

# WESEA

Autonomous Coastal Monitoring System



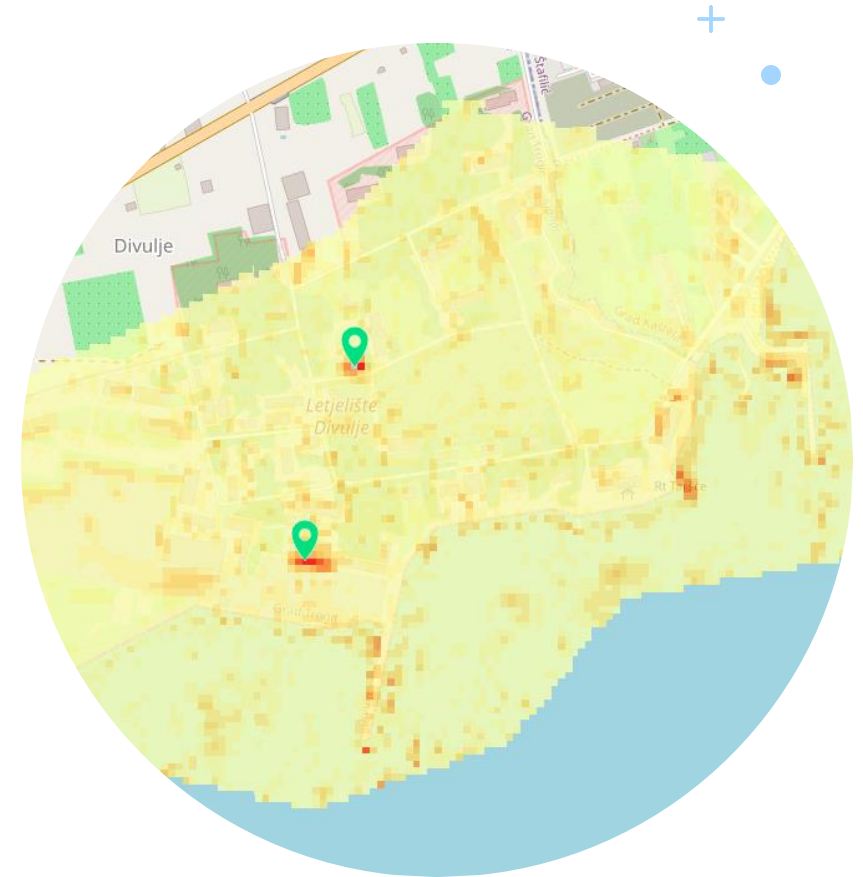
# Objectives

## General:

- develop a stable scientific basis for the upgrade, optimization and automatization of Croatia's coastal monitoring system
- focus on buildings and other infrastructures (illegal beaches, embankments, docks, bridges) in coastal areas. Sea incidents that we know of and are frequent (grounding of ships or accidents on crude oil tankers and cargo ships etc.) were not included in a scope of the project at this stage.

## Detailed:

- to develop an accurate and functional hybrid architecture for automated monitoring and classification of changes in the coastal environment of Split-Dalmatia County based on space technology products and machine learning models
- prototype a proof-of-concept web GIS application for the continuous and automated monitoring of coastal changes
- development of such software solution that aims to successfully detect > 80% of incidents with less than 30% errors of all interventions larger than approx. 300m<sup>2</sup> based on previously mentioned technologies and data.



# ESA NoR Sponsorship - Benefits

## SentinelHub - Yearly subscription

- Consistent data fetching from 2018 (for now) onwards using the API
- Low infrastructure costs (processing is done by SentinelHub)
- Automatization of change detection process for each available date
- Integration of the pipeline to the PoC application
- Easier update of the pipeline in next phases of the project

## PlanetScope data

- Testing the system on High resolution data for the business model evaluation and planning
- Detection of "smaller" changes on the coast (crucial for the presentation to potential end-users)
- Evaluation of the approach and difference between open & commercial data
- Easier planning of the datasets to be used for the next phase of the project (pros/cons of multiple approaches)

# ESA NoR Sponsorship - Benefits

- One major software release with incremental functional enhancement – WeSea – PoC web GIS application
- Risk of not delivering on time mitigated by using the resources provided by ESA NoR
- In order to implement the desired functionalities extracted from the user requirements, WeSea is structured as a set of components:
  - Module for selection of satellite imagery used for change detection and classification purposes,
  - Module for automated batch download of the satellite imagery,
  - Module for analysis of the satellite imagery (multispectral indices),
  - Module for co-registration of the satellite images,
  - Module for calculation of change detection maps,
  - Module for training of the machine learning algorithms,
  - Module for prediction of the class of change maps,
  - Module for visualization of detection in form of an interactive map,
  - Analytical dashboard design for statistical and reporting insights.

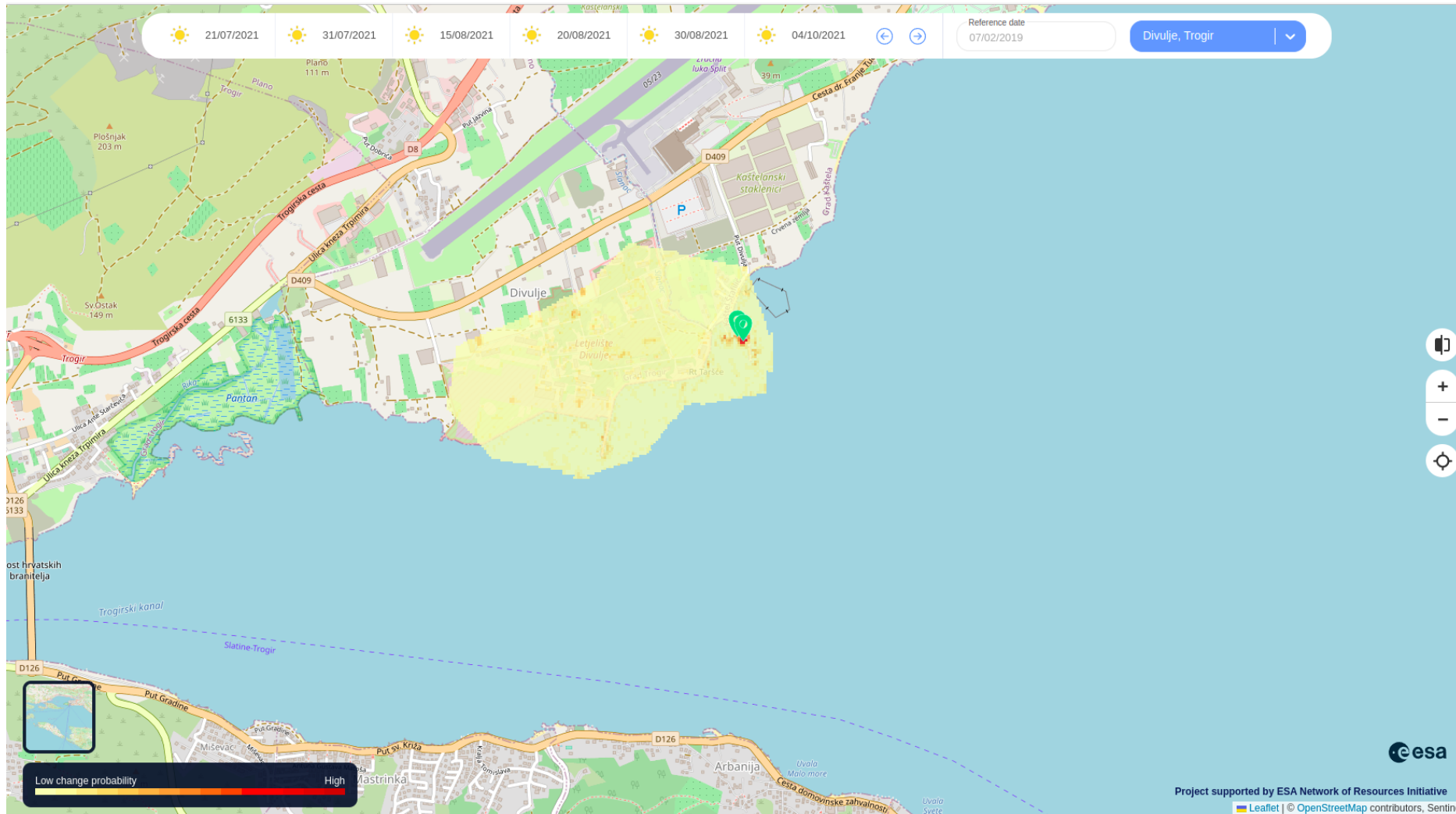
# Results

- The application (development version) is currently deployed on the test environment provided by LIST LABS - <https://wesea-dev.listlabs.net/> (will be moved to production in the next phase of the project)
- 5 random areas of interest are being monitored (from 2018 and ongoing), independent of input data provided by Split-Dalmatia County and LIST LABS
- The final accuracy of the change detection & classification algorithm, respectively (using the ground truth data provided by Split-Dalmatia County) are presented in the following tables:

Total number of changes	28
Number of changes detected	23
Number of changes not detected	5
Accuracy	82%

Total number of samples	5706
Number of classes (labels)	3 (builtin, ship, other)
Overall accuracy	95.16%
Kappa Coefficient	0.899

# Results



Changes visualized on an interactive map



# Results

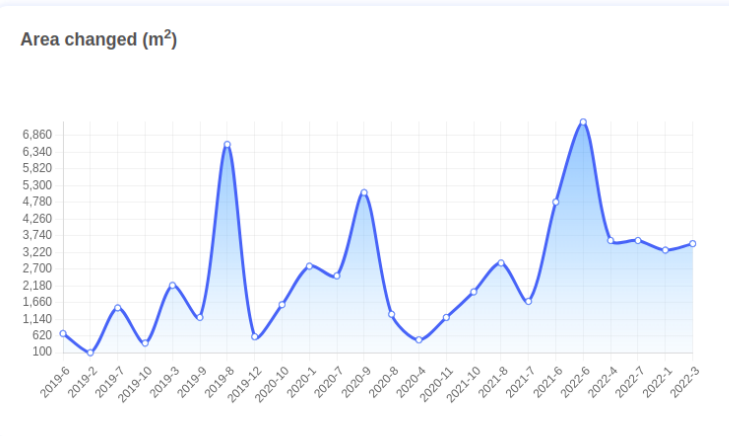
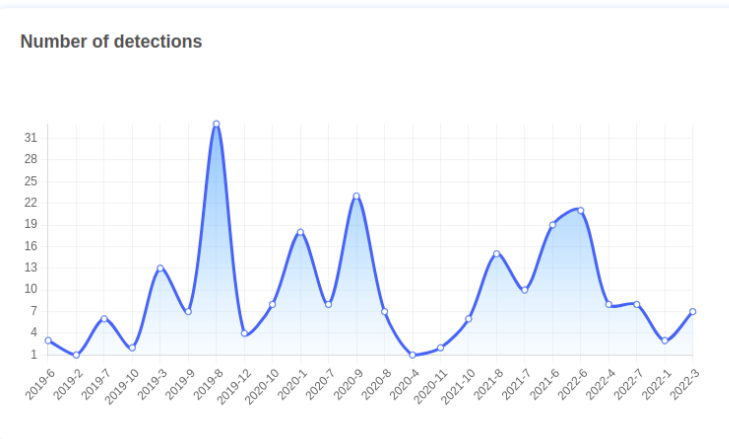
## Dashboard

Location	Area	Date	Probability	Class	Status	Map
Divulje, Trogir	299m <sup>2</sup>	2019-08-06	78%	Built-up	Detected	
Divulje, Trogir	100m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	100m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	299m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	199m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	299m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	199m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	100m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	100m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	
Divulje, Trogir	199m <sup>2</sup>	2019-08-11	78%	Built-up	Detected	

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Filter by location  
Divulje, Trogir

Time span  
01/2018 - 12/2022



Analytical dashboard showing statistics for specific area of interest



# Highlights of the achievements

- Detection of illegal construction in the coastal zone (protection of maritime property and coastal ecosystem)
- Timely detection of coastal erosion
- Resources saving due to data-driven manual inspection (there is no need to inspect entire coastline)
- Detection of changes in hard-to-reach locations (i.e., isolated areas of the central Dalmatian islands)
- Unique system on a national level





# Final thoughts and next steps

- Market research analysis
- Definition of the go-to-market strategy
- Design of the customer feedback documentation
- Apply for ESA funding for the next phase
- Improvement of the change detection algorithm (different levels of the thresholding)
- Improvement of the classification algorithm (more robust dataset with bigger number of labels and features)
- Pitching to potential end users