

# NATURAL DISASTERS MANAGEMENT IN COASTAL AND MARINE ENVIRONMENTS

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Assistant Professor

5 November 2019



**MARINE  
REMOTE SENSING  
GROUP**  
<http://mrsg.aegean.gr/>

DEPARTMENT OF MARINE SCIENCES  
UNIVERSITY OF THE AEGEAN

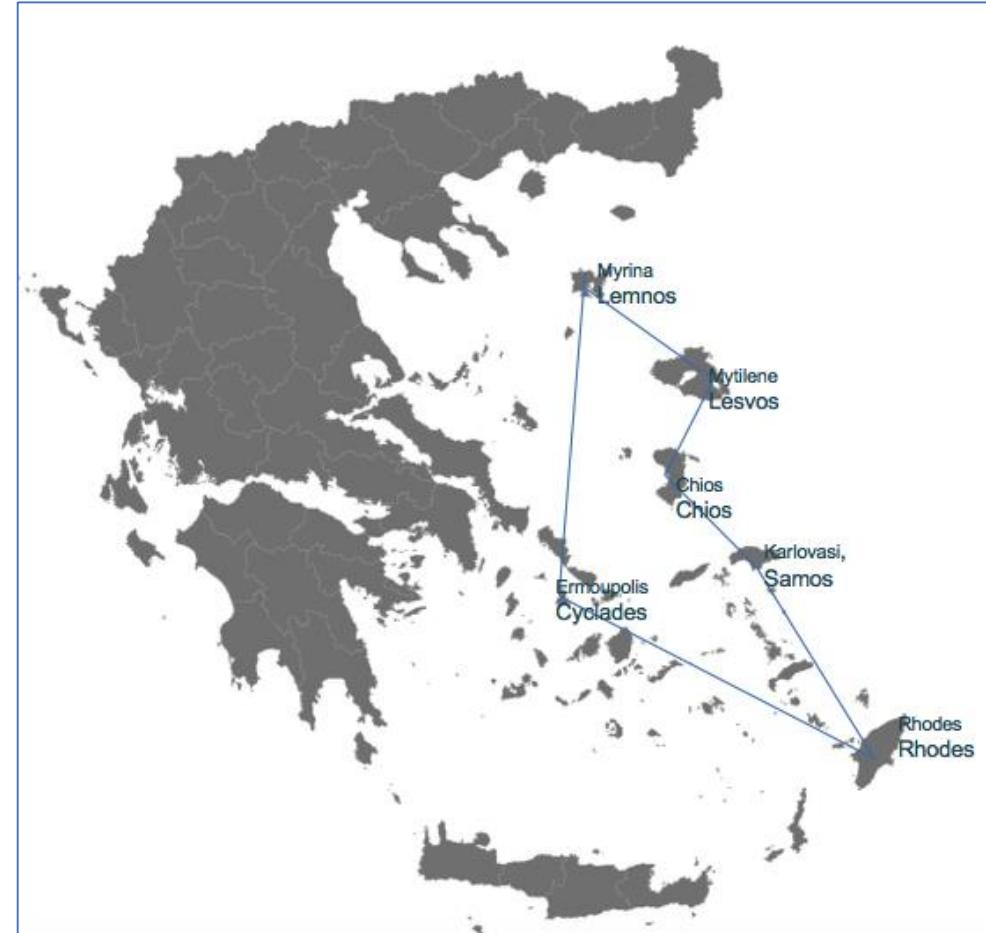


# University of the Aegean

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The University of the Aegean (UAegean) was founded in 1984 as a network University; it is spread in 6 campuses on six of the islands of the Aegean Archipelago.

UAegean offers 18 undergraduate (BA or BSc) and 28 postgraduate (MA or MSc) programmes



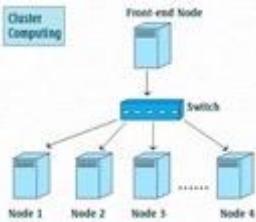
# Department of Marine Sciences

- Marine Environmental Quality
- Ecosystem Management and Sustainable Fisheries
- Oceanography and Coastal Applications



Mytilini,  
Lesvos Island

# Marine Remote Sensing Group (MRSG)



MARINE  
REMOTE SENSING  
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DEPARTMENT OF MARINE SCIENCES  
UNIVERSITY OF THE AEGEAN  
<http://mrsg.aegean.gr>



Multispectral  
Sentinel-2  
Sentinel-3

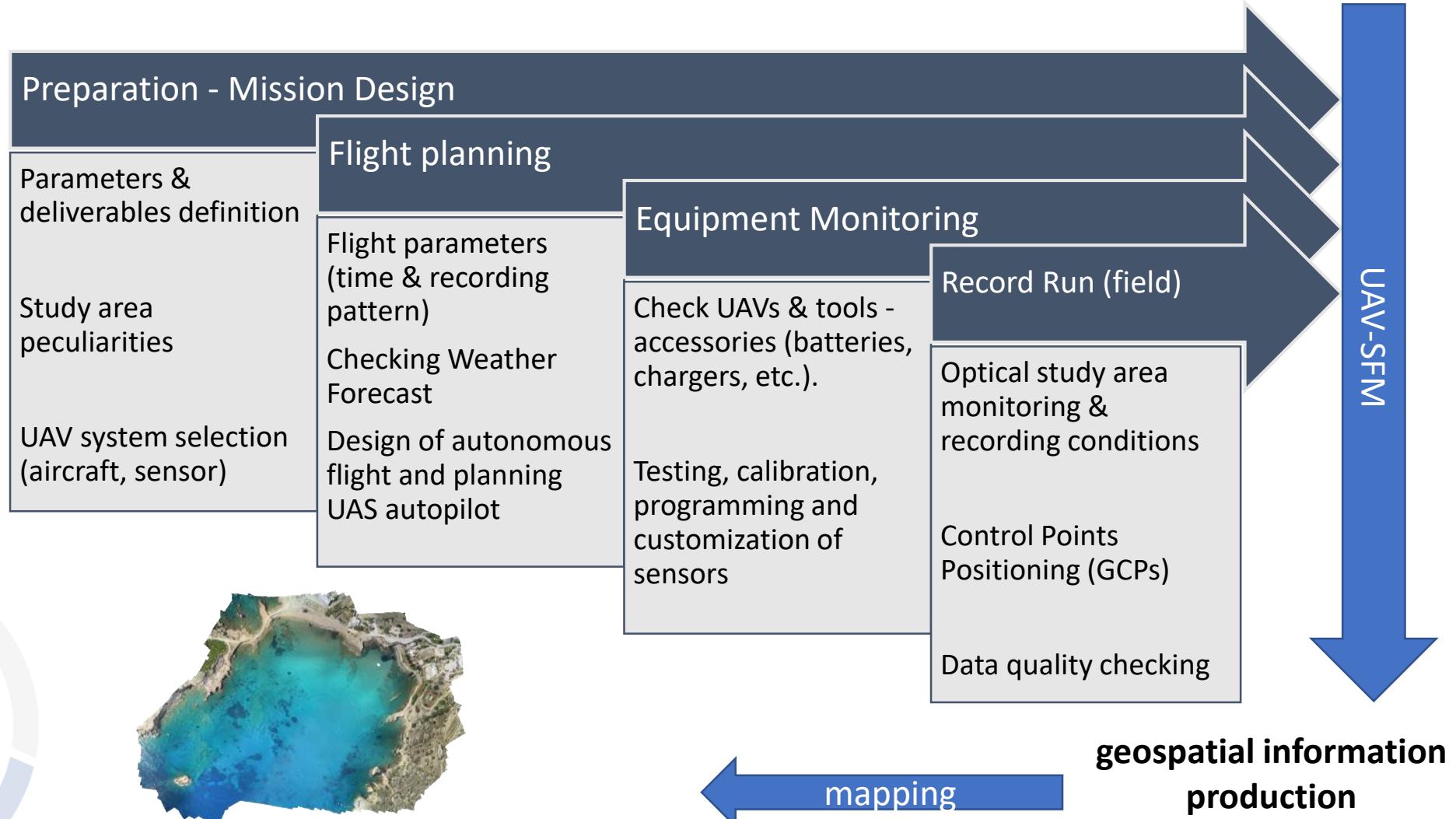


Agro Mapping



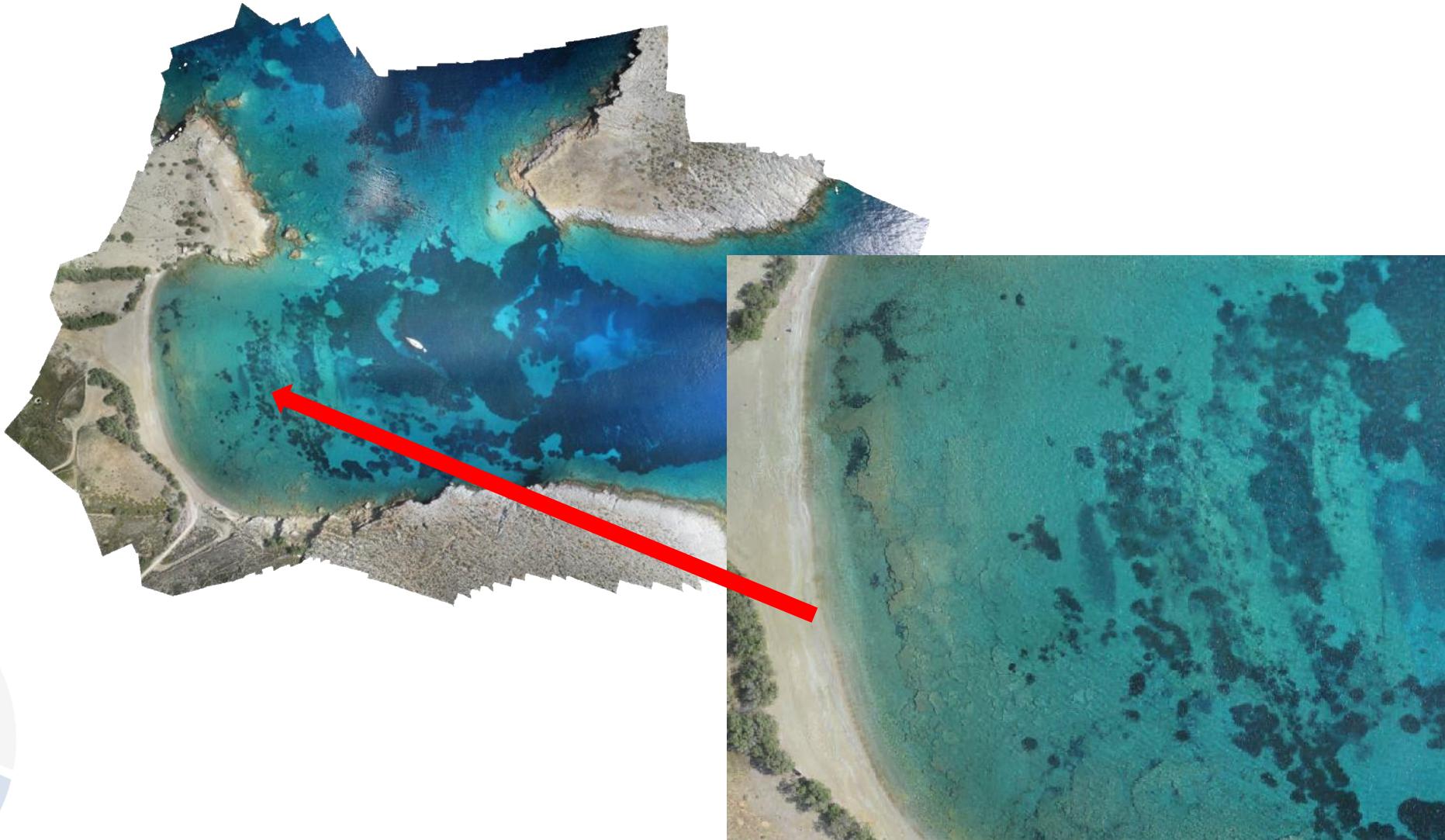
Hyperspectral

# Orthophoto Maps Creation



# Details of cm

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# Marine Remote Sensing Group (MRSG)

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## Thematic Areas

### **Oil spill detection**

- Synthetic Aperture Radar (SAR)
- Ocean mesoscale phenomena classification
- SAR preprocessing

### **Marine Litter Detection**

- UAV's for beach monitoring
- Water monitoring (UAV's, satellites)

### **UAV's for coastal management**

- Coastal mapping
- Morphology

### **Coastal habitant mapping**

- Seagrass in local, regional & country level
- Reefs, sand
- Marine spatial planning

### **Operational satellite oceanography**

- Chlorophyll, algae bloom
- TSM, SST



# Coastal habitant mapping

Research

# Seagrass mapping (processing levels)

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- Country scale

**30 m resolution**

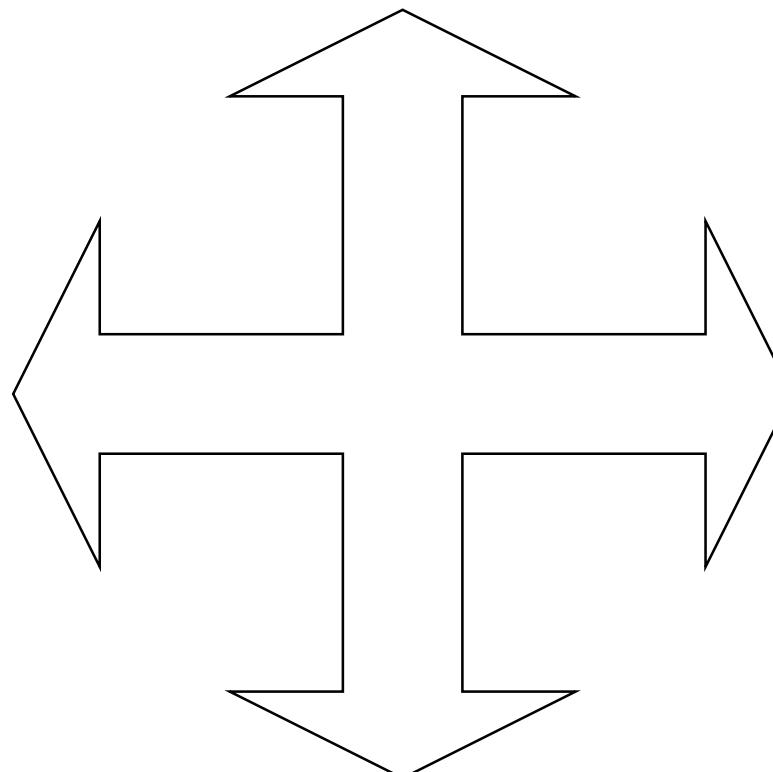
- Regional scale

**3 m resolution**

- Local area mapping

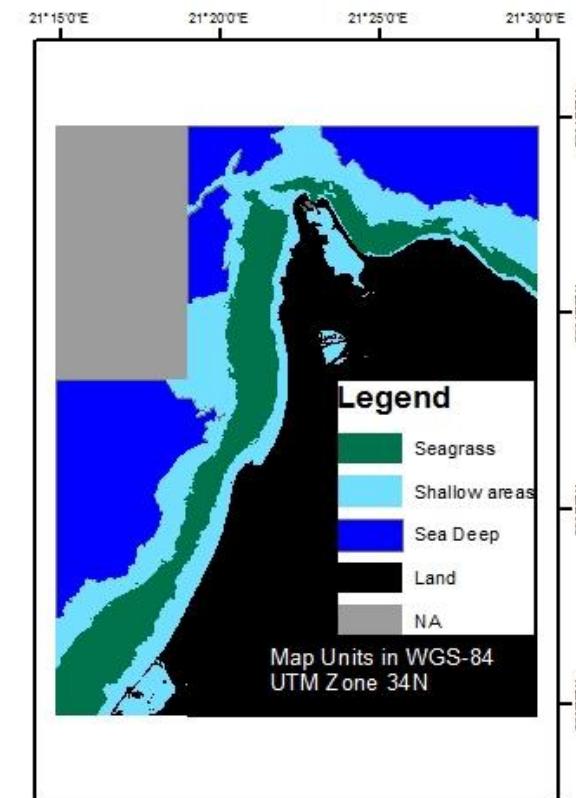
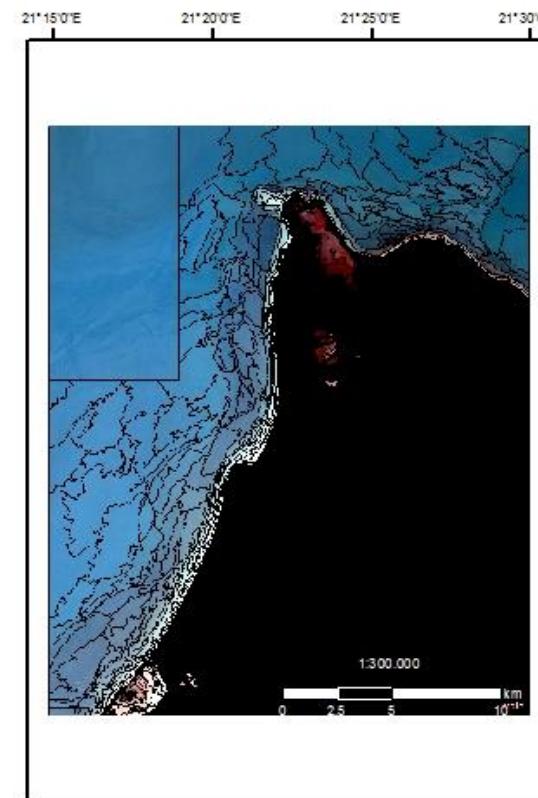
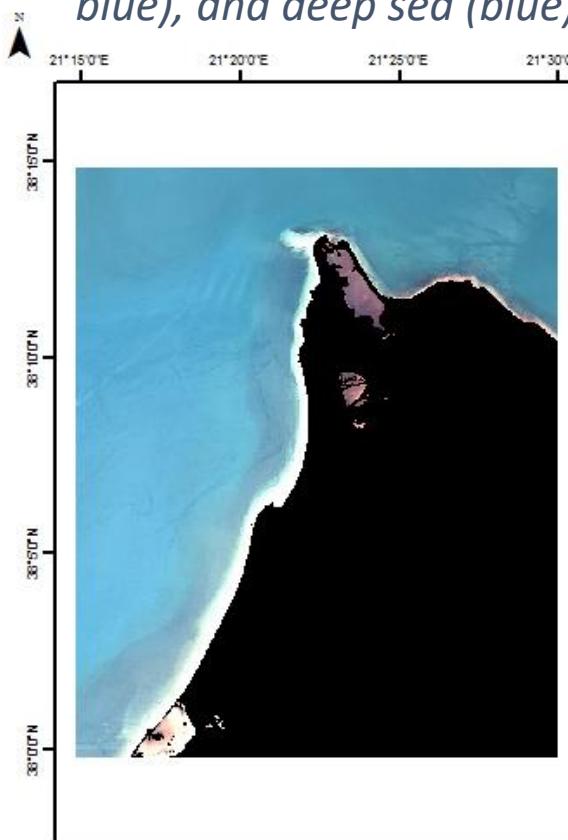
**0.03 m resolution**

- Ground truth



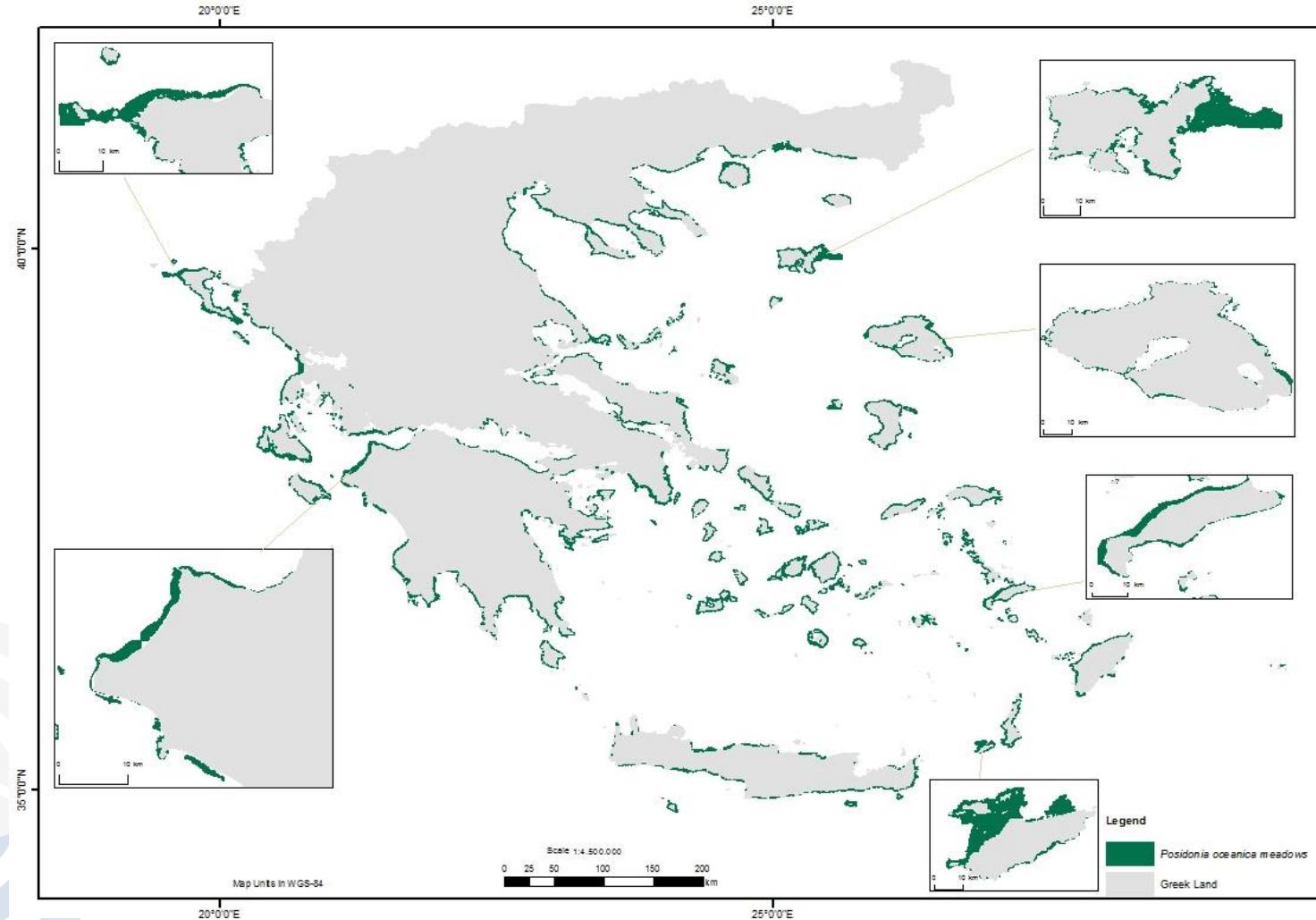
# Seagrass mapping

An example of the results. Right: image after preprocessing step. Middle: object-based image analysis. Left: classification of the object into seagrass (green), coastal areas (light blue), and deep sea (blue).



# Seagrass mapping

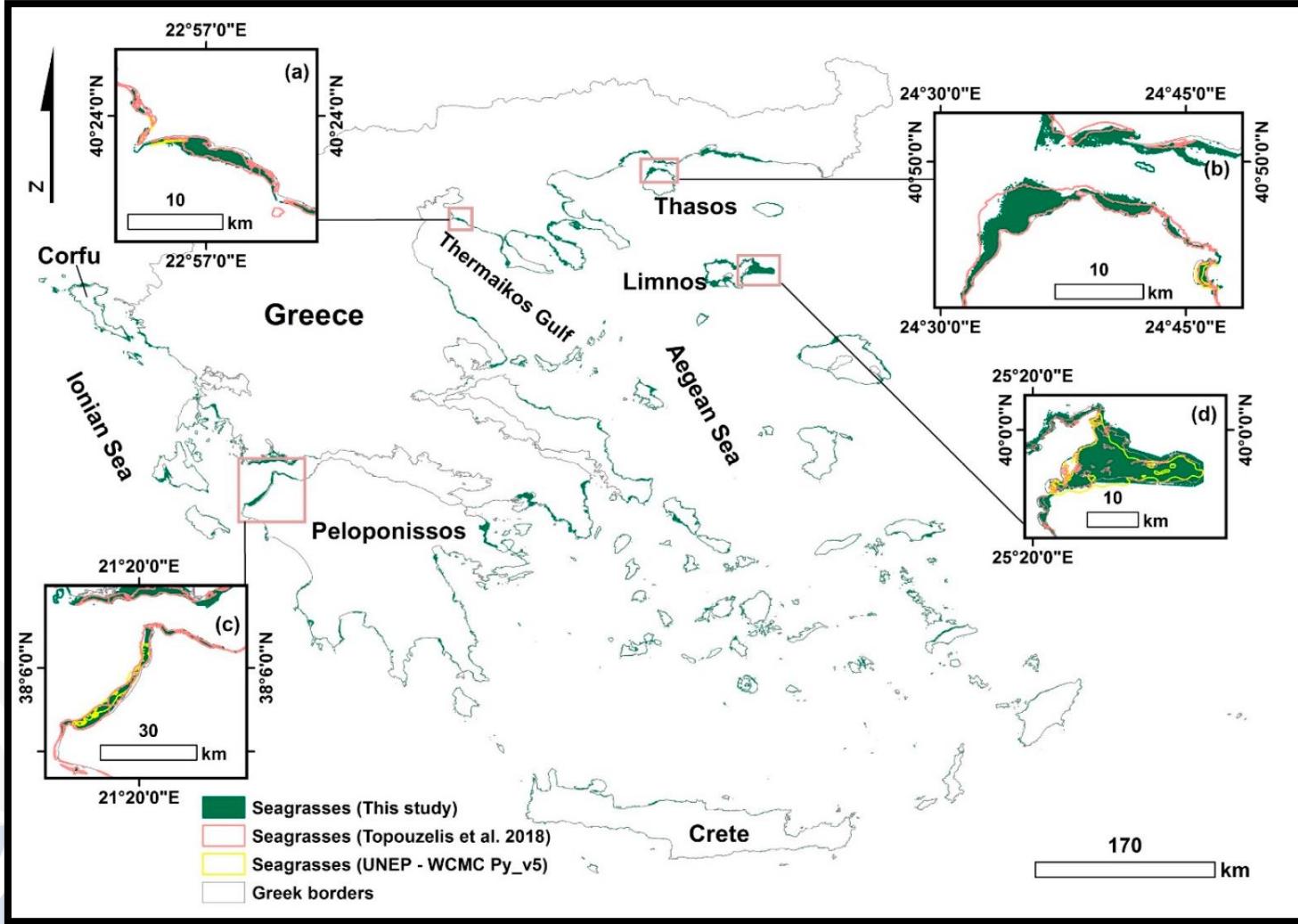
*Seagrass meadows detected in Greek territorial waters.*



**K. Topouzelis, D. Makri, N. Stoupas, A. Papakonstantinou, S. Katsanevakis (2018)**  
*Seagrass mapping in Greek territorial waters using Landsat-8 satellite images, International Journal of Applied Earth Observation & Geoinformation, 2018, v 67, Pages 98-113. DOI: [10.1016/j.jag.2017.12.013](https://doi.org/10.1016/j.jag.2017.12.013)*

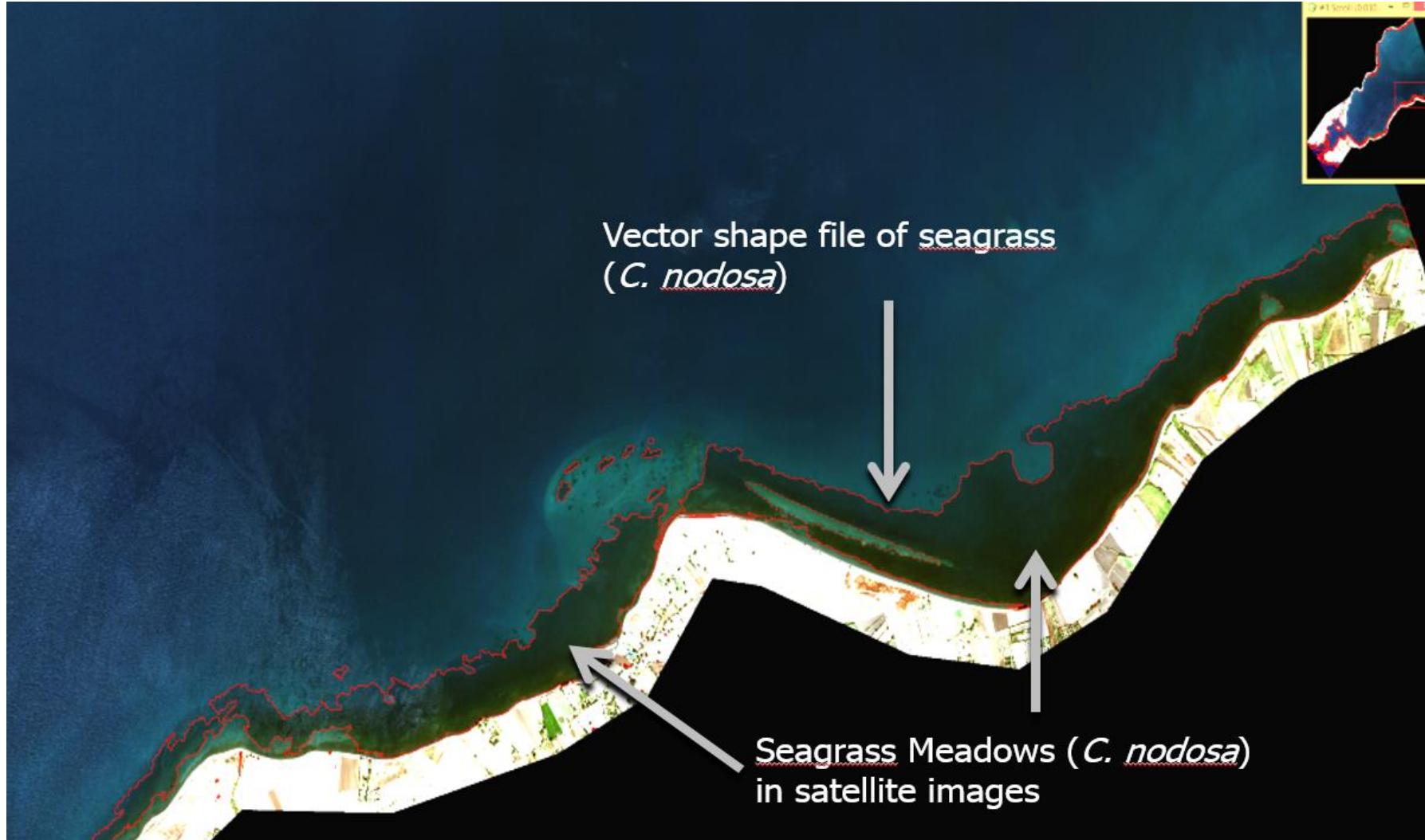
# Seagrass mapping

*Seagrass meadows detected in Greek territorial waters.*



Traganos, D., Aggarwal, B., Poursanidis, D., Topouzelis, K., Chrysoulakis, N., Reinartz, P. (2018). Towards Global-Scale Seagrass Mapping and Monitoring Using Sentinel-2 on Google Earth Engine: The Case Study of the Aegean and Ionian Seas. *Remote Sens.* 2018, Vol. 10, Page 1227 10, 1227. DOI: [10.3390/RS10081227](https://doi.org/10.3390/RS10081227)

# Seagrass mapping (fine resolution)



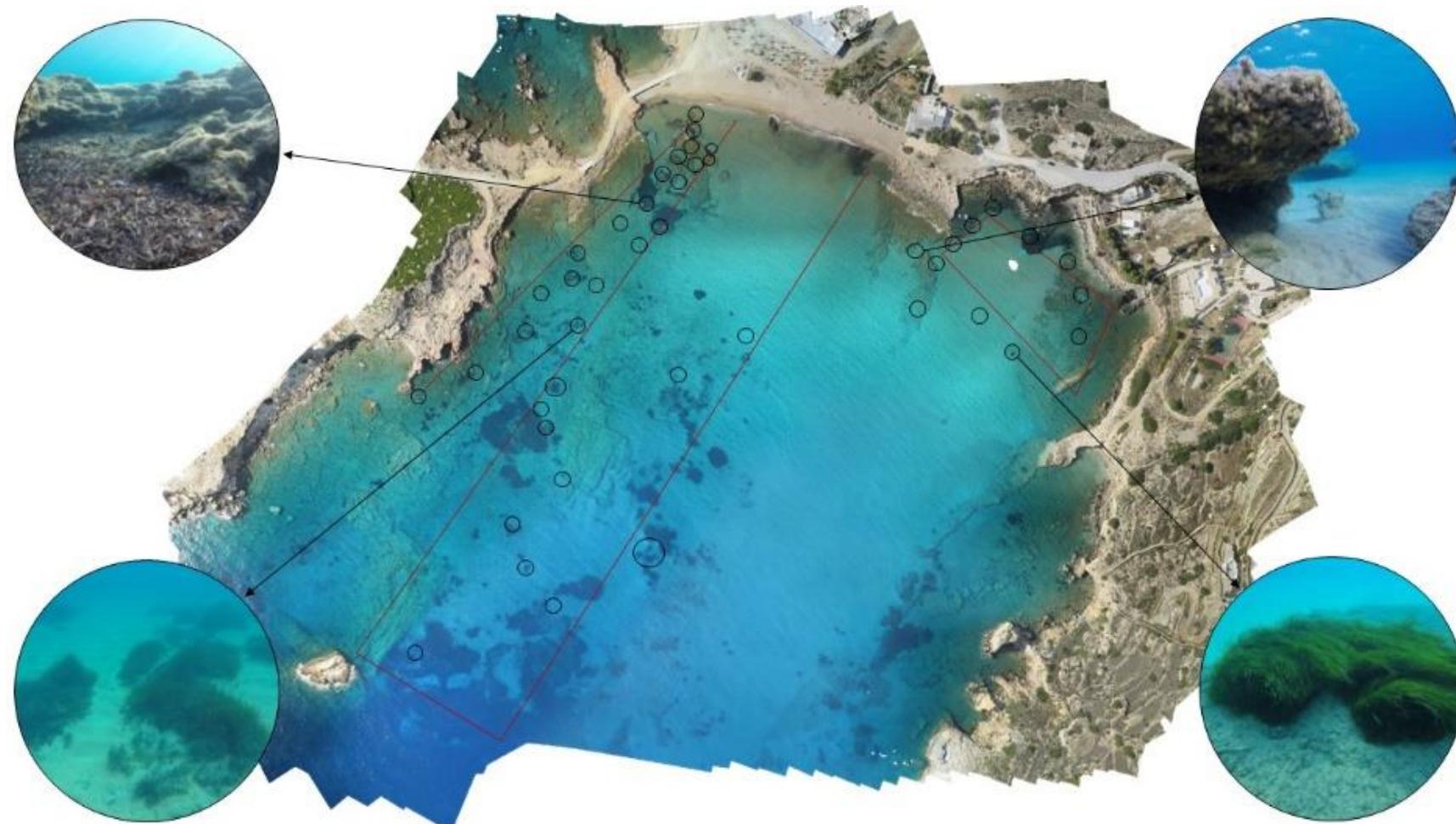
# Ground truth (underwater images)

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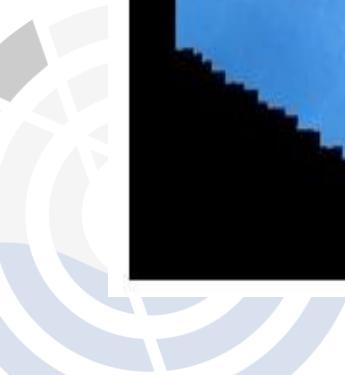
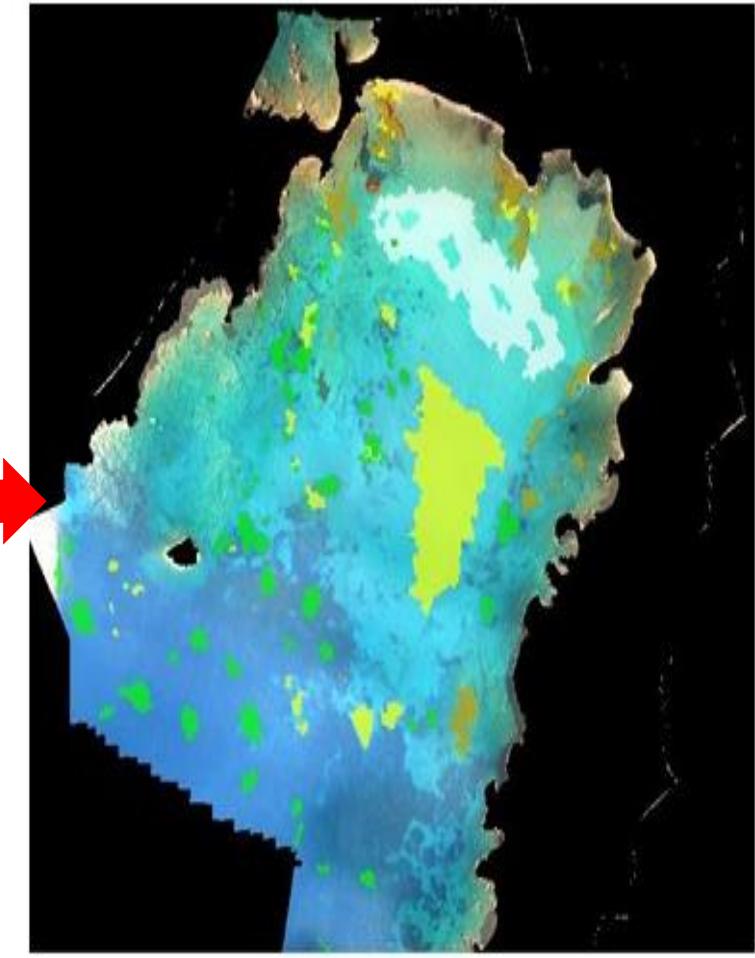
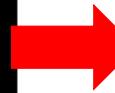
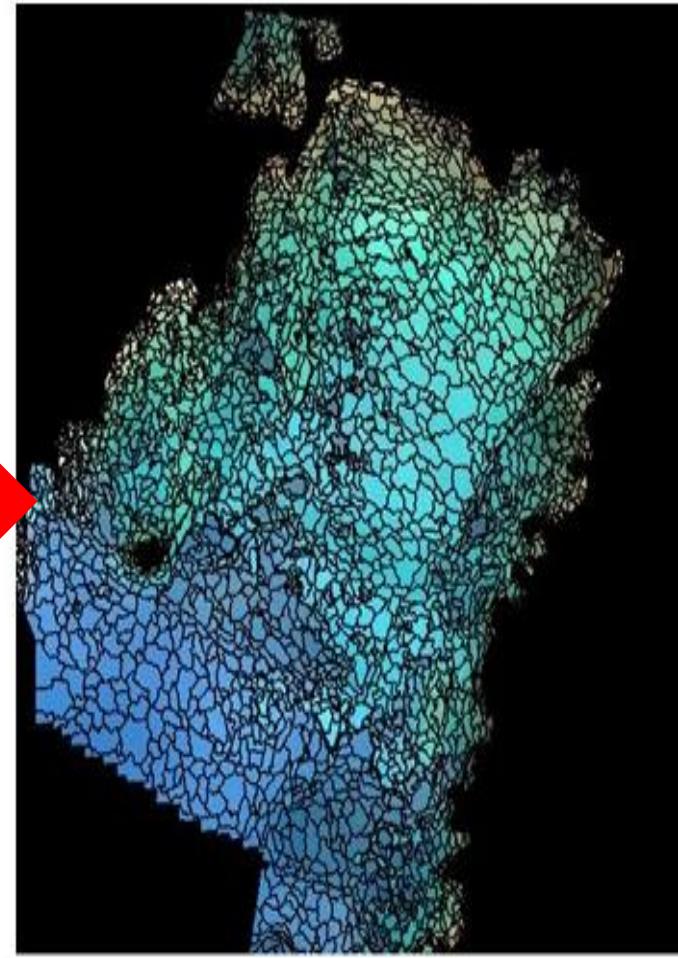
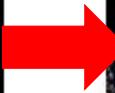
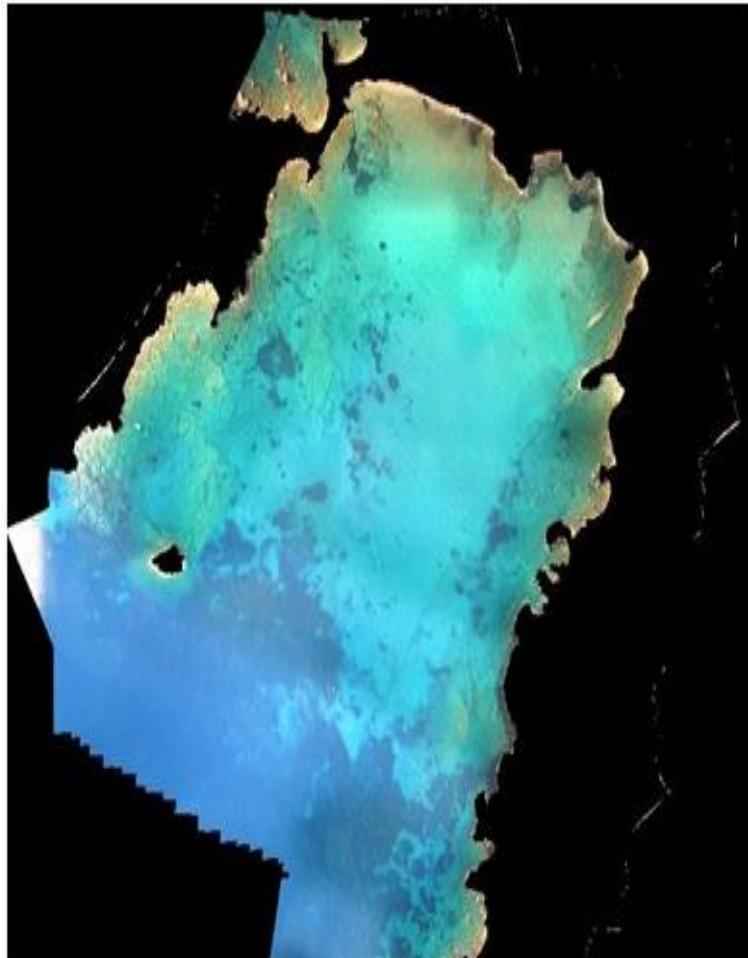
# Koubara beach, Ios, Greece

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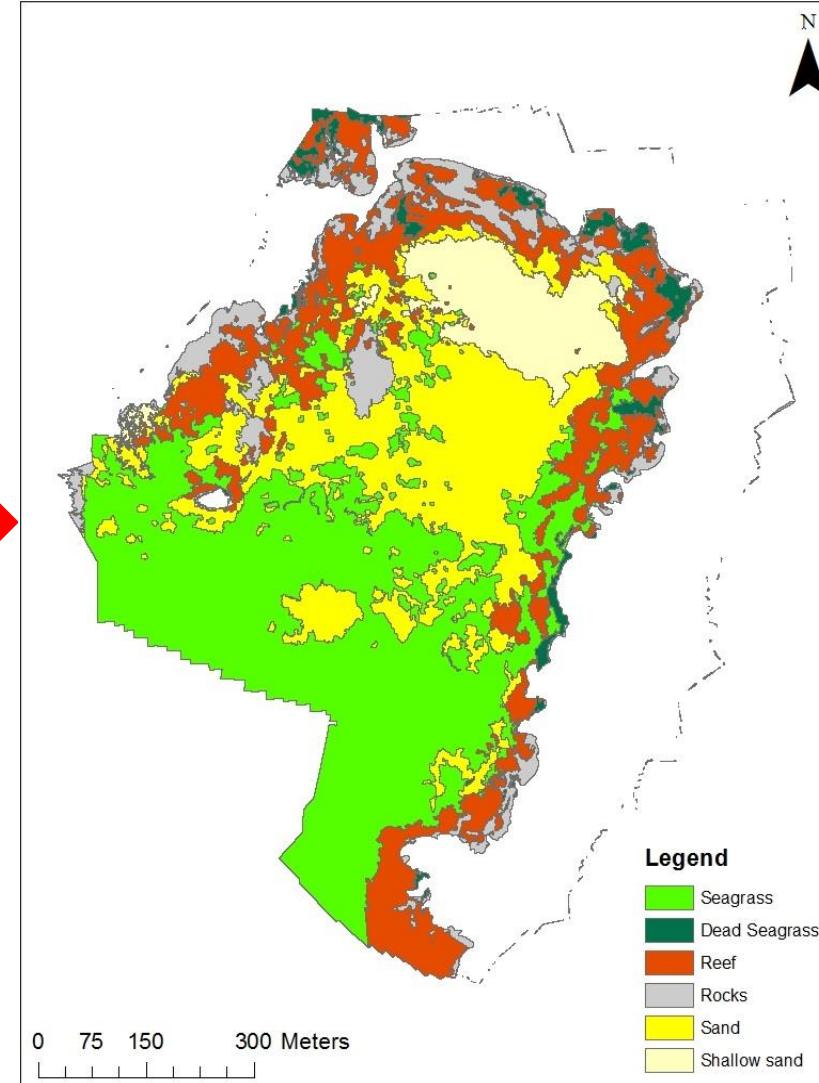
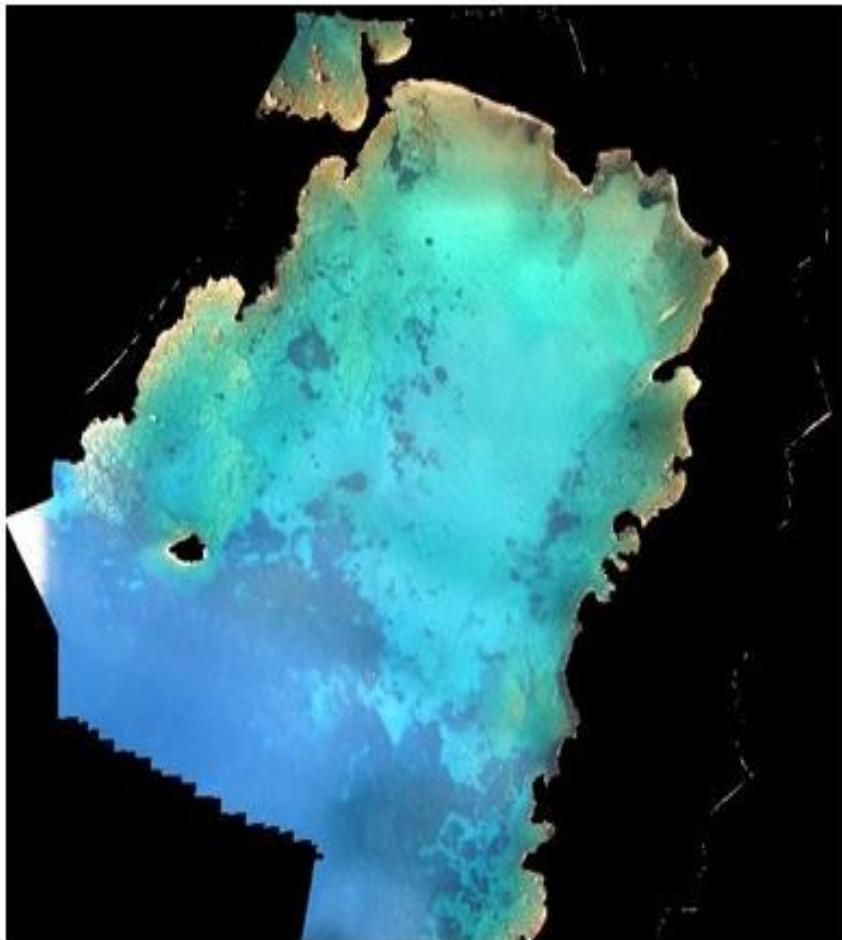


# GEOBIA

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# Results



# Accuracy assessment

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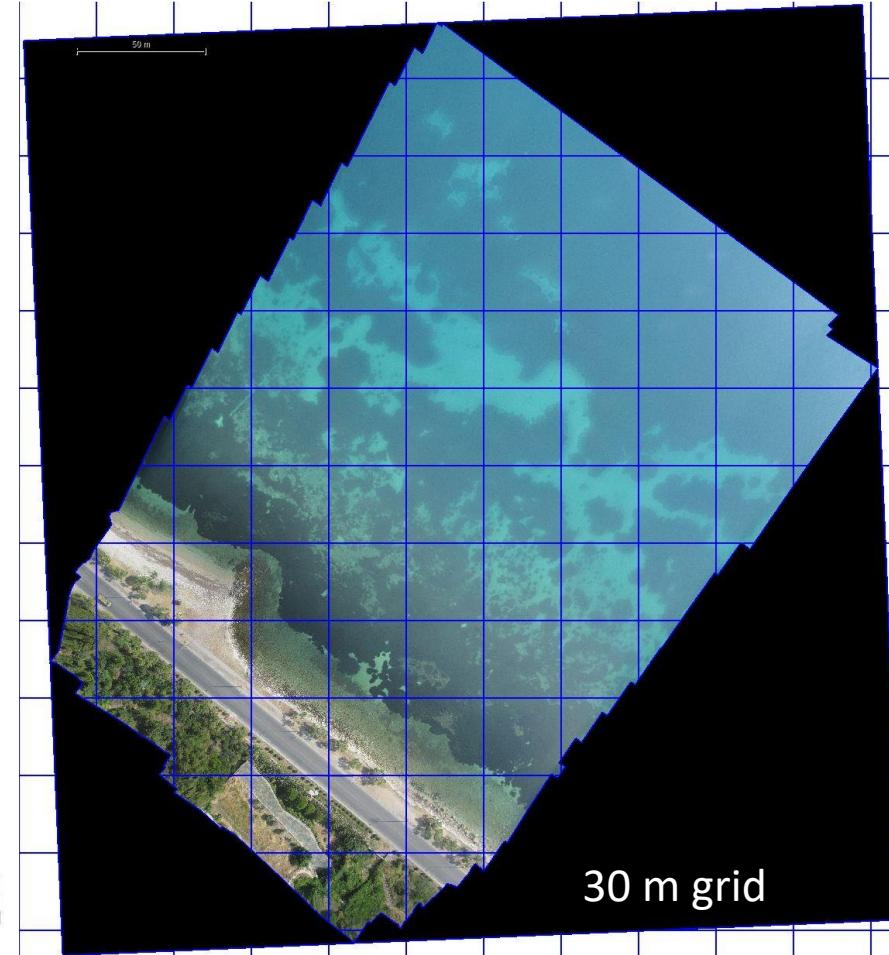
## Confusion Matrix

User/ Reference Class	Dead seagrass	Seagrass	Reef	Rocks	Sand	Shallow sand	Sum	User's Accuracy (%)
Unclassified	0	0	0	0	0	0	0	0
Dead seagrass	6703	0	0	151	0	0	6854	97,80
Seagrass	0	9453	0	0	0	0	9453	100
Reef	0	529	10916	3826	0	0	15271	71,48
Stones	0	0	2224	5770	0	0	7994	72,18
Sand	0	0	1460	2485	14980	0	18925	79,15
Shallow sand	0	0	0	114	5004	19809	24927	79,47
<b>Sum</b>	<b>6703</b>	<b>9982</b>	<b>14600</b>	<b>12346</b>	<b>19984</b>	<b>19809</b>	<b>83424</b>	
Producer's Accuracy (%)	100	94,7	74,8	46,7	75,0	100		81,07

K coefficient =0,765

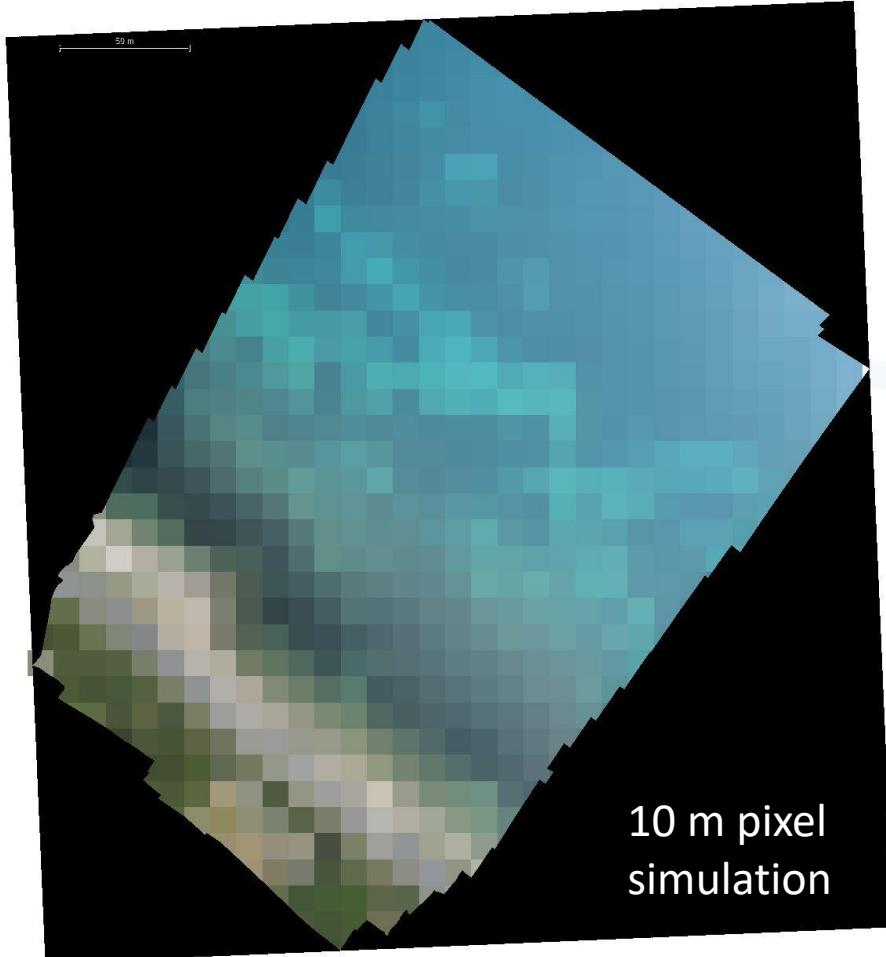
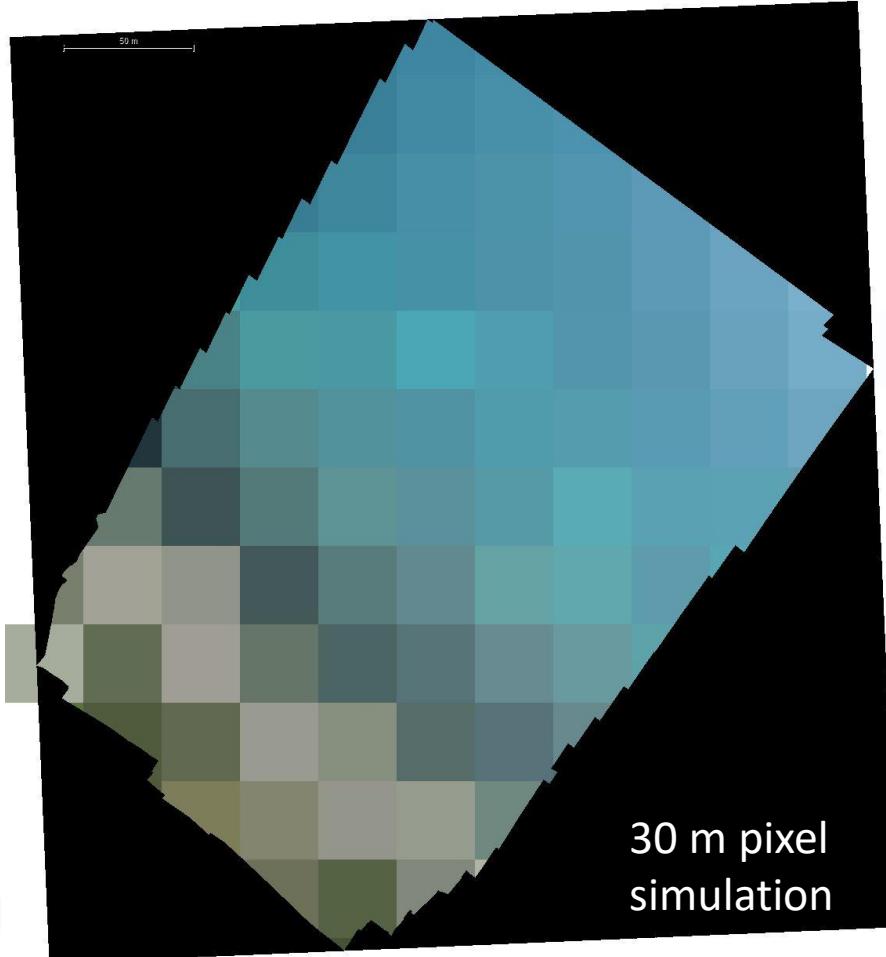
# Seagrass mapping (ground truth)

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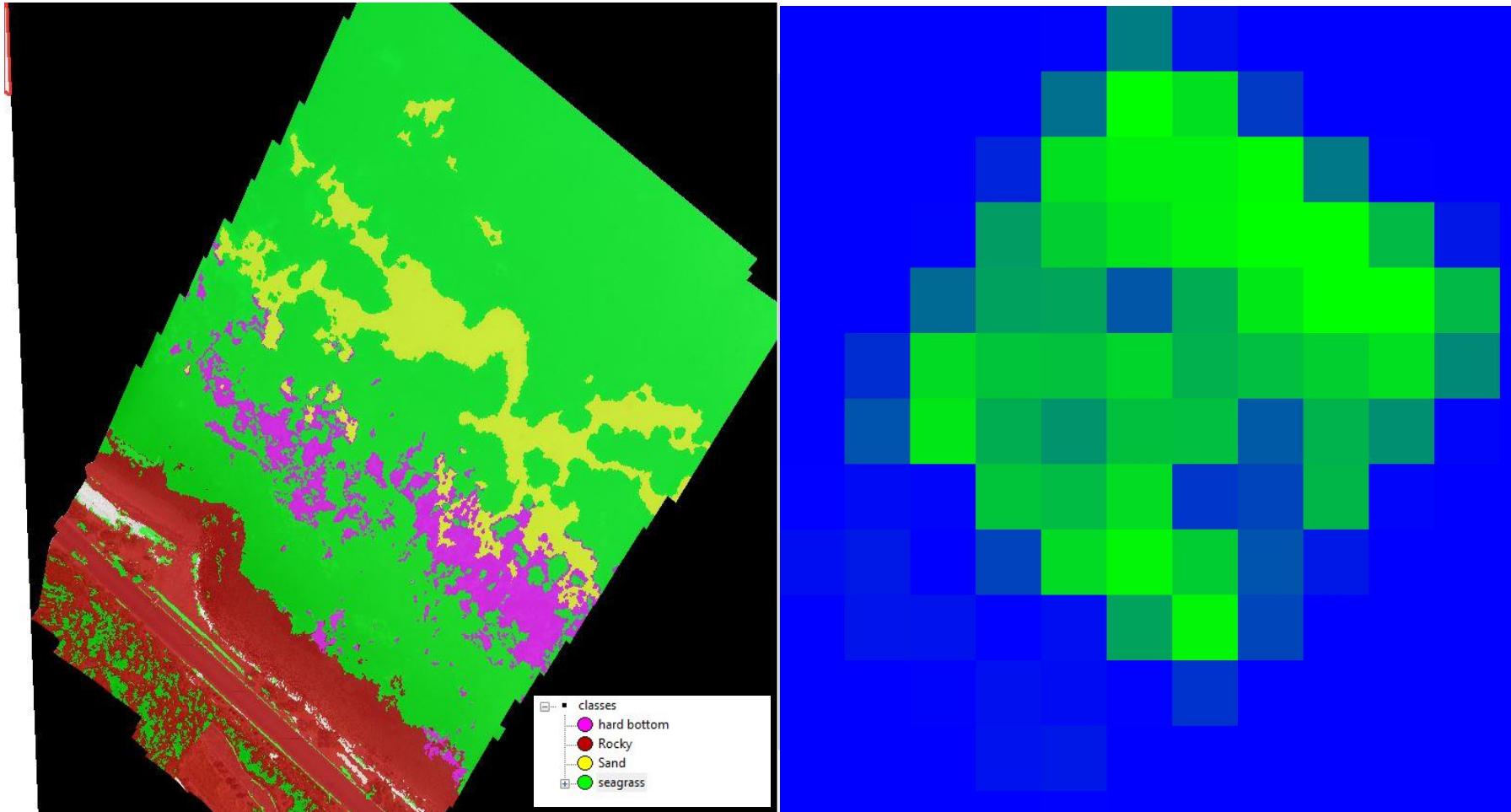


# Seagrass mapping (ground truth)

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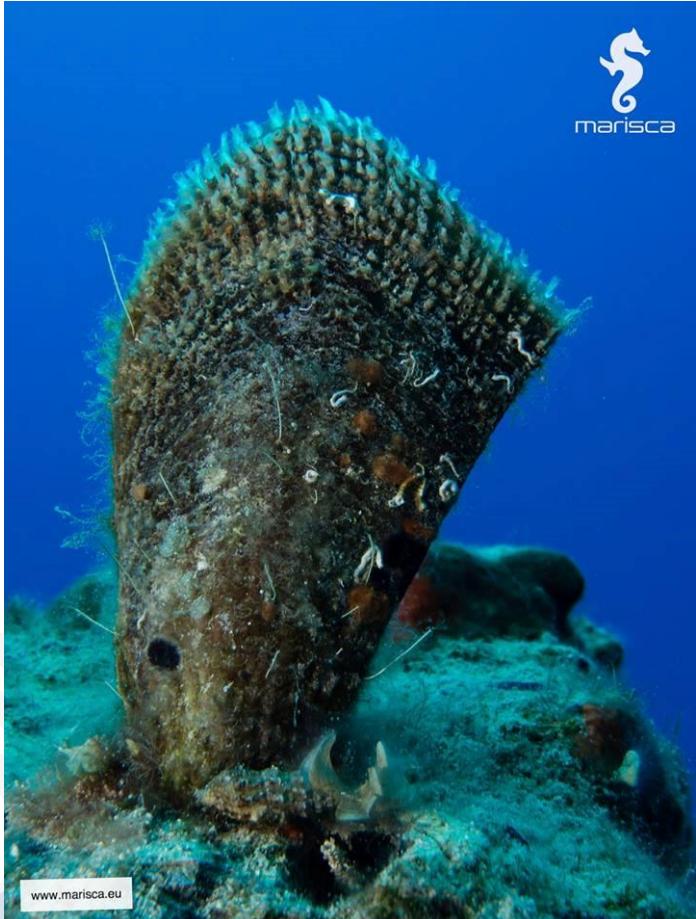
# Seagrass mapping (ground truth)



# Disaster assessment and management

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## Mass mortality of *Pinna nobilis* in Lesvos



parasite *Haplosporidium pinnae*

# Disaster assessment and management

Mediterranean Marine Science

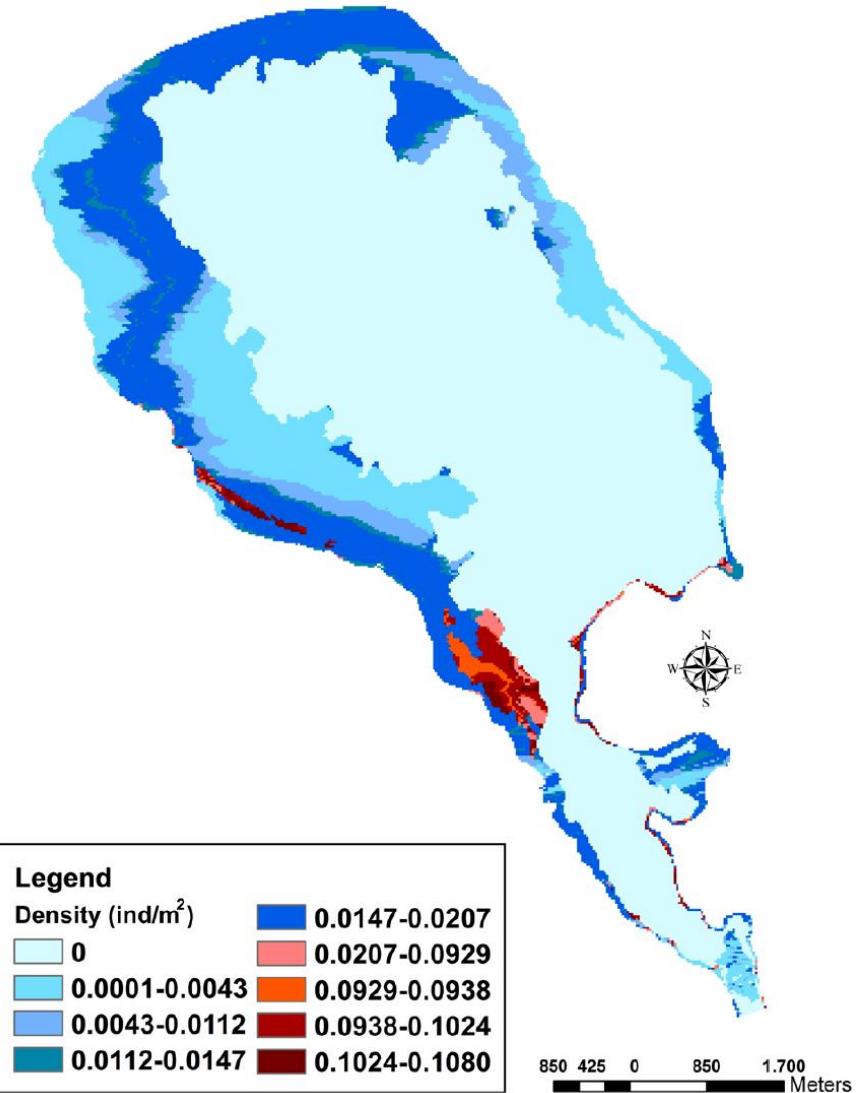
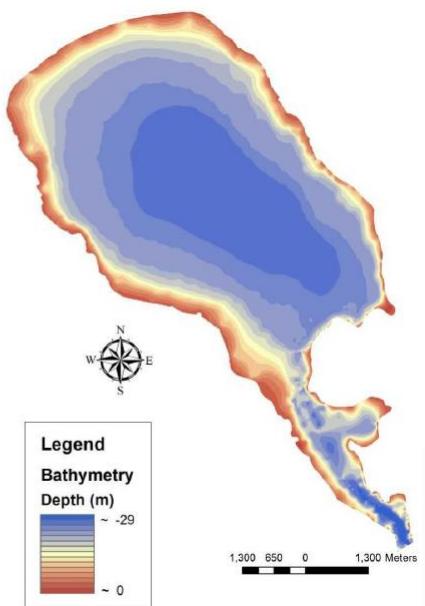
Indexed in WoS (Web of Science, ISI Thomson) and SCOPUS  
The journal is available online at <http://www.medit-mar-sc.net>  
DOI: <http://dx.doi.org/10.12681/mms.14156>

Research Article

## Spatial distribution, abundance and habitat use of the endemic Mediterranean fan mussel *Pinna nobilis* in Gera Gulf, Lesvos (Greece): comparison of design-based and model-based approaches

ALEXANDROS TSATIRIS, VASILEIOS PAPADOPoulos, DESPINA MAKRI,  
KONSTANTINOS TOPOUZELIS, EVA MANOUTSOGLOU, THOMAS HASIOTIS  
and STELIOS KATSANEVAKIS

Department of Marine Sciences, University of the Aegean, 81100 Mytilene, Greece

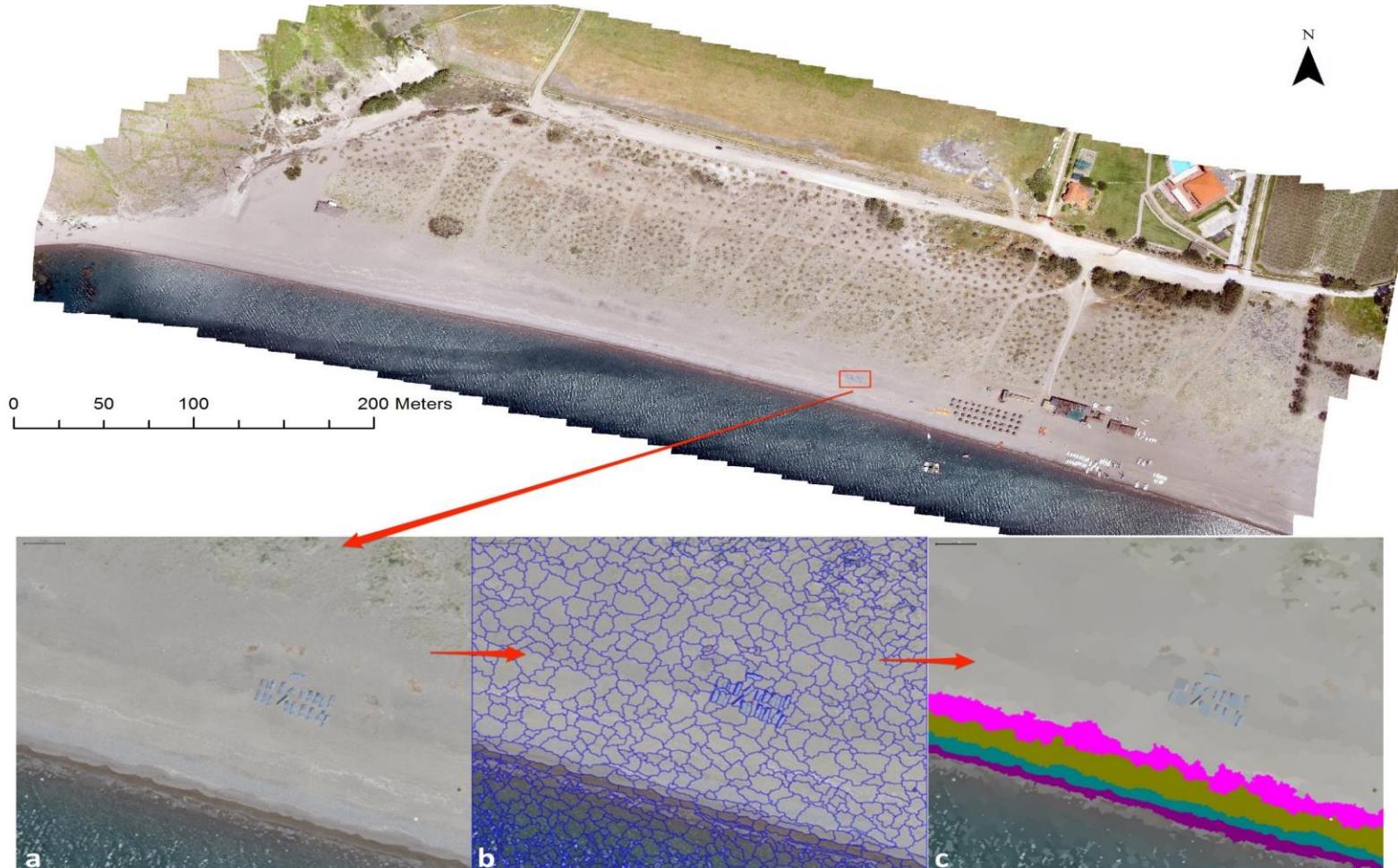
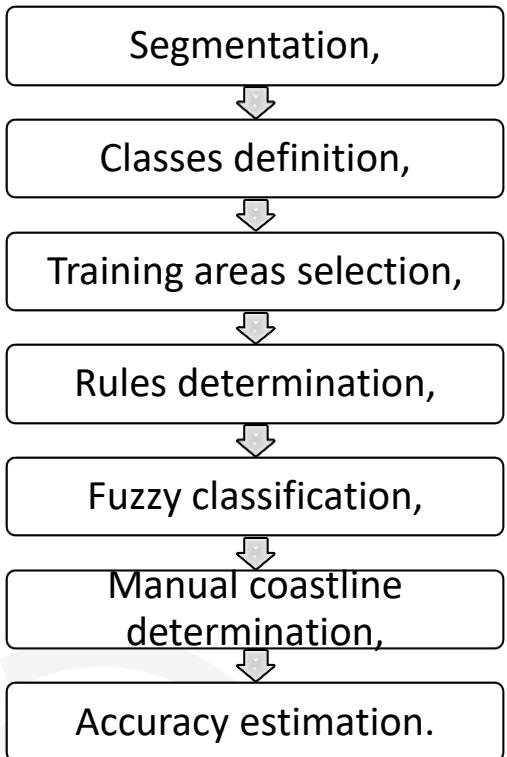




# UAS's for coastal management

Research

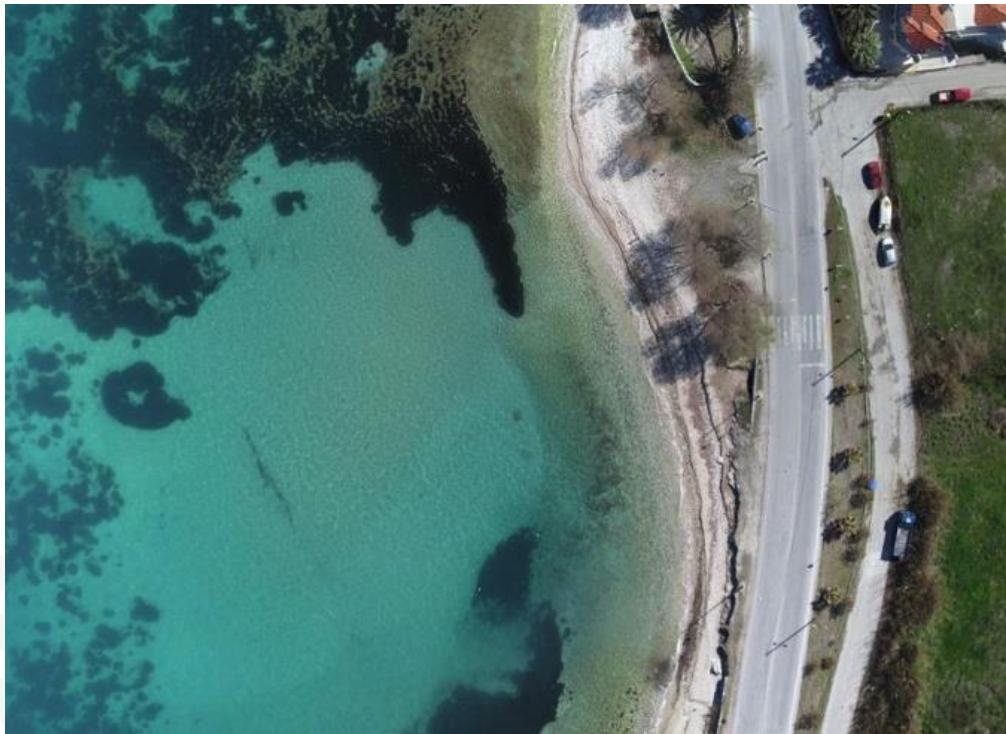
# Monitoring Coastal Morphology



# Monitoring Coastal Morphology

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The generated orthophoto from the Neapolis study site has a spatial resolution of 3 cm



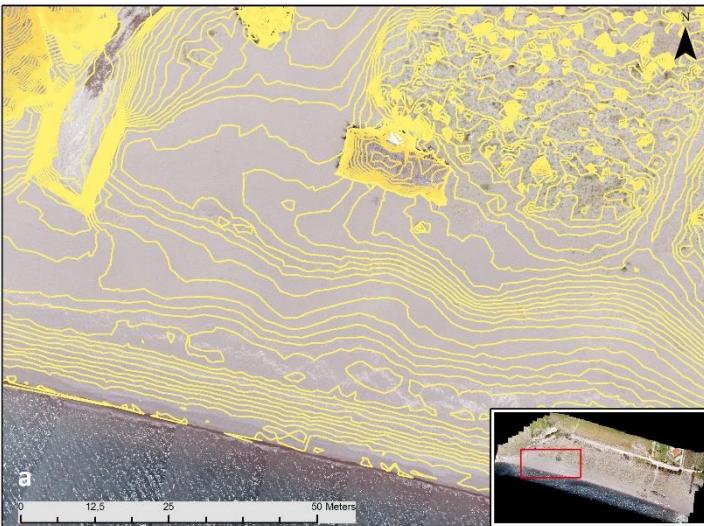
Swash zone, wrack lines, and berm zone are illustrated in 3D.

2D & 3D visualization  
of Neapoli Istoriko Beach



3D visualisations clearly show the structure of coastal zone.

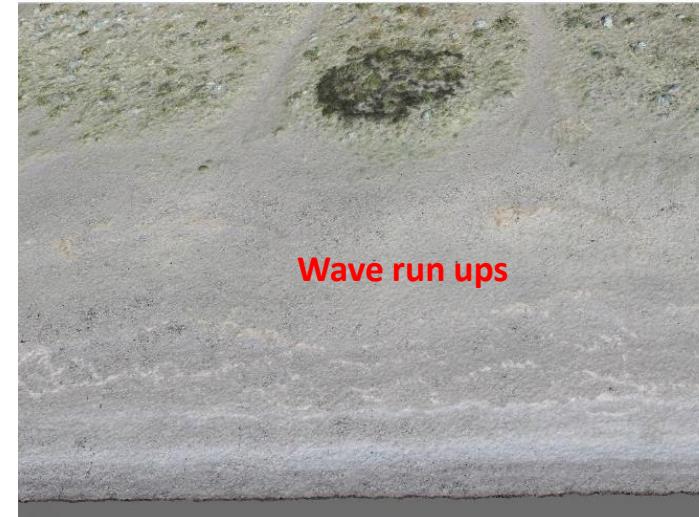
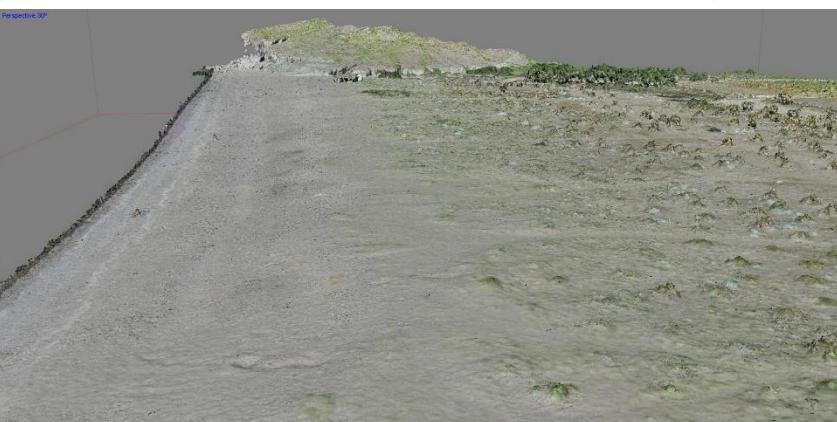
# 2&3D visualization



The generated orthophoto for Eressos study has a spatial resolution of 3 cm

Orthophoto maps  
50 cm and 1 m  
Isolines

Digital Surface  
model

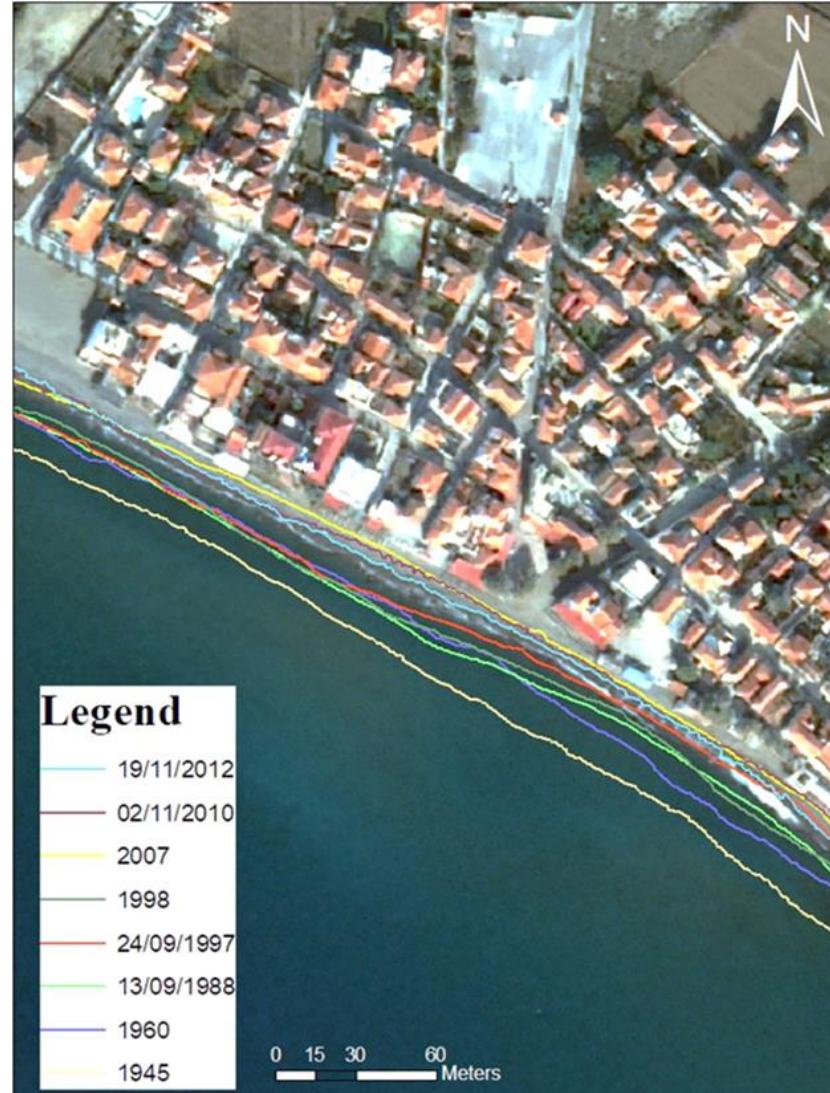
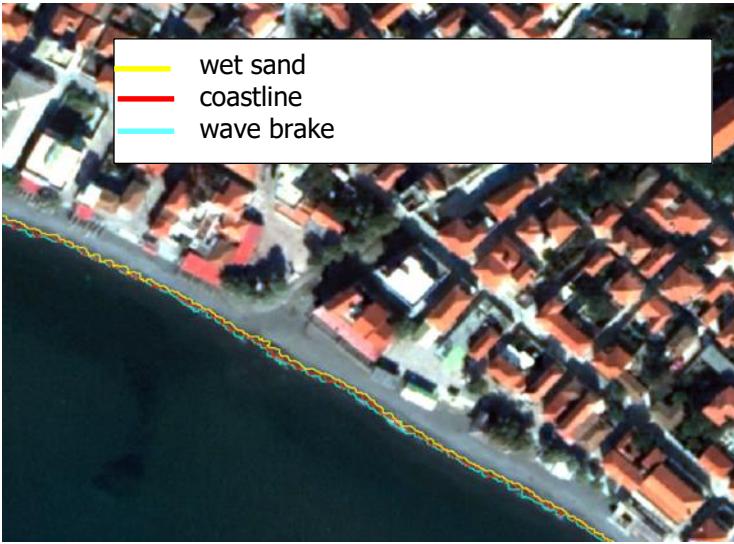


# Monitoring Coastline change detection

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# Lesvos Island (Eressos beach)



## Santorini (Kamari Beach)

date	Satellite	Spatial resolution multi spectral (m)	Spatial resolution panchromatic (m)	No of bands	Pansharpening
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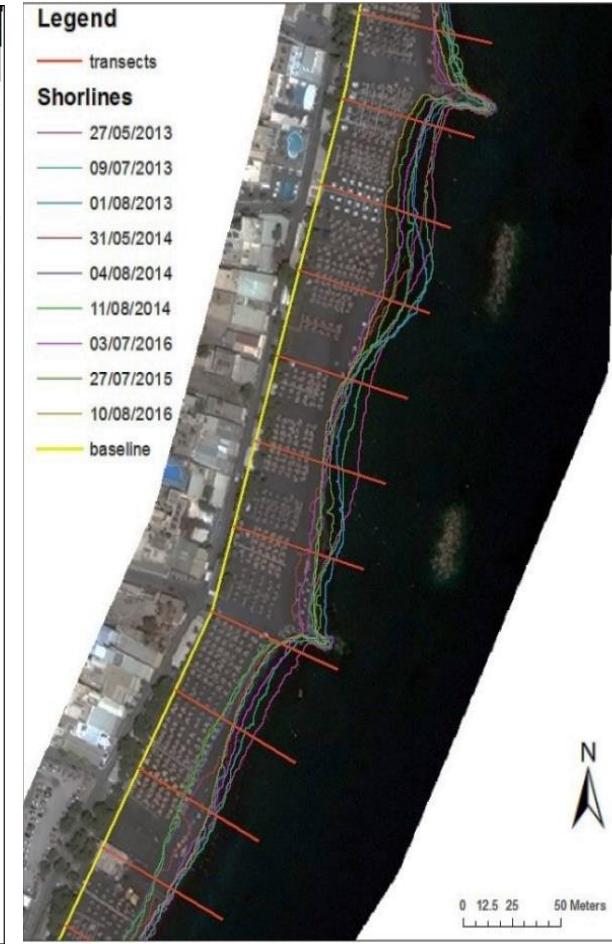
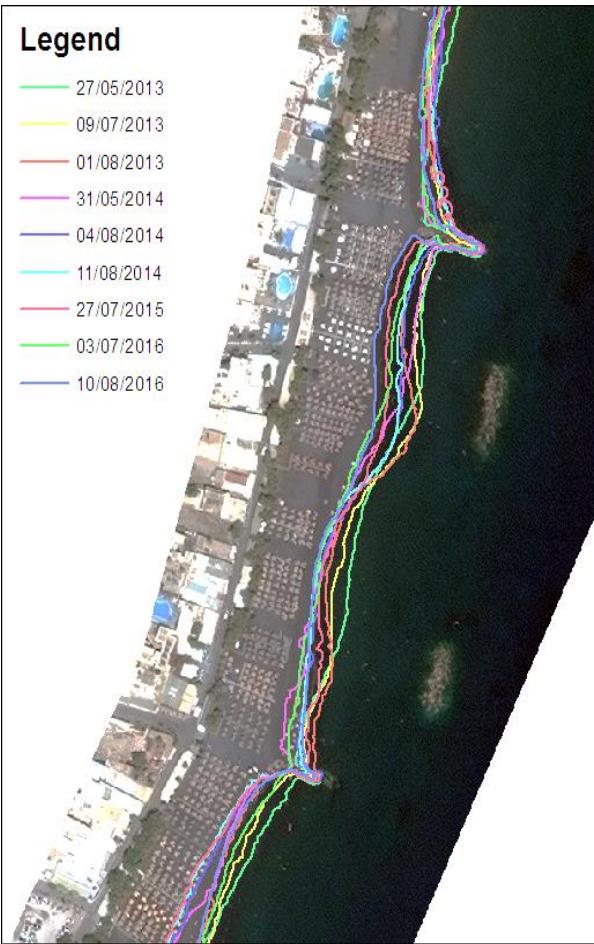
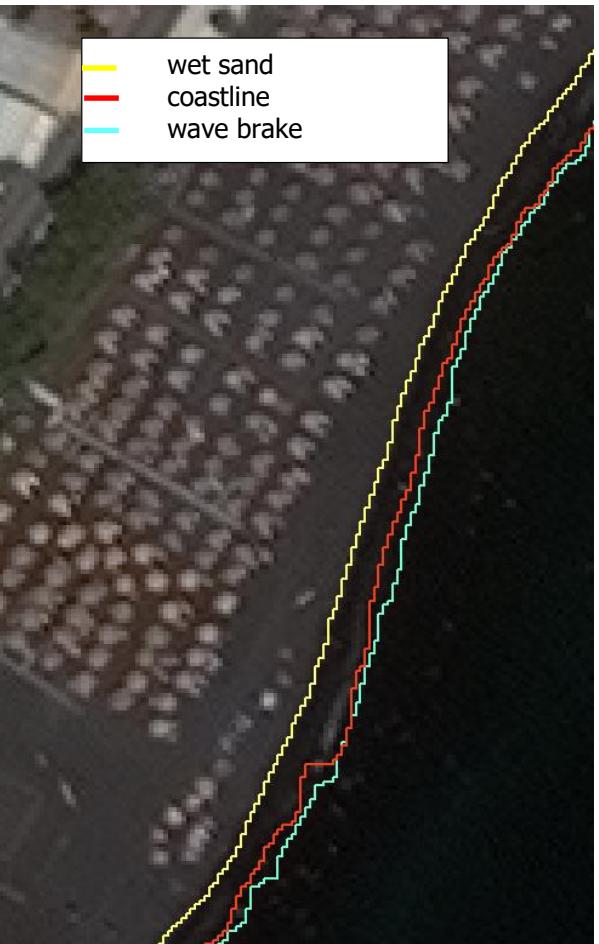
07/08/2012	GEOEYE-1	1.65	0.5	4 bands	
27/05/2013	GEOEYE-1	1.65	0.5	4 bands	
09/07/2013	WORLDVIEW-1		0.5		
01/08/2013	GEOEYE-1	1.65	0.5	4 bands	
31/05/2014	Pleiades	2	0.5	4 bands	✓
04/08/2014	WORLDVIEW-2	2	0.5	4 bands	✓
11/08/2014	WORLDVIEW-2	2	0.5	4 bands	
27/07/2015	WORLDVIEW-2	2	0.5	8 bands	✓
03/07/2016	WORLDVIEW-2	2	0.5	4 bands	
10/08/2016	WORLDVIEW-2	2	0.5	4 bands	

date	bands	Zone 1	Zone 2	Water presence	Index
07-08-12					NDWI
27-05-13	Green, Nir	0.42	0.45	0.53	NDWI
09-07-13	Panchromatic		0.34		THRESHOLDING
01-08-13	Green, Nir	0.43		0.5	NDWI
31-05-14	Green, Nir	0.39	0.43	0.5	NDWI
04-08-14	Green, Nir	0.42	0.46	0.55	NDWI
11-08-14	Green, Nir	0.45		0.48	NDWI
27-07-15	Costal, Nir	0.64	0.72	0.78	WV-WI
03-07-16	Green, Nir	0.45	0.5	0.55	NDWI
10-08-16	Green, Nir	0.25	0.3	0.4	NDWI

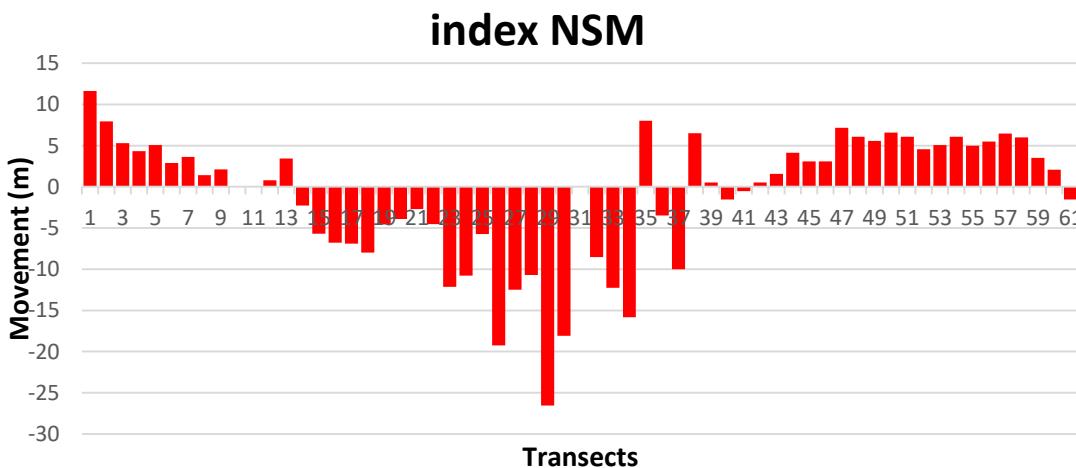
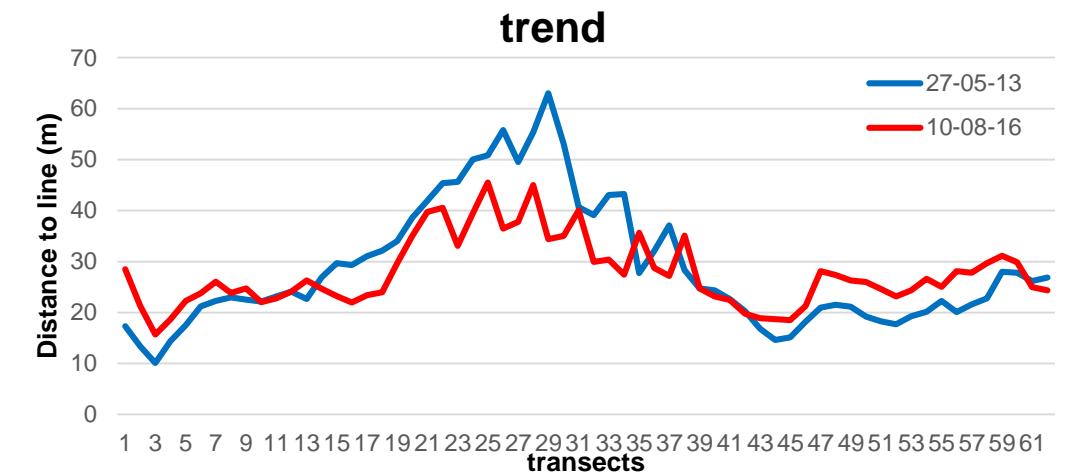
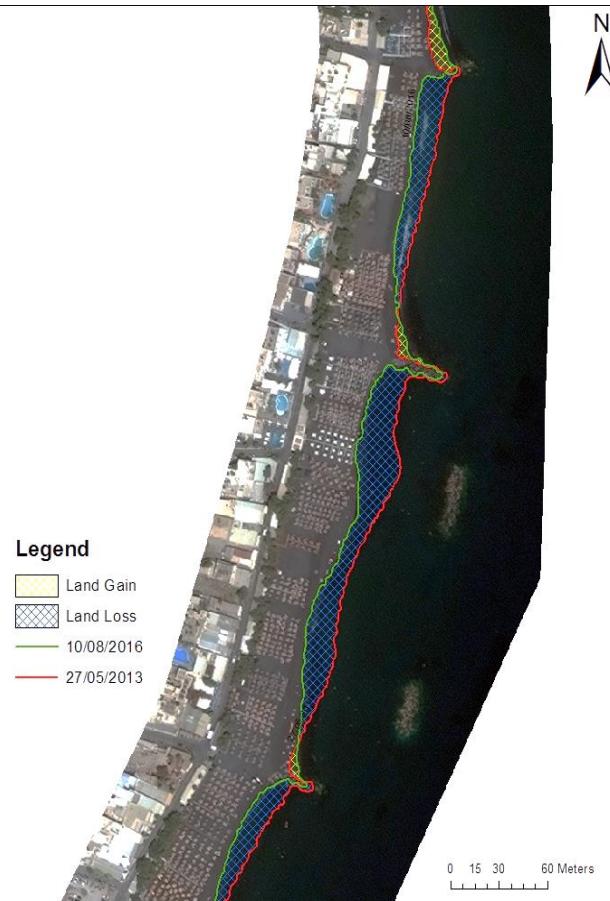


Εικόνα GEOEYE-1 (27/05/2013) Santorini

## Santorini (Kamari Beach)



## Santorini (Kamari Beach)





# Marine Litter Detection

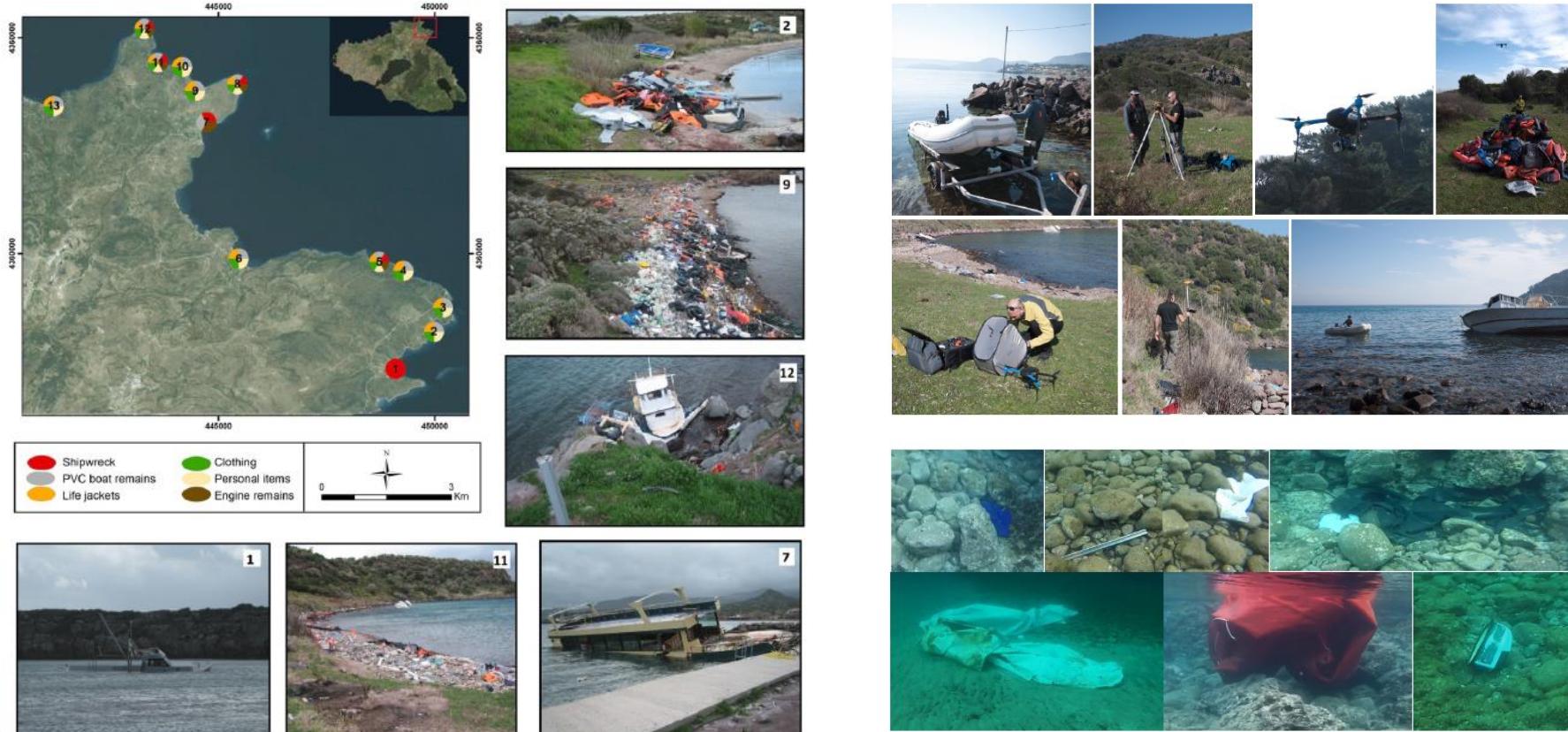
Research

# Costal marine litter detection

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# Costal marine litter detection



*Preliminary study on the emerging marine litter problem along the eastern coast of Lesbos*

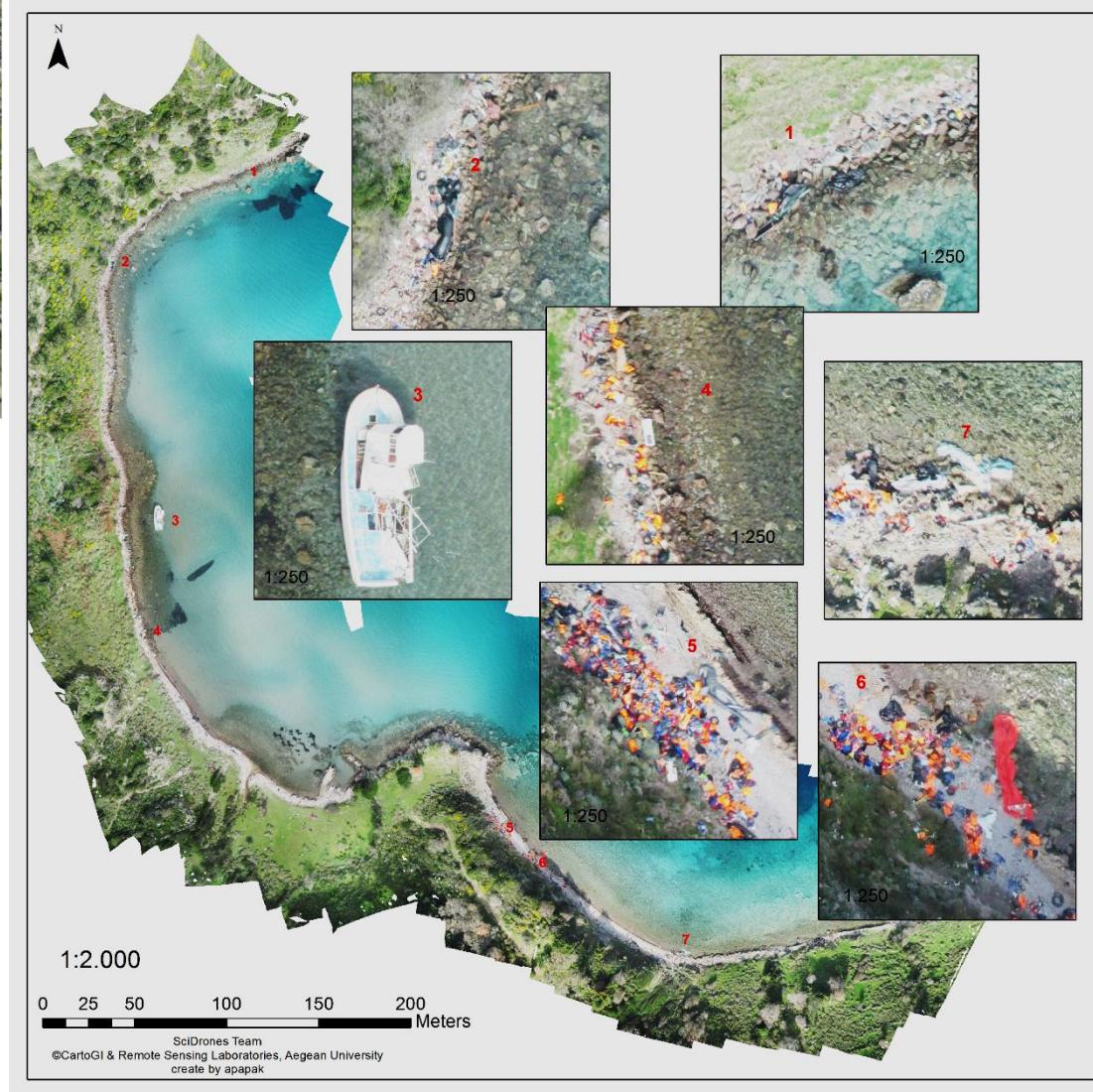
A.F. Velegrakis, O. Andreadis, A. Papakonstantinou, K. Topouzelis, S. Katsanevakis, E. Manoutsoglou, M. Doukari, F. Psarros, and Th. Hasiotis

# Costal marine litter detection

Tsonia Beach



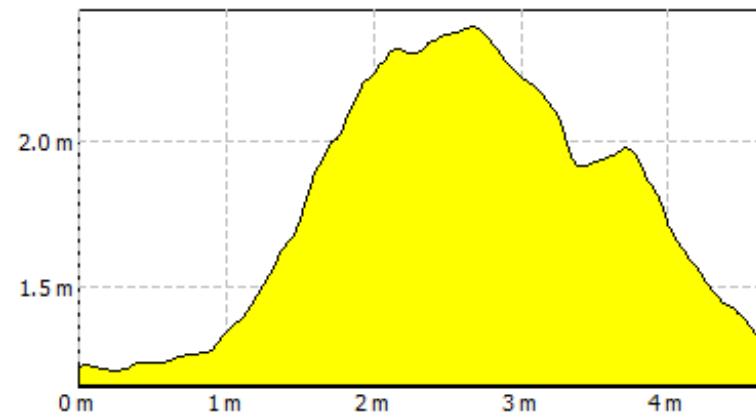
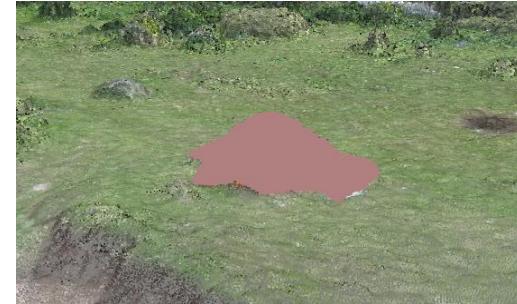
- The type of litter recorded was
  - mostly lifejackets
  - ship wrecks
  - PVC boat remains,
  - discarded clothing and personal items,
  - boat engines and engine fragments.
- The litter concentrations varied along the coastline in terms of their distribution over the "dry" (land) beach and the nearshore seabed.



# Costal marine litter detection



Litter Volume:  $3.721 \text{ m}^3$   
Area : $10.741\text{m}^2$   
Perimeter:  $16.781 \text{ m}$   
Max Height:  $2.4 \text{ m}$



# Plastic Litter Project 2018

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## Drone Mapping and Satellite Testing for Marine Plastic on Aegean Sea

Three artificial plastic targets 10 x 10 m:

- 1) 3600 x 1.5 L plastic bottles,
- 2) 135 plastic bags and
- 3) 200 sqm fishing net.

UAV: Optical, IR, Thermal  
Satellites: Sentinel-2, Sentinel-1,  
WVIII, TerraSAR-X, Planet



# Plastic Litter Project 2018



UNIVERSITY OF THE AEGEAN  
ΤΜΗΜΑ ΕΠΙΣΤΗΜΩΝ ΤΗΣ ΘΑΛΑΣΣΑΣ

MUNICIPAL PORT FUND  
OF LESVOS  
ΔΗΜΟΤΙΚΟ ΔΙΑΜΕΡΙΣΚΟ  
ΥΑΝΤΖΟΥ ΛΕΣΒΟΥ

MARINE  
REMOTE SENSING  
GROUP  
DEPARTMENT OF MARINE SCIENCES  
UNIVERSITY OF THE AEGEAN

Plastic Litter  
Project 2018

Ένα πείραμα εντοπισμού (τεχνητών) πλαστικών στόχων  
στην επιφάνεια της θάλασσας με τη χρήση ΣυμΕΑ  
(drone) και δορυφορικών εικόνων.  
<https://mrsrg.aegean.gr>

7/6/2018  
Τοποθεσία "Plaz", ακτή Τσαμάκια  
Μυτιλήνη Λέσβος

# Plastic Litter Project 2018

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7 June 2018

# Plastic Litter Project 2018



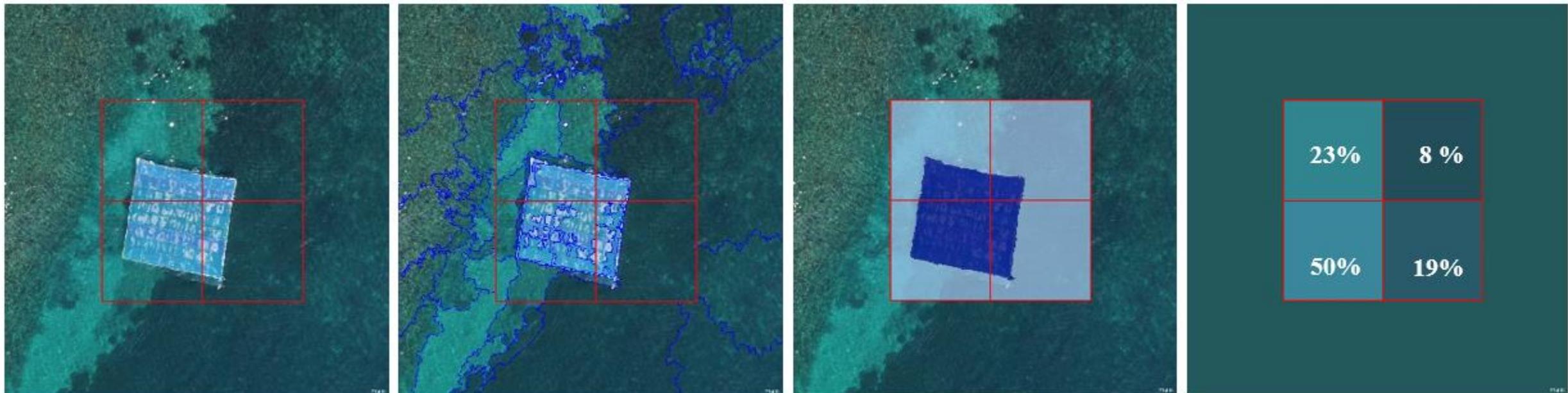
PlanetScope satellite  
7 June 2018



Sentinel-2 satellite  
7 June 2018

# Plastic Litter Project 2018

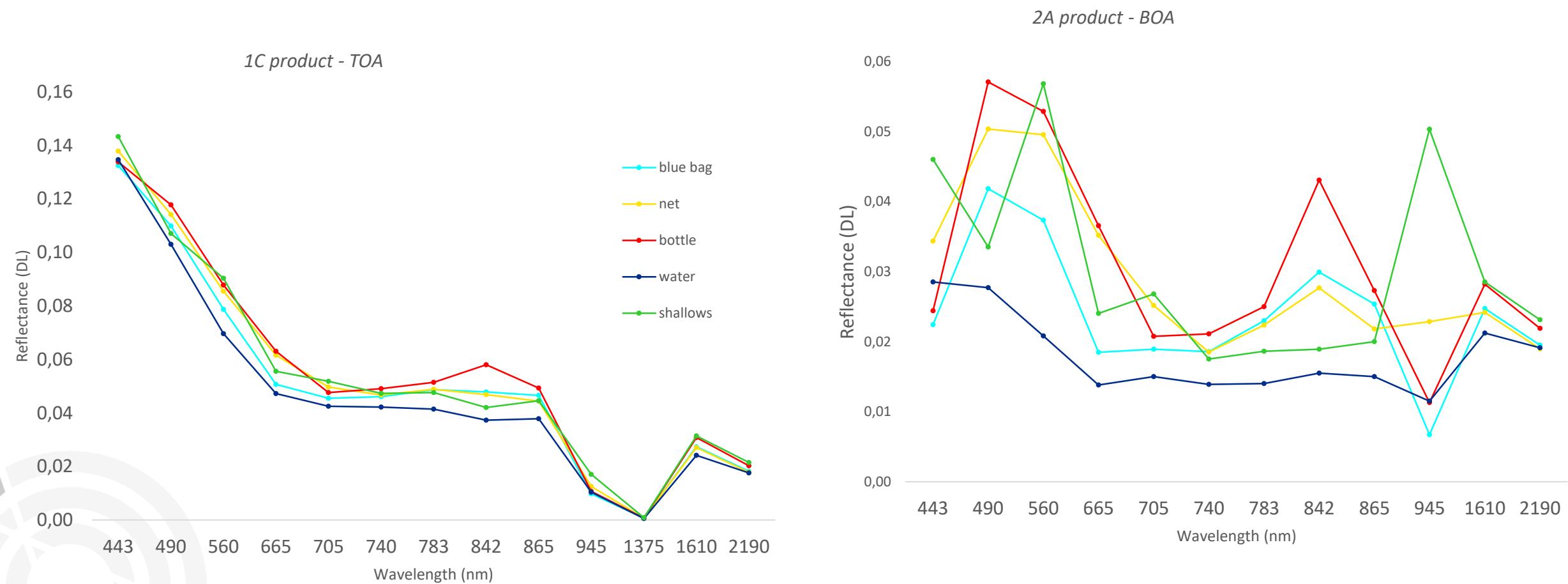
## Combining Sentinel-2 and UAS data



Percentage plastic coverage calculation for each Sentinel-2 pixel using the A5100 orthophotomap

Topouzelis, K., Papakonstantinou, A., Garaba, S.P. (2019). *Detection of floating plastics from satellite and unmanned aerial systems ( Plastic Litter Project 2018 ).* Int J Appl Earth Obs Geoinf. 79, 175–183. DOI: [10.1016/j.jag.2019.03.011](https://doi.org/10.1016/j.jag.2019.03.011)

# Plastic Litter Project 2018



# Plastic Litter Project 2019

EO tracking of marine debris in the Mediterranean Sea from public satellites (EO Science for Society permanently open call for proposals)



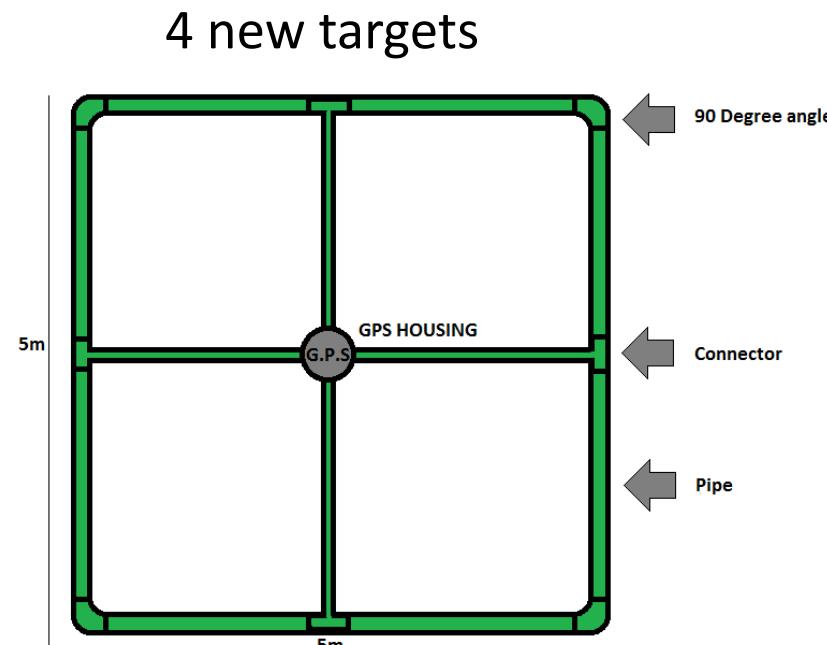
University of the Aegean



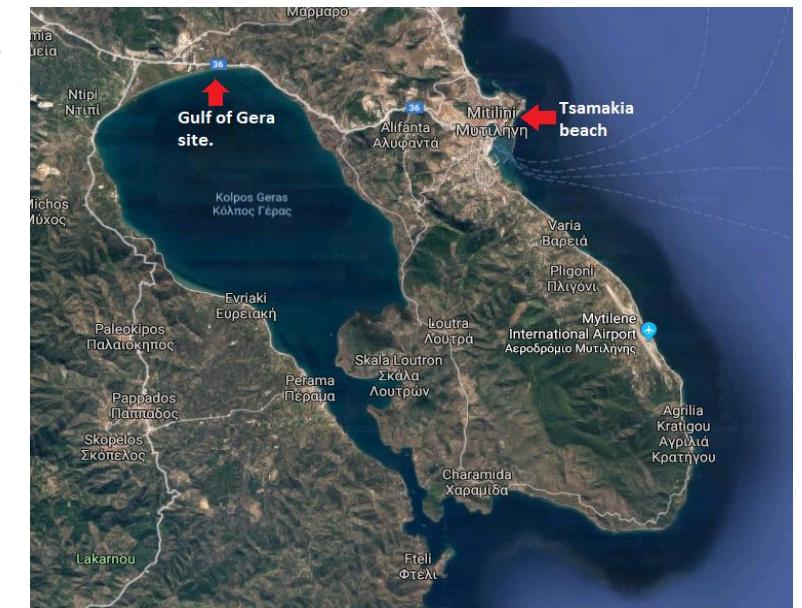
CNR-ISMAR



Universidad de Cádiz



Lesvos Island



# Plastic Litter Project 2019

**18/4/2019**

Targets in line 100 % bottles  
and 100 % bags



**03/5/2019** Separated targets 100  
% bottles and 100 % bags &  
smaller mixed targets



**18/5/2019** Pair Targets in line 75  
% bottles and 75 % bags &  
smaller mixed targets



**18/4/2019**

**03/5/2019**

**08/5/2019**

**13/5/2019**

**18/5/2019**

**23/5/2019**

**28/5/2019**

**02/6/2019**

**07/6/2019**

**12/6/2019**

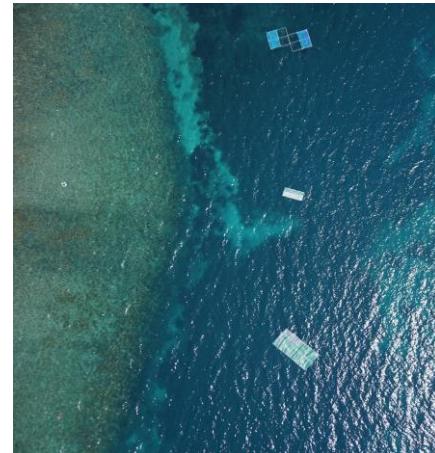
**17/6/2019**

**22/6/2019**

**27/6/2019**

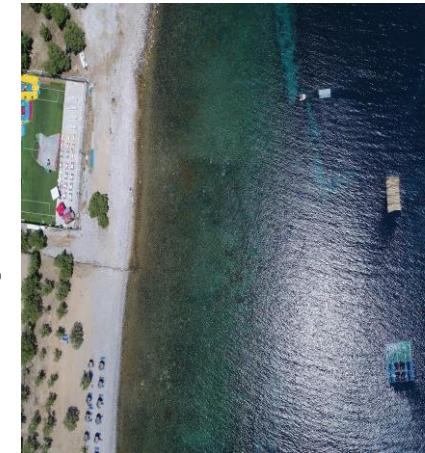
**28/5/2019**

Pair Targets in line 50  
% bottles and 50 %  
bags & smaller  
mixed targets

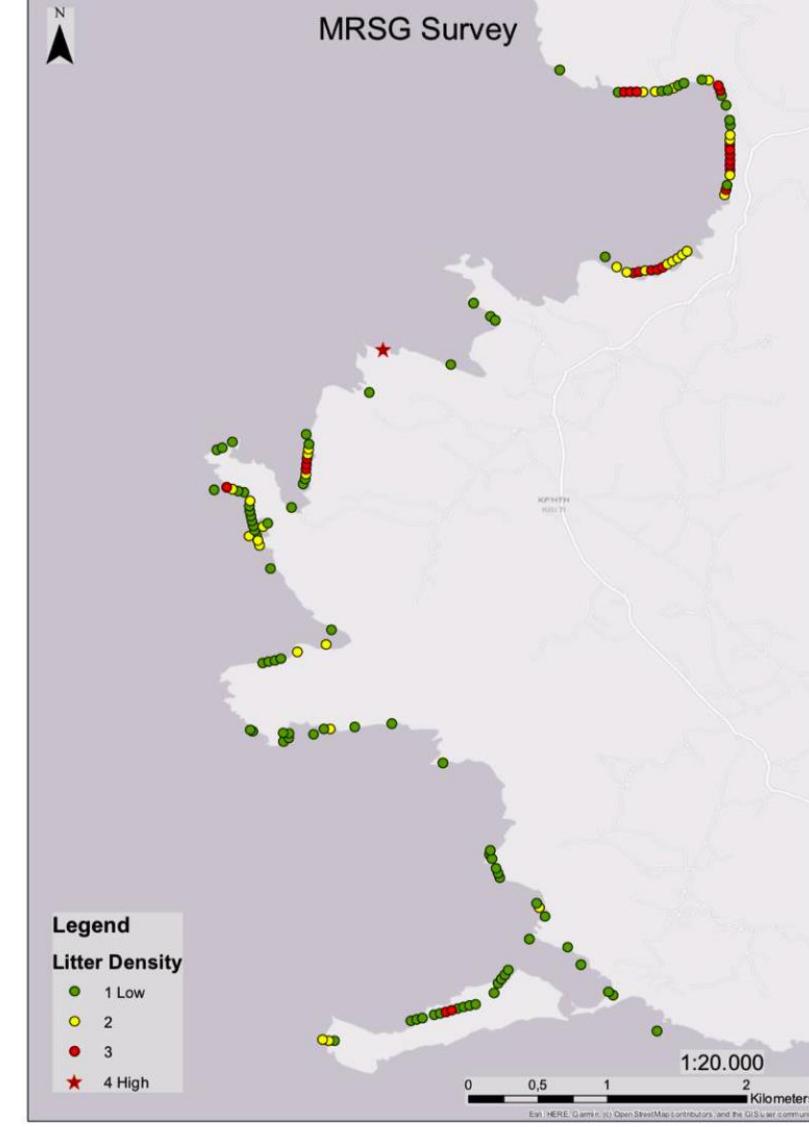
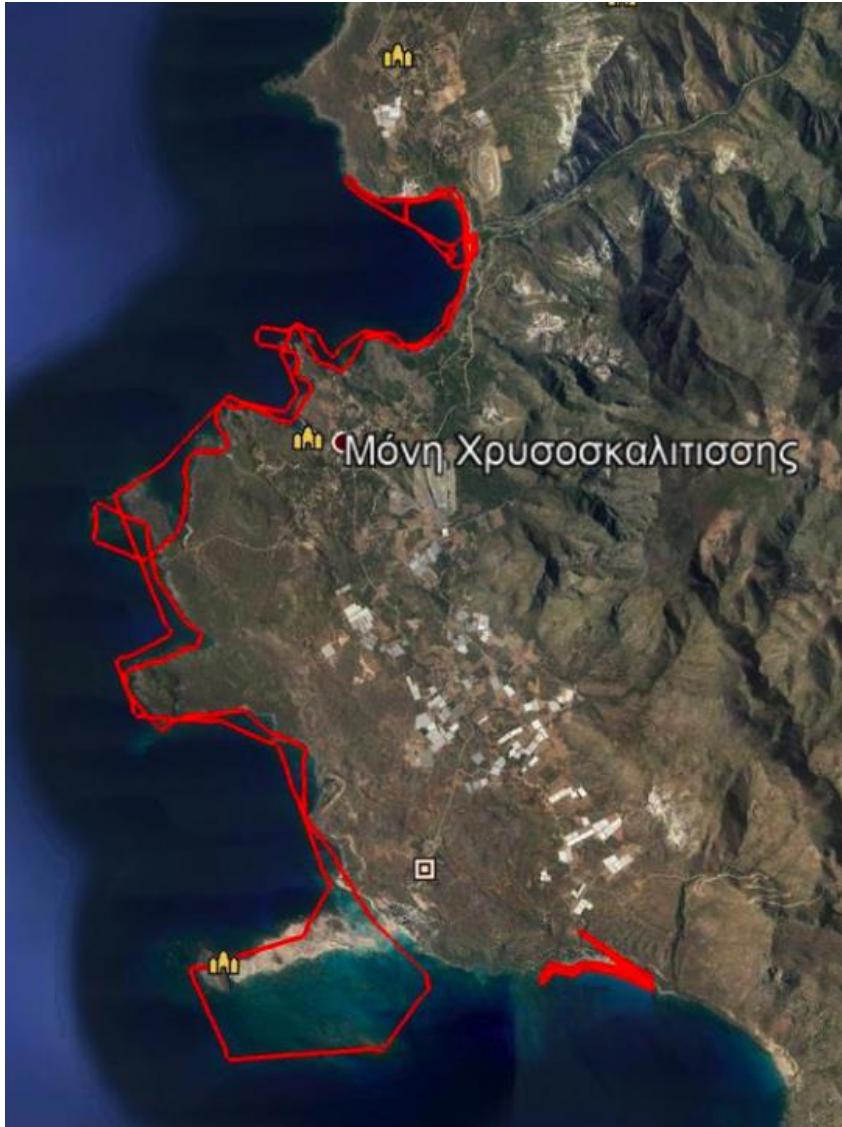


**07/6/2019**

Targets in square 25  
% bottles and 25 %  
bags & smaller  
mixed targets



# Creta Island Oct 2019





# **Oil spill detection**

Research and application

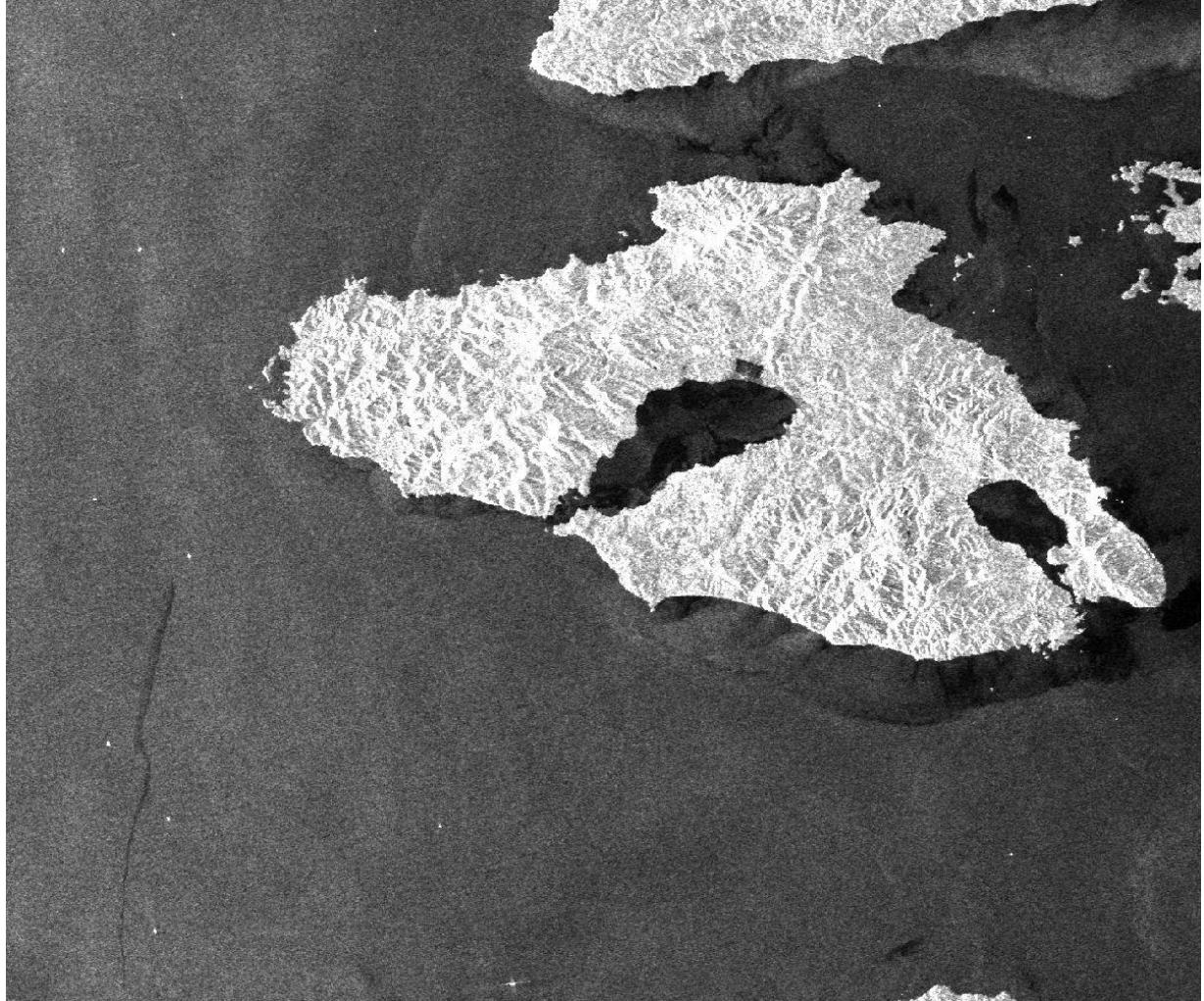
# Oil spill detection

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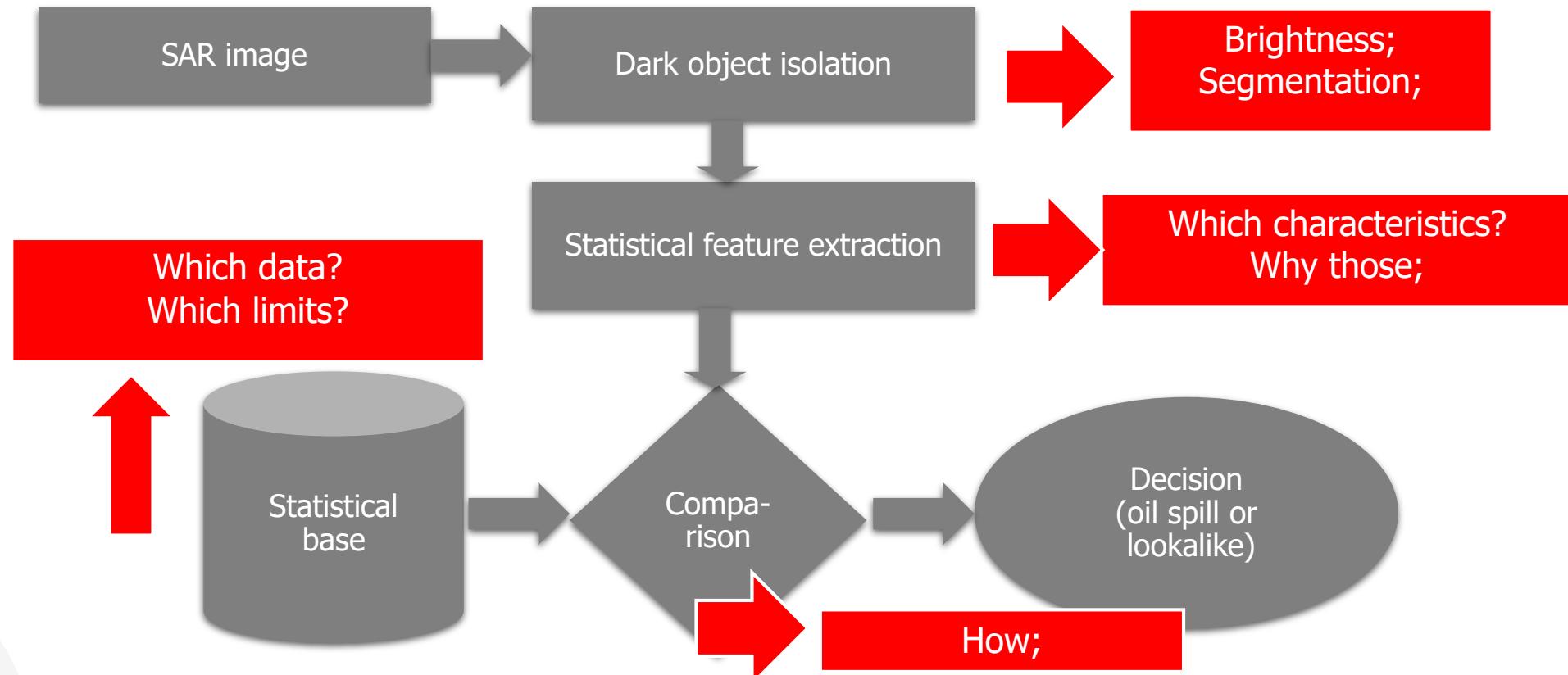
Photo-interpretation

Semi-automatic detection

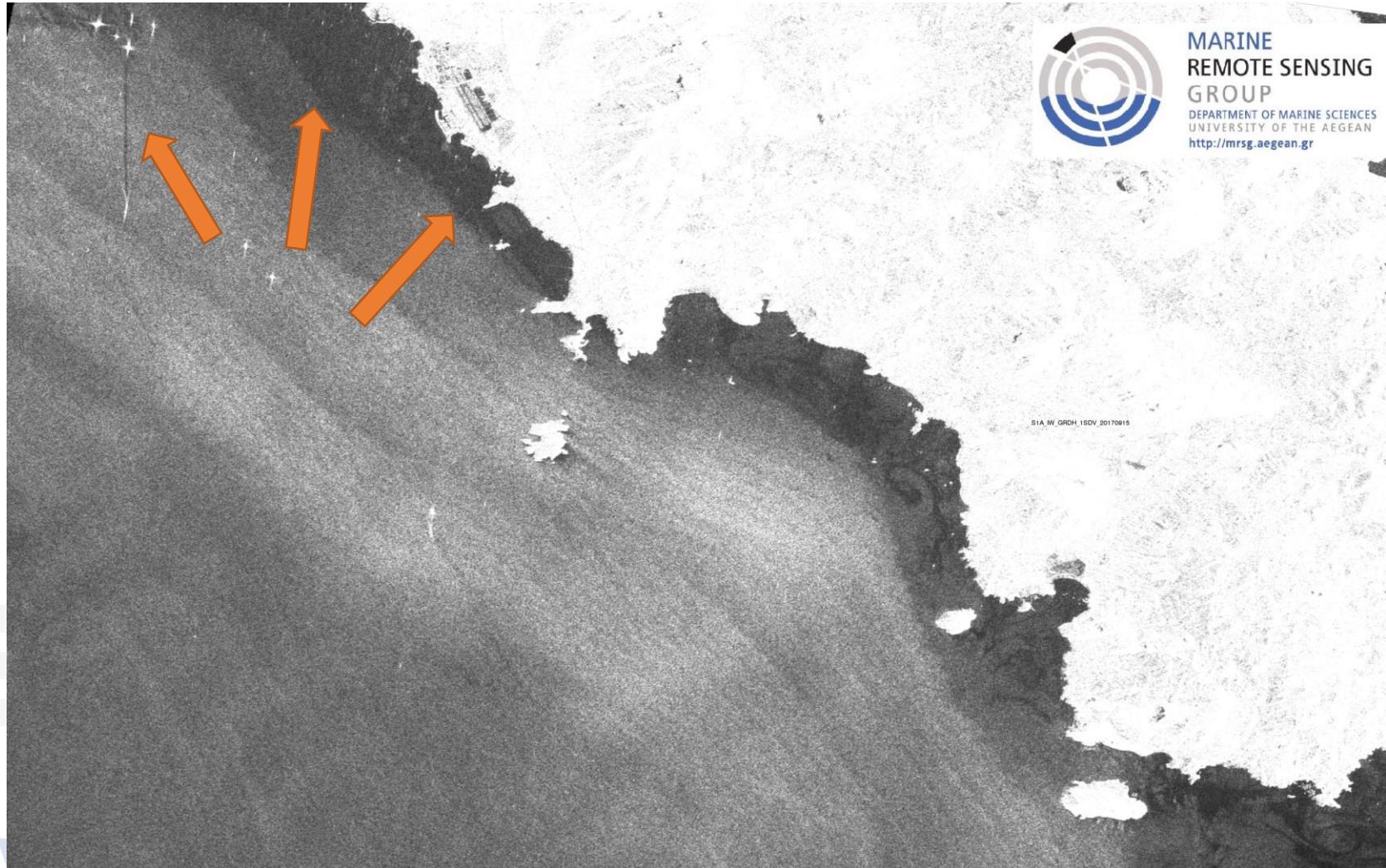
Long term analysis



# Oil spill detection



# Oil Spill detection



**Salamina Oil spill  
from satellite  
(15/9/2017)**

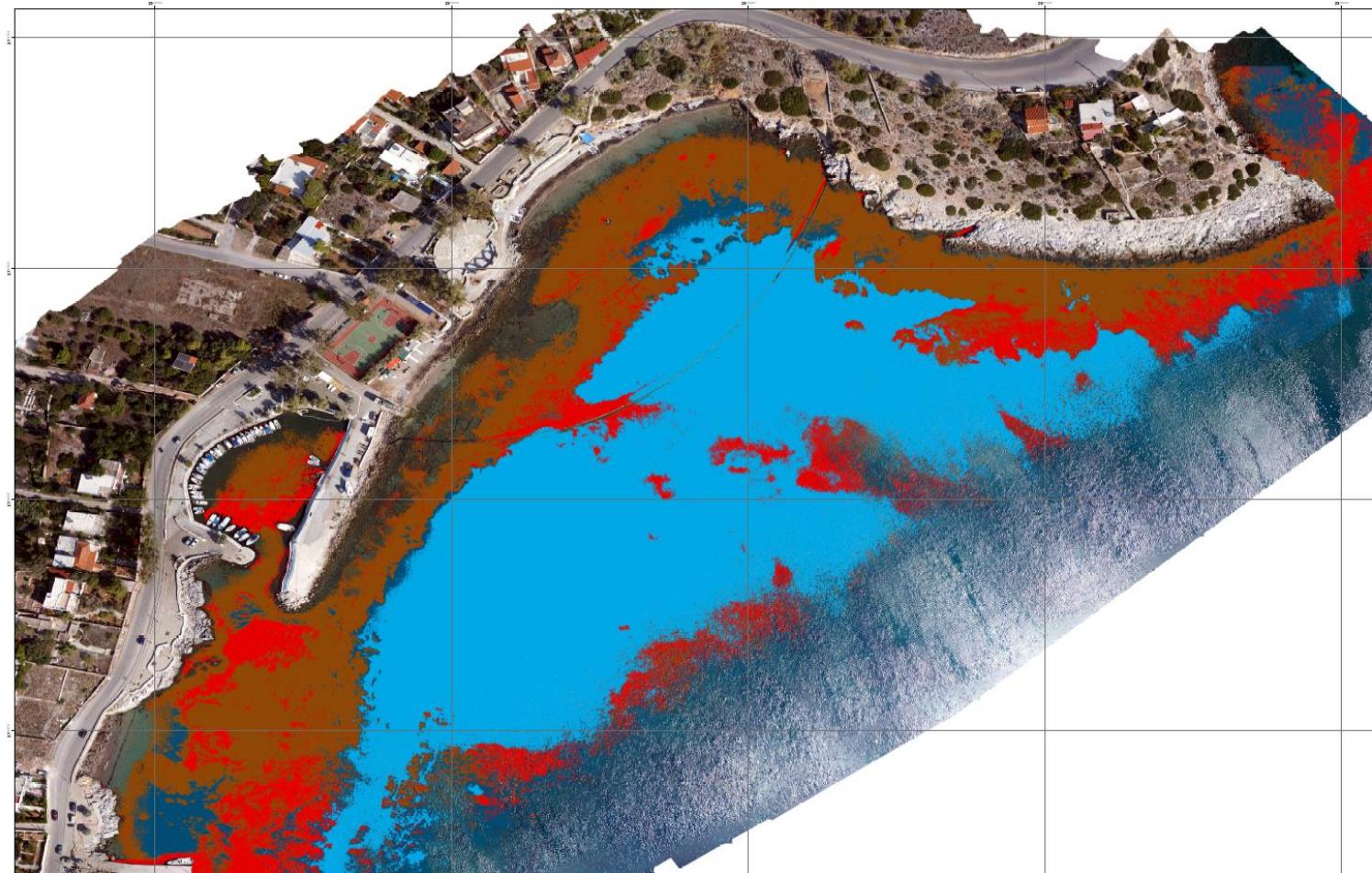
# Oil Spill Mapping with UAVs

Salamina Oil spill (2017)



# Oil Spill Mapping with UAVs

Salamina Oil spill (2017)



## Legend

Classification\_Band\_composite.tif

### Class\_Name

- OIL
- OIL Residues
- Clear seabed
- Clear Rock- Rock seabed
- Clear Sand seabed



# Marine Remote Sensing Group

<http://mrsg.aegean.gr>



## RESEARCH

The Marine Remote Sensing Group (MRGs) in the University of the Aegean conducts research for the exploration, analysis and visualization of the satellite and UAV data in the coastal environment. We combine state of the art algorithms and in situ measurements to develop new methods, technologies, and products for the visual representation of marine geospatial information. The group has gain expertise in several disciplines of marine remote sensing including oil spill detection, oceanic phenomena identification, seagrass mapping, coastal bathymetry and coastline detection. Hereafter we present ongoing and completed research projects.



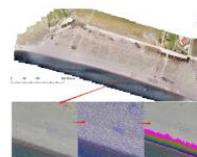
### Marine Spatial Planning

MRSGroup using UAV collects spatial data for the study of coastal areas and seamedows.



### High Precision Survey of coastal areas

Geospatial data production for the Port of Skala Polichnitos using UAV surveys.



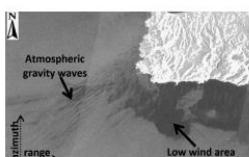
### Coastal Mapping

Coastline Zones Identification and 3D Coastal Mapping Using UAV Spatial Data



### Marine Litter Detection

Mapping and detecting the extent of the refugee arrival related marine litter problem along the eastern coast of Lesbos.



### Mapping mesoscale phenomena in SAR images

Detection and classification of mesoscale atmospheric phenomena above sea in SAR imagery



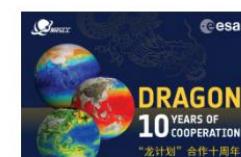
### H2020, SEO-DWARF

SEO-DWARF: Semantic EO Data Web Alert and Retrieval Framework, Marie Skłodowska-Curie Research & Innovation Staff Exchange (RISE), H2020



### Seagrass mapping

Local area mapping, regional scale, country scale, ground truth



### Dragon-4, Oceans & coastal zones

Monitoring from space for ocean and coast sustainability



# MARINE REMOTE SENSING GROUP

DEPARTMENT OF MARINE SCIENCES  
UNIVERSITY OF THE AEGEAN

<http://mrsg.aegean.gr/>

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Thank you!