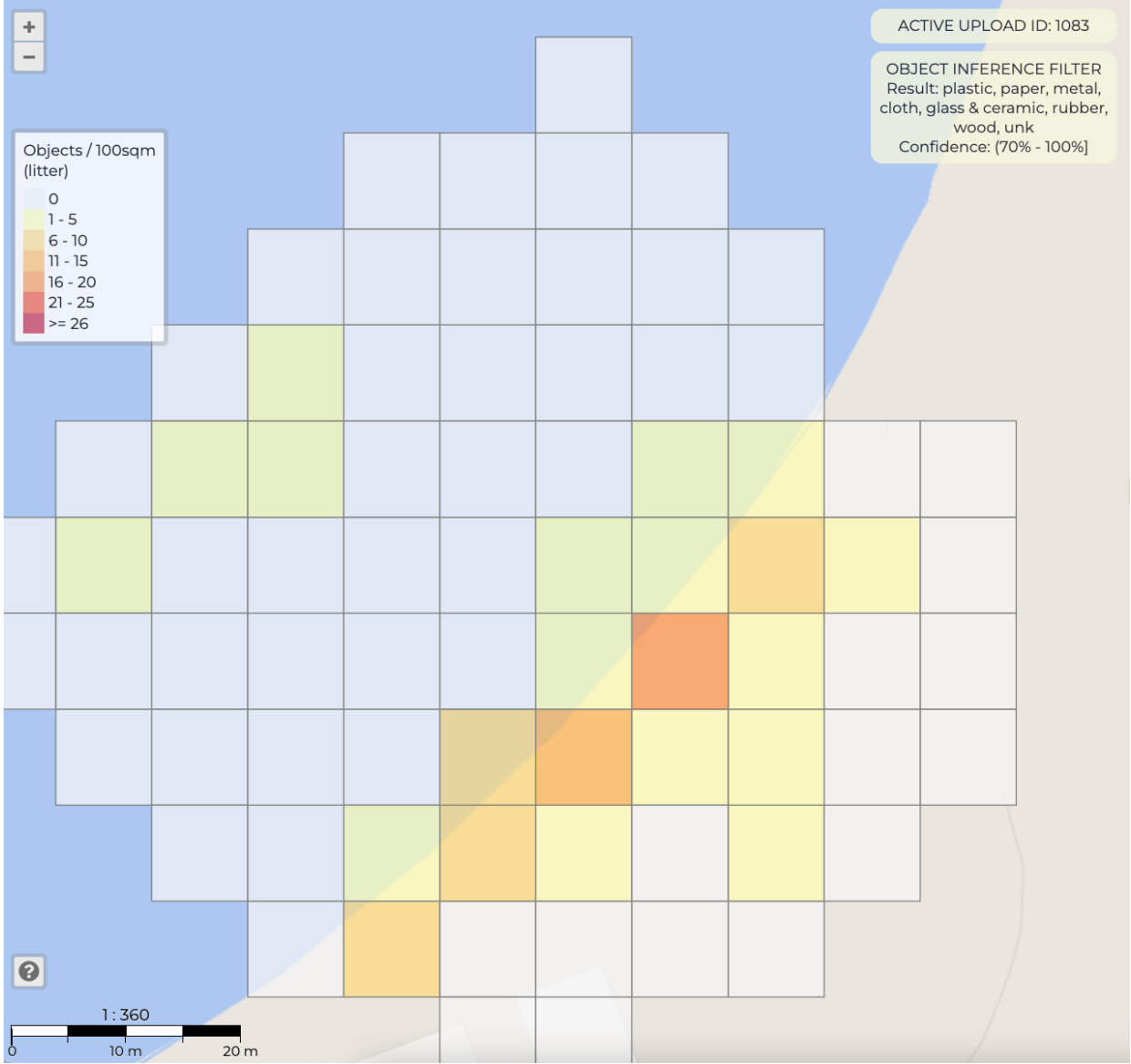
Case study: Japan - Uwajima beach



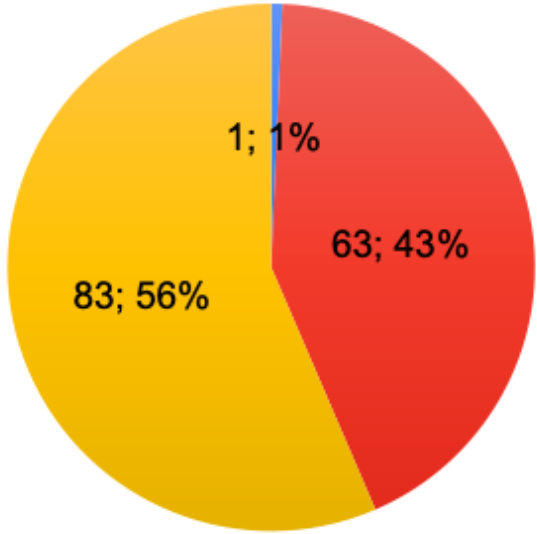
Case study: Japan - Uwajima beach



Case study: Japan - Uwajima beach



Japan - Uwajima beach Confidence level 70%-100%



■ Metallic ■ Plastic ■ Wooden

MTL	0,7
Metallic	1
Plastic	63
Wooden	83
SUM	147

Dataset selection

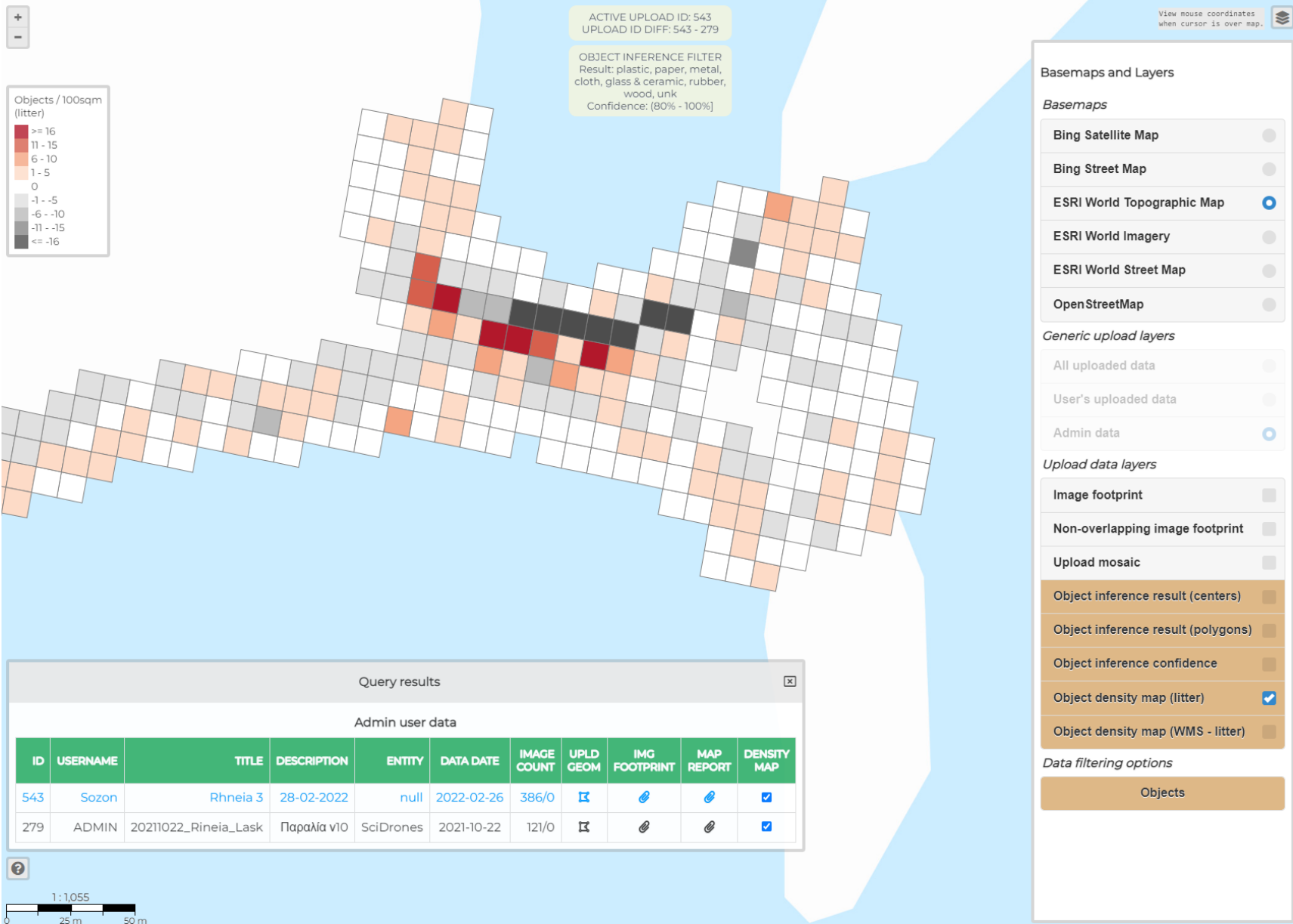
- Dataset/coastal zone selection
- Selection between datasets in different time periods
- In the example: Rineia Island at Cyclades, Greece
- 3 datasets in the same coastal zone

The screenshot displays a GIS application interface. The main map shows a topographic view of Rineia Island with several green circular markers and yellow lines indicating dataset selection. The interface includes a sidebar on the right with 'Basemaps and Layers' and 'Upload data layers' sections. A 'Query results' window is open at the bottom, showing a table of 'Admin user data'.

ID	USERNAME	TITLE	DESCRIPTION	ENTITY	DATA DATE	IMAGE COUNT	UPLD GEOM	IMG FOOTPRINT	MAP REPORT	DENSITY MAP
41	ADMIN	20210622_Rineia_MISSION_12	20210622_Rineia_MISSION_12 line for Laskaridis	SciDrones	2021-06-22	121/0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
279	ADMIN	20211022_Rineia_Lask	Παραλία v10	SciDrones	2021-10-22	121/0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
543	Sozon	Rhneia 3	28-02-2022	null	2022-02-26	386/0	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

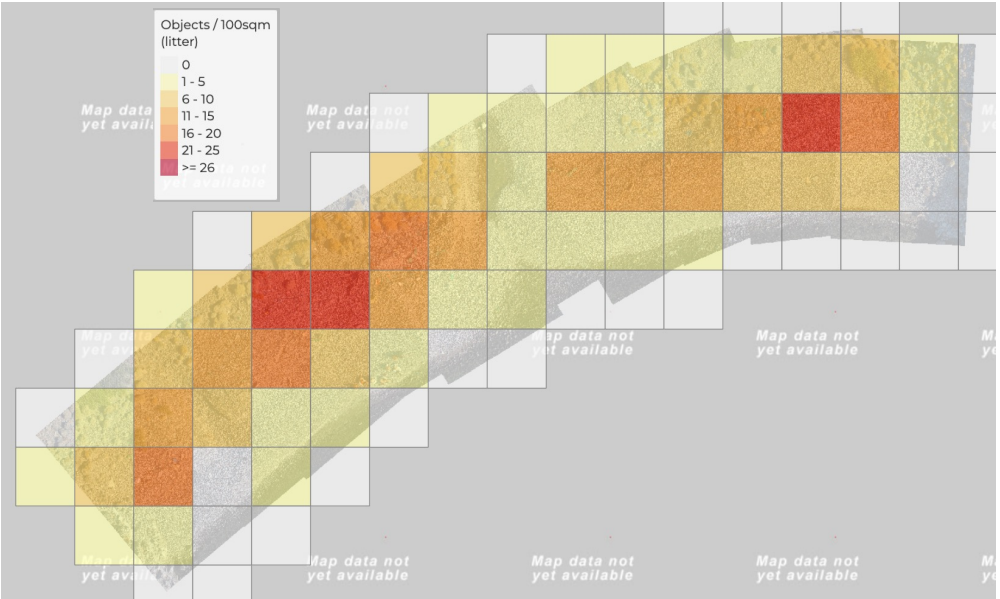
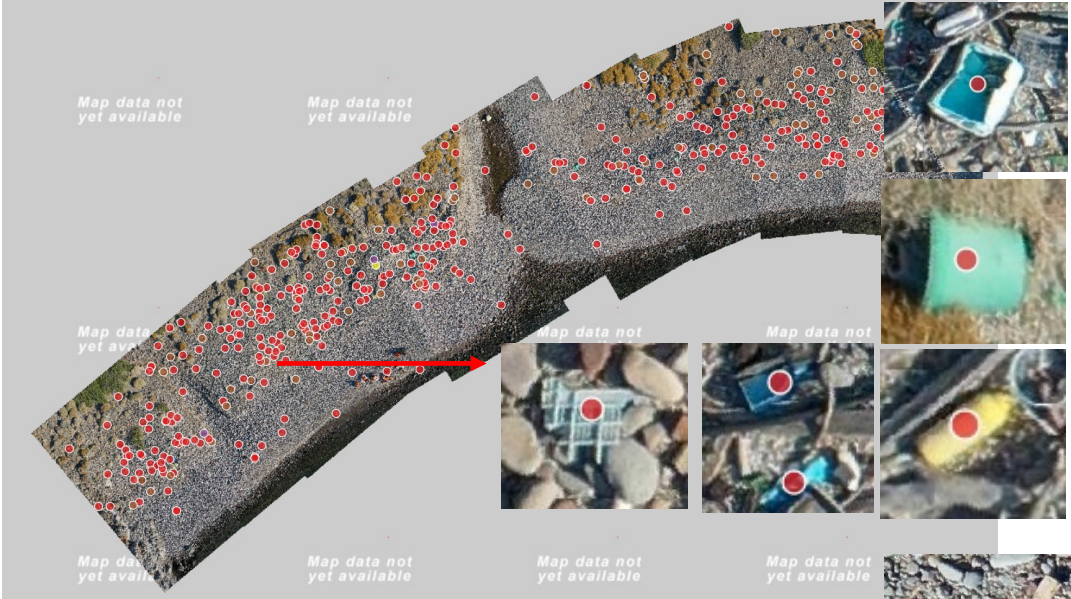
Example: Rinia Island, Greece

- Time series comparison
- (example of 8months difference)

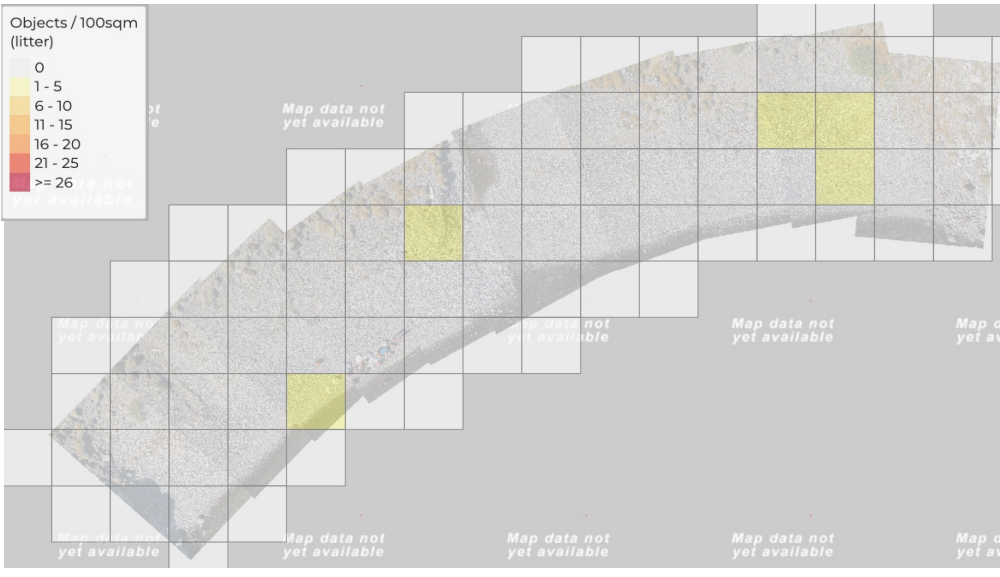
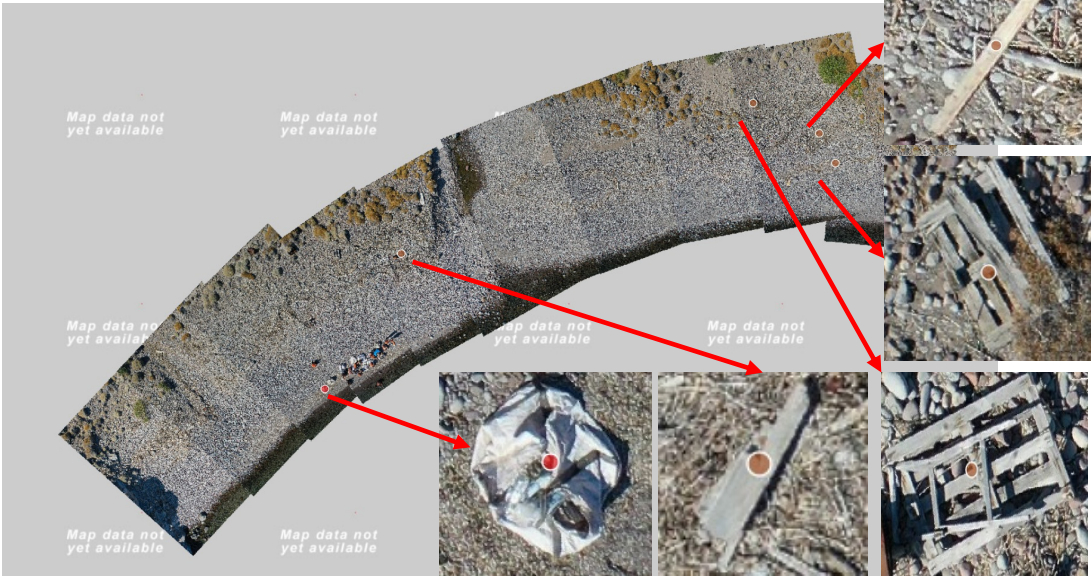


Example: Beach 21 - Lesvos – 11/09/2022

Before cleaning



After cleaning



Thank you



Costal Marine Litter Observatory (CMLO)

<https://cmlo.aegean.gr/>

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