WORSICA

Water Monitoring Sentinel Cloud Platform

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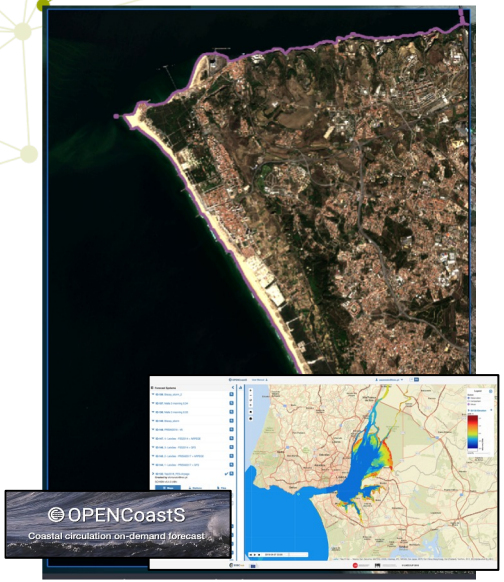
LABORATÓRIO NACIONAL DE ENGENHARIA CIVIL

What is WORSICA?

- **WORSICA (Water mOnitoRing SentInel Cloud plAtform)**
  - a web service that aims at integrating remote sensing and in-situ data for the determination of water presence in coastal and inland areas, applicable to a range of purposes from the determination of flooded areas (from rainfall, storms, hurricanes or tsunamis) to the detection of large water leaks in major water irrigation networks.

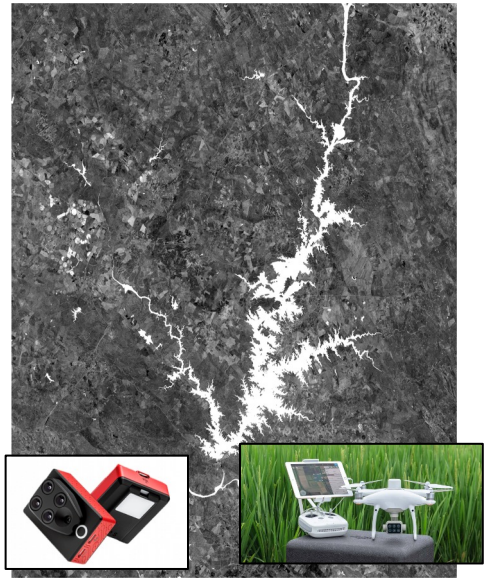
- **WORSICA will reuse and connect some work from other projects/services from LNEC:**
  - OPENCoastS (https://opencoasts.ncg.ingrid.pt)
  - WADI (https://www.waditech.eu)
  - Mosaic.pt (http://mosaic.lnec.pt)

WORSICA - *Main products*



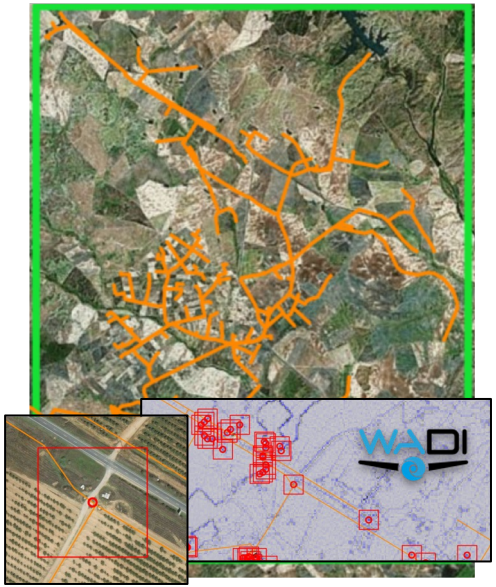
Coastline detection

Use of remote sensing (Sentinel-2, Pleiades and multispectral drone imagery) for the detection of water-land interface and possible calculation of the Digital Elevation Model for each line using the EOSC-hub OPENCoastS service and Fassoni et al. (2021) methodology.



Water bodies detection

Determination of water indexes to detect water bodies in inland areas (lagoons, reservoirs, etc.), using satellite and drone-based imagery.

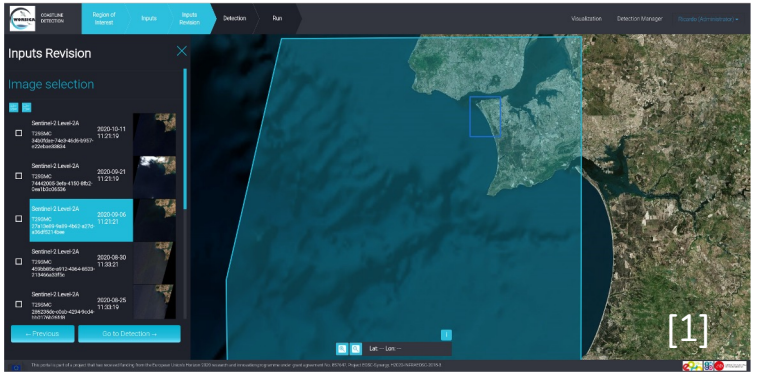


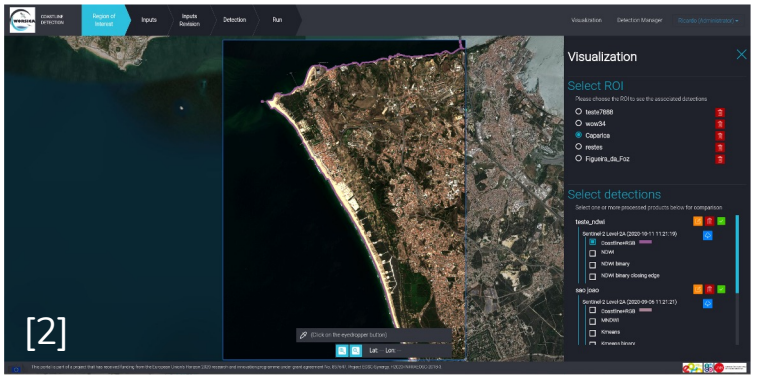
Water leak detection

Take advantage of the work developed in H2020-WADI project (with “low resolution” images from sentinel-2) and try to improve it using Pleiades and drone-based imagery.

WORSICA
Target Users and Usage model

- **Users**: researchers in coastal engineering as well as water irrigation networks management.
- **Access:** Done via a single webportal
- **Usage**: Configure and run the workflow, by choosing the Region of Interest (ROI) and the image sets [1]. The service will download the image sets, process them and generate the final products (water maps) [2].





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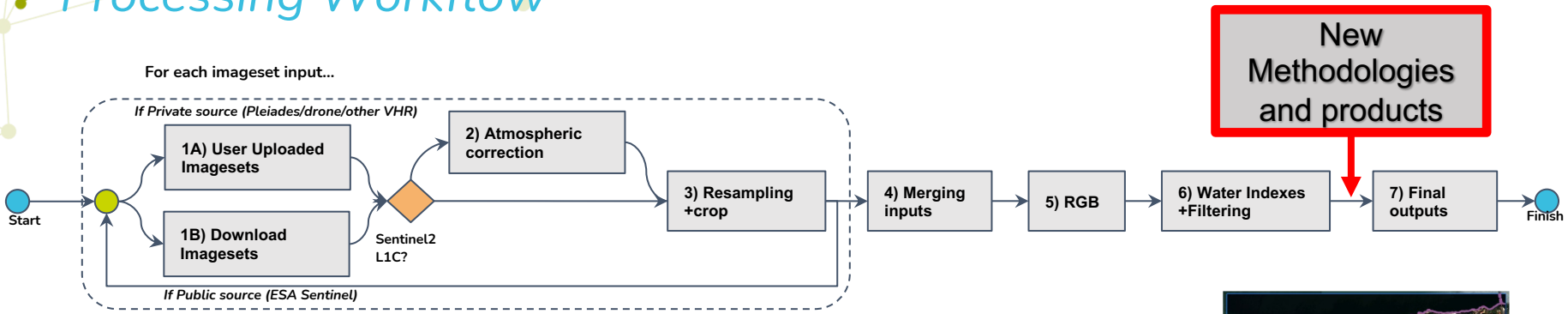
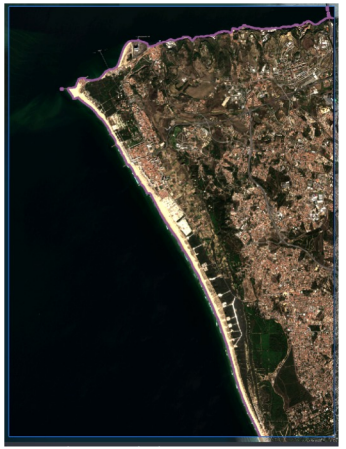
Processing Workflow



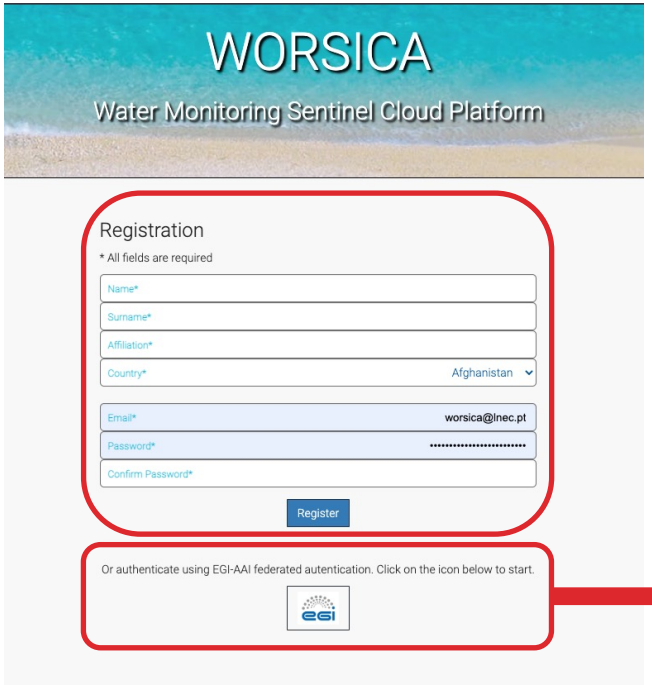


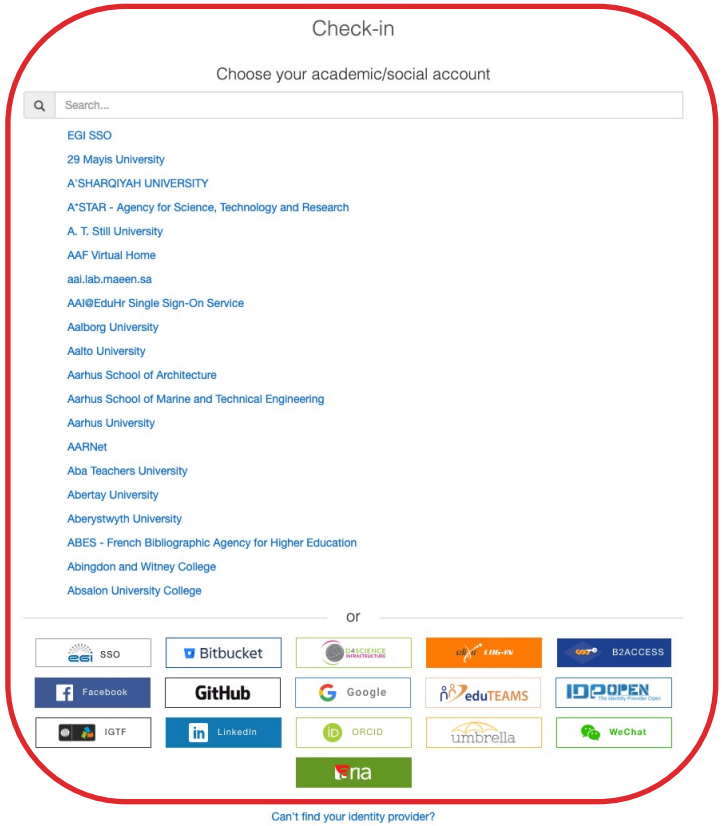
- **Workflow**
  - This processing workflow is done sequentially.
  - For bigger ROIs, more inputs, more time and more resources are needed to process.
  - Applying this workflow to a big processing job (e.g water leak detection), that require processing **hundreds** of image sets, takes a lot of time to complete (days).
  - For a ROI, for the same day, it can have more than one image set available for download (different orbits), thus the need for merging first inputs.

WORSICA Web Portal

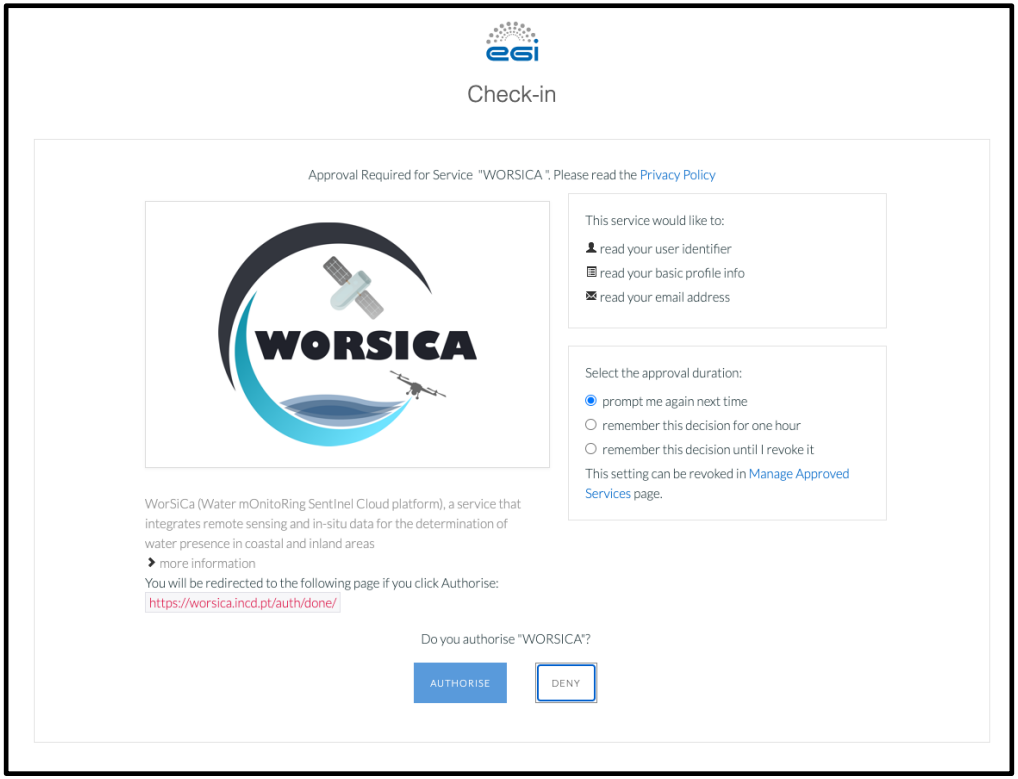
https://worsica.incd.pt

WORSICA Web Portal





WORSICA Web Portal



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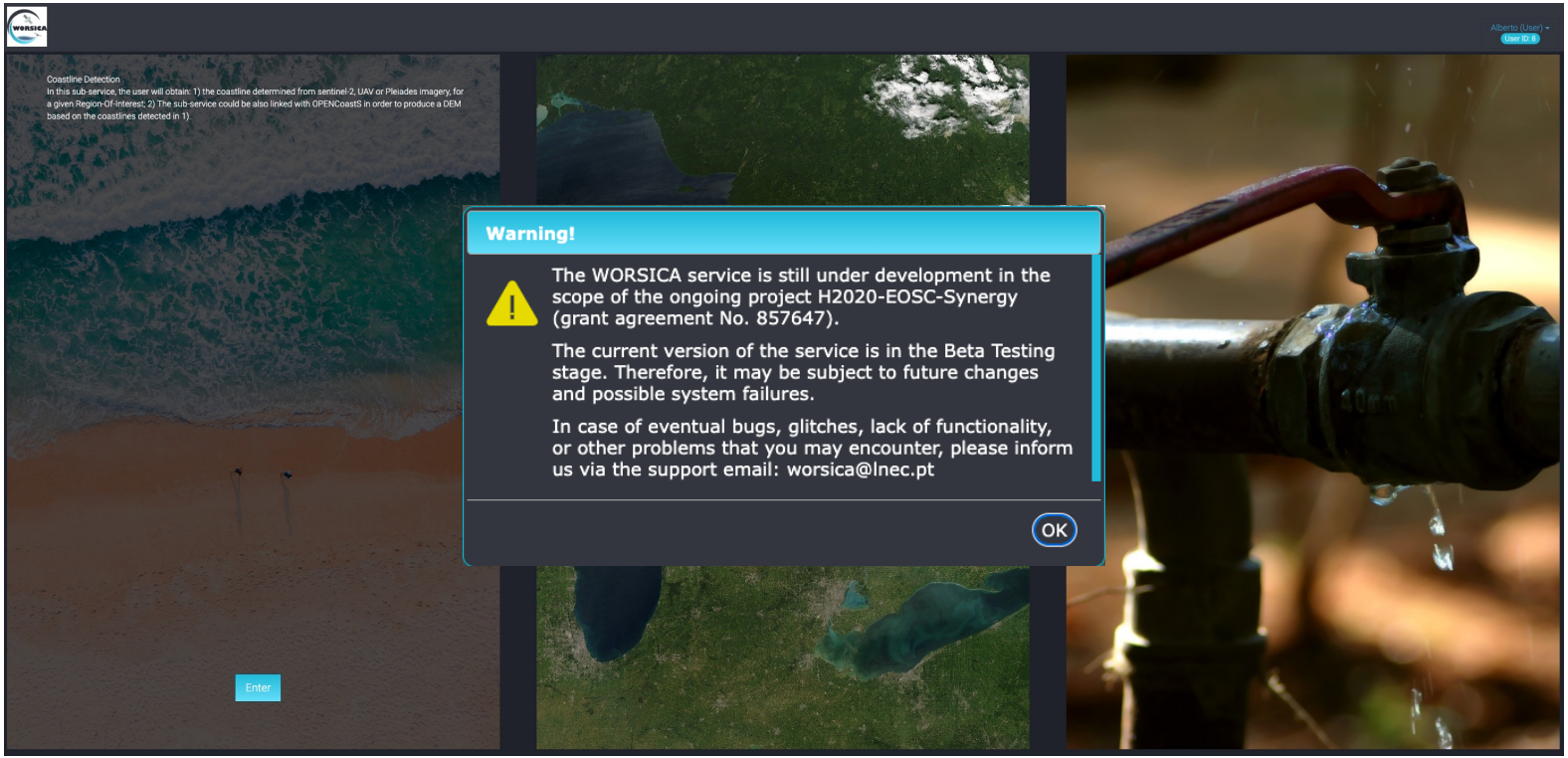

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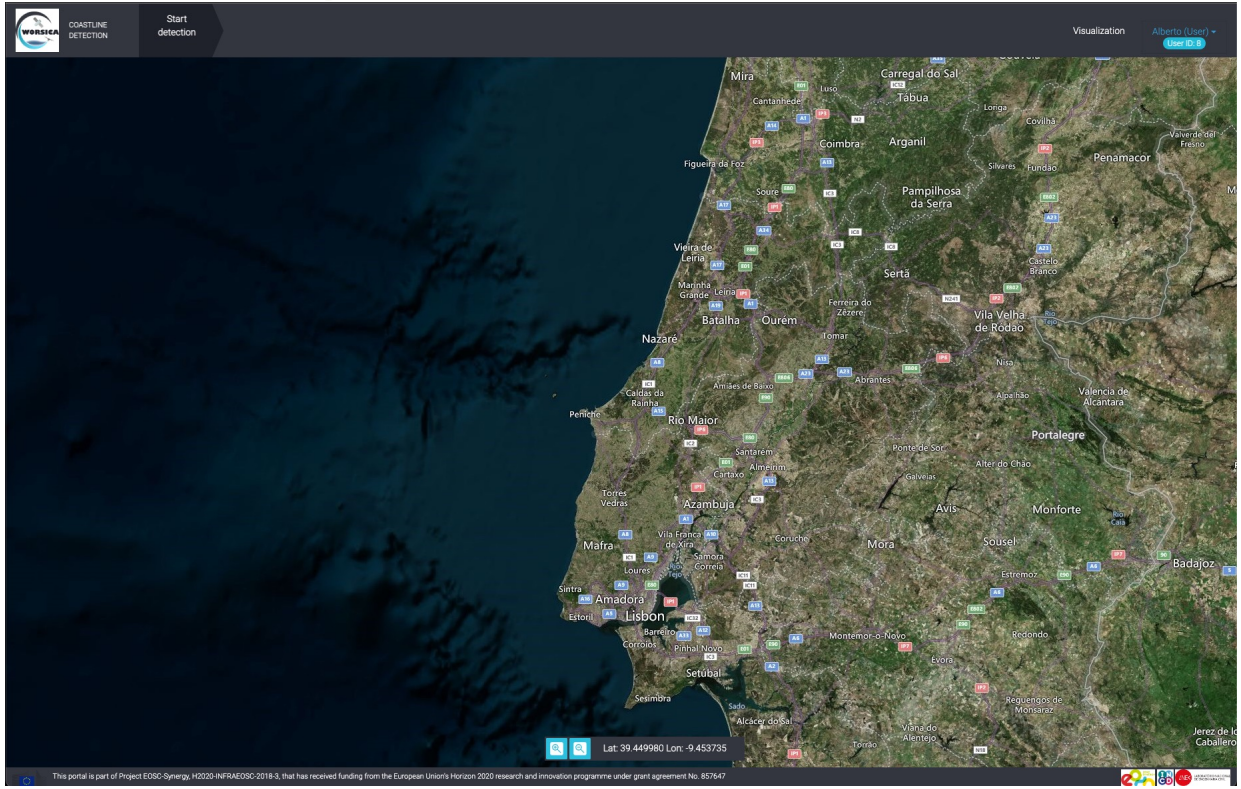
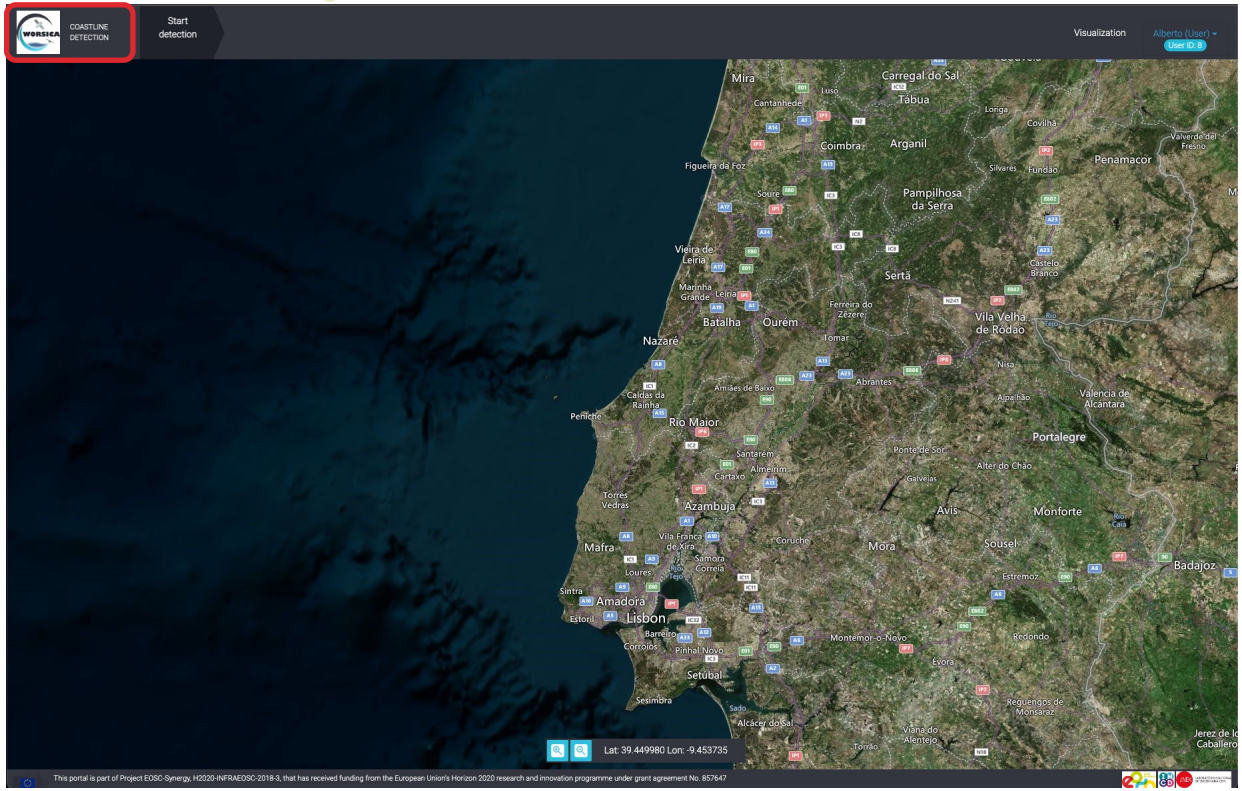


WORSICA Web Portal

Product Identification



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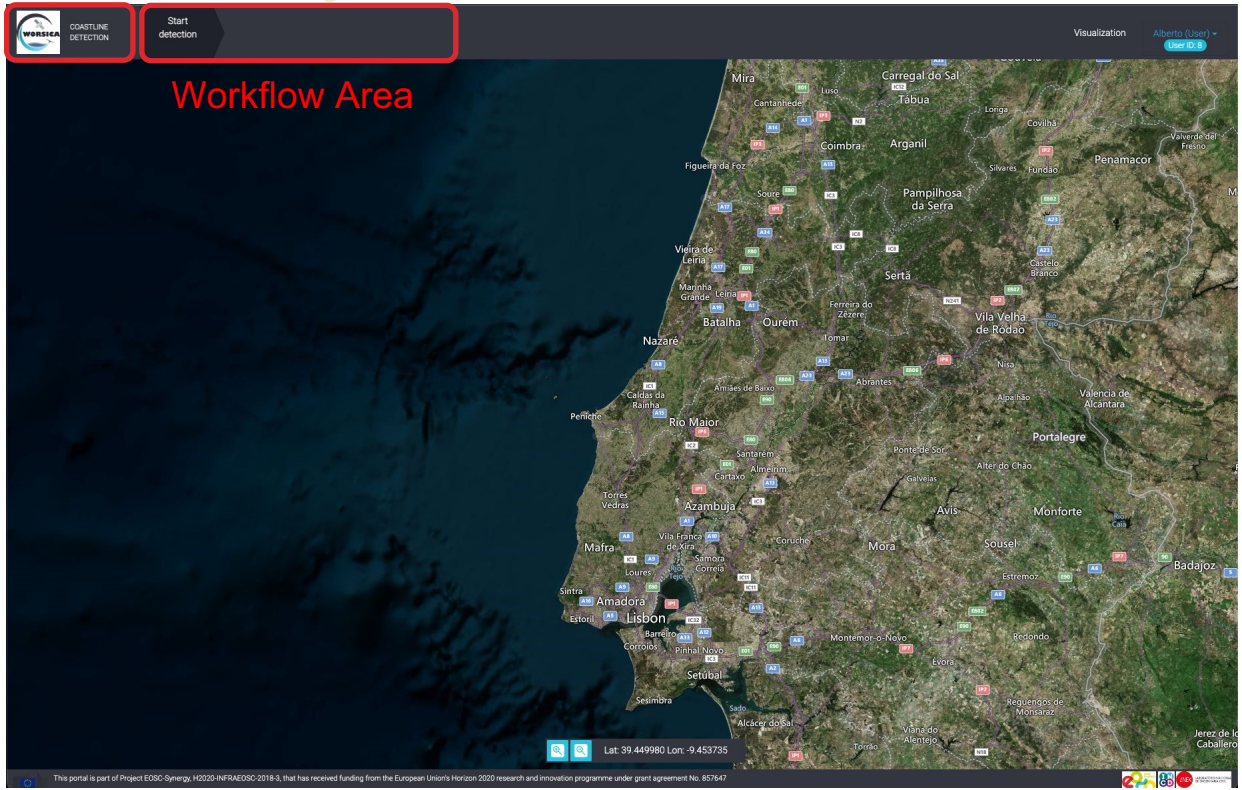

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Product Identification

WORSICA Web Portal

Product Identification

User Profile Area

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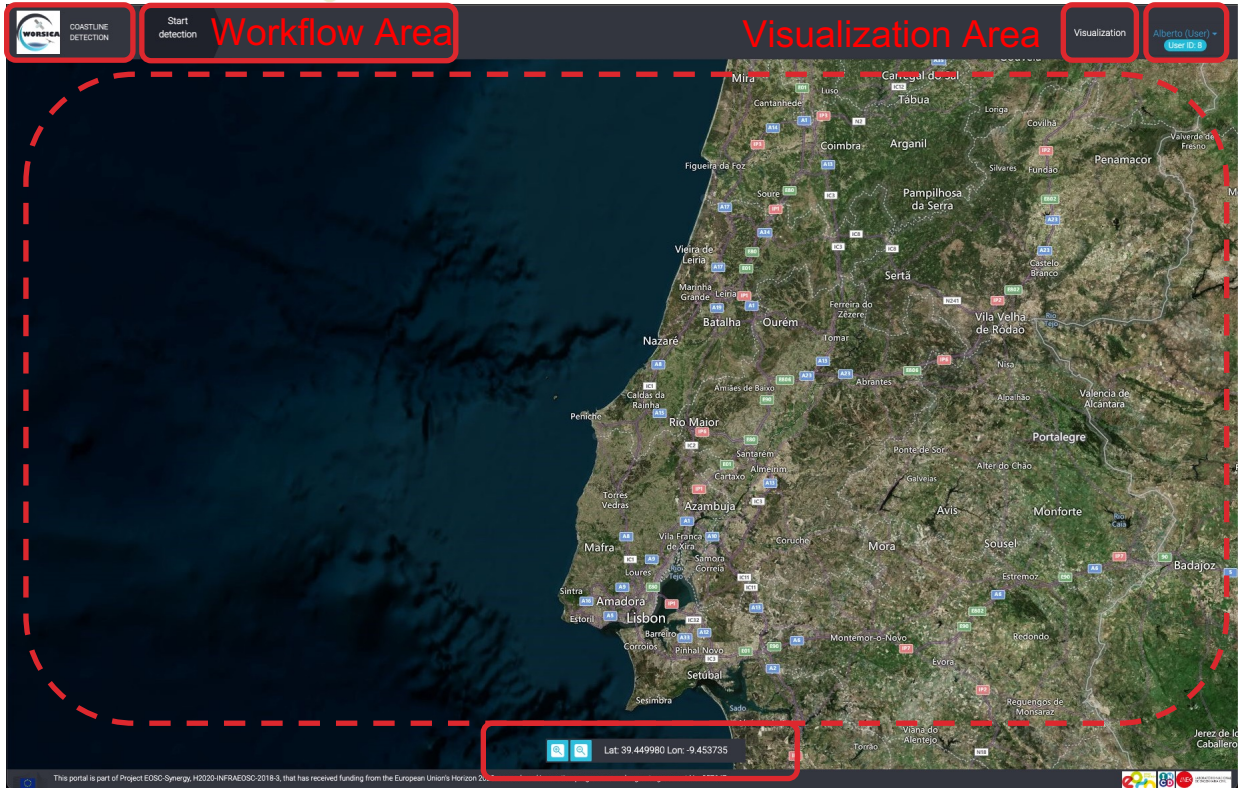
WORSICA Web Portal

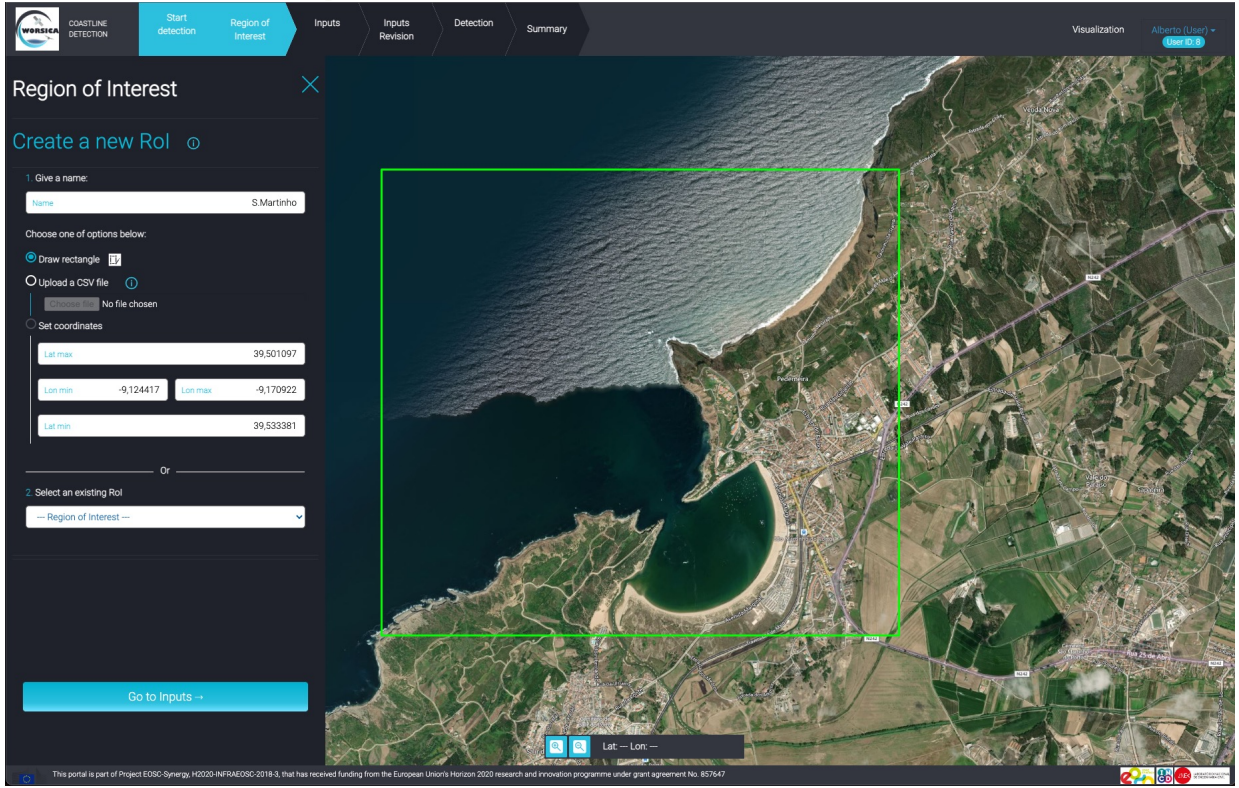
Product Identification



User Profile Area

Navigation Area

WORSICA Web Portal



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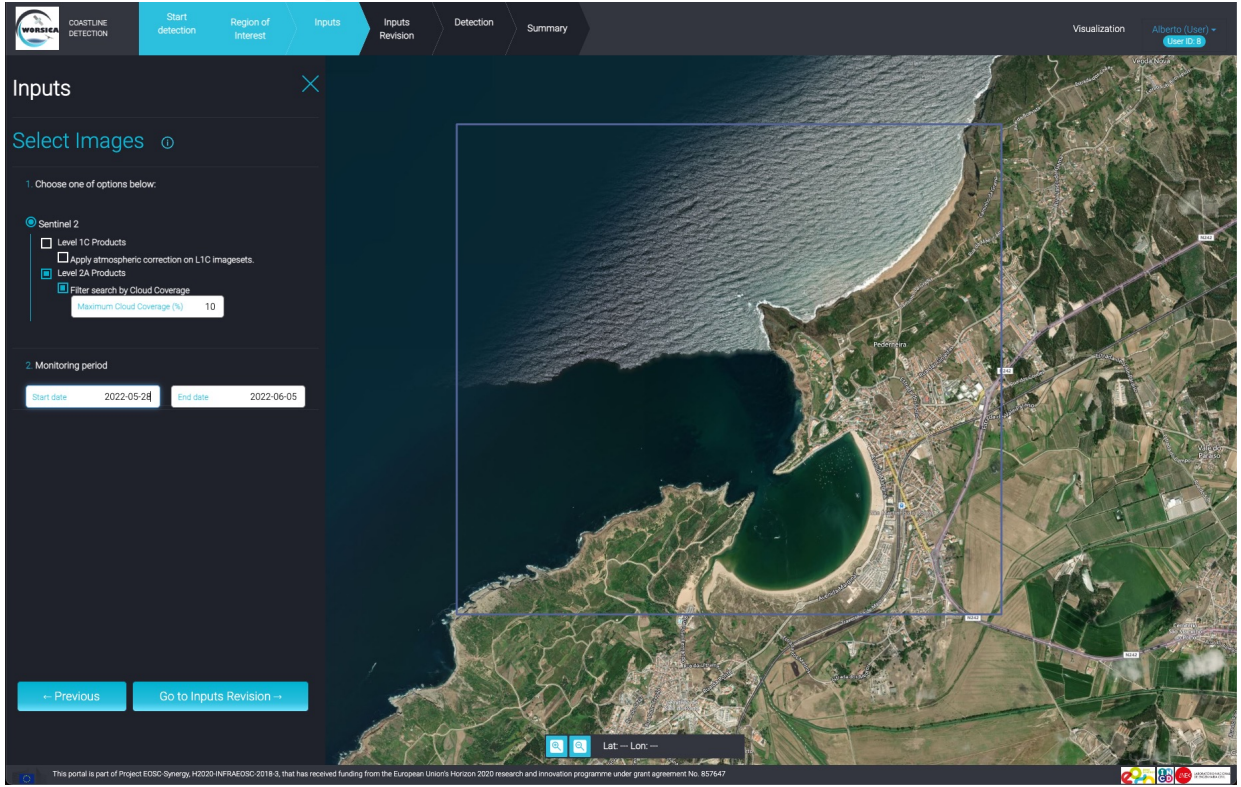

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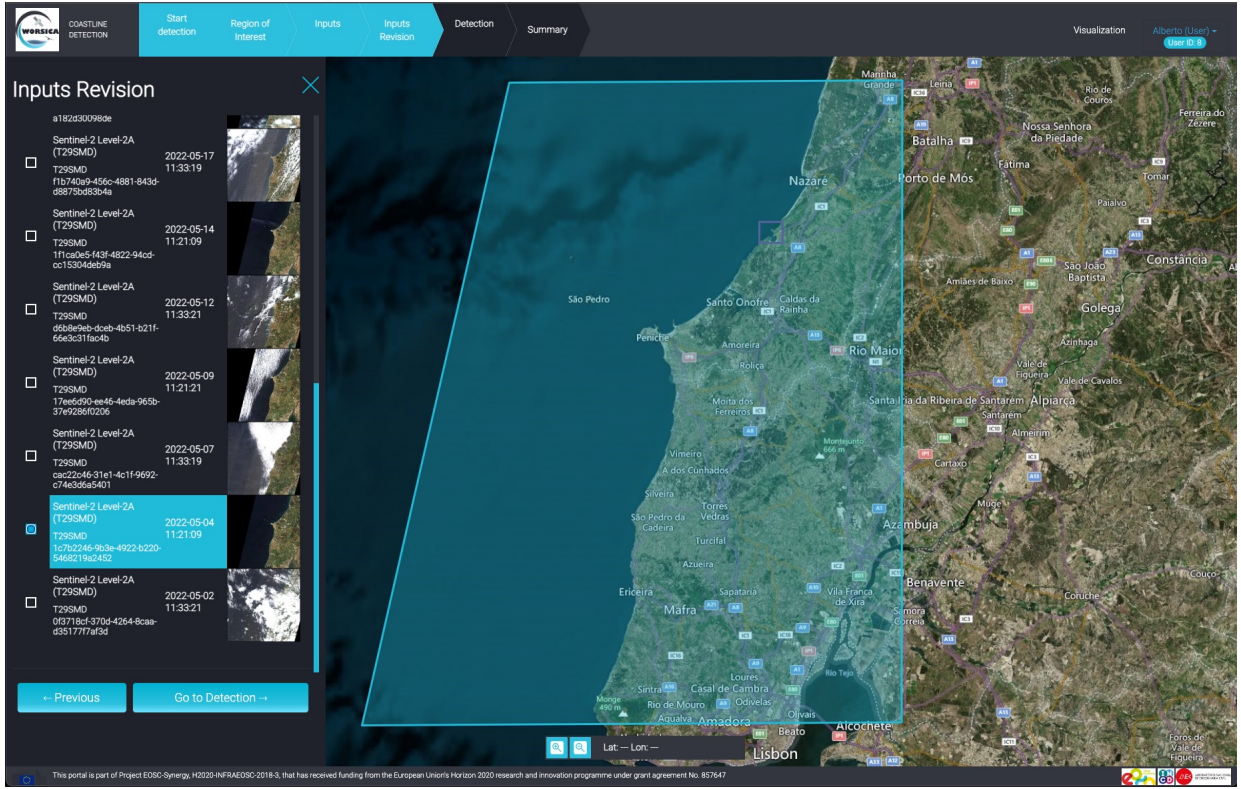

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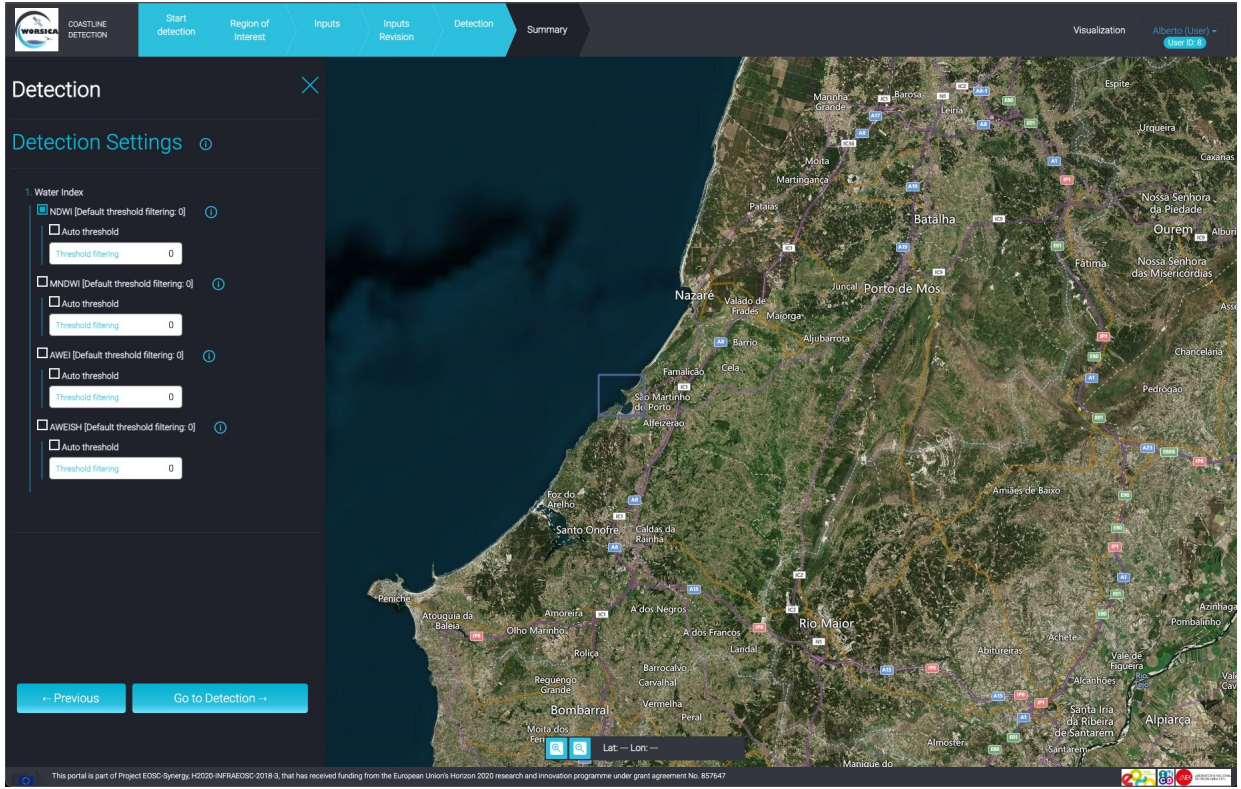

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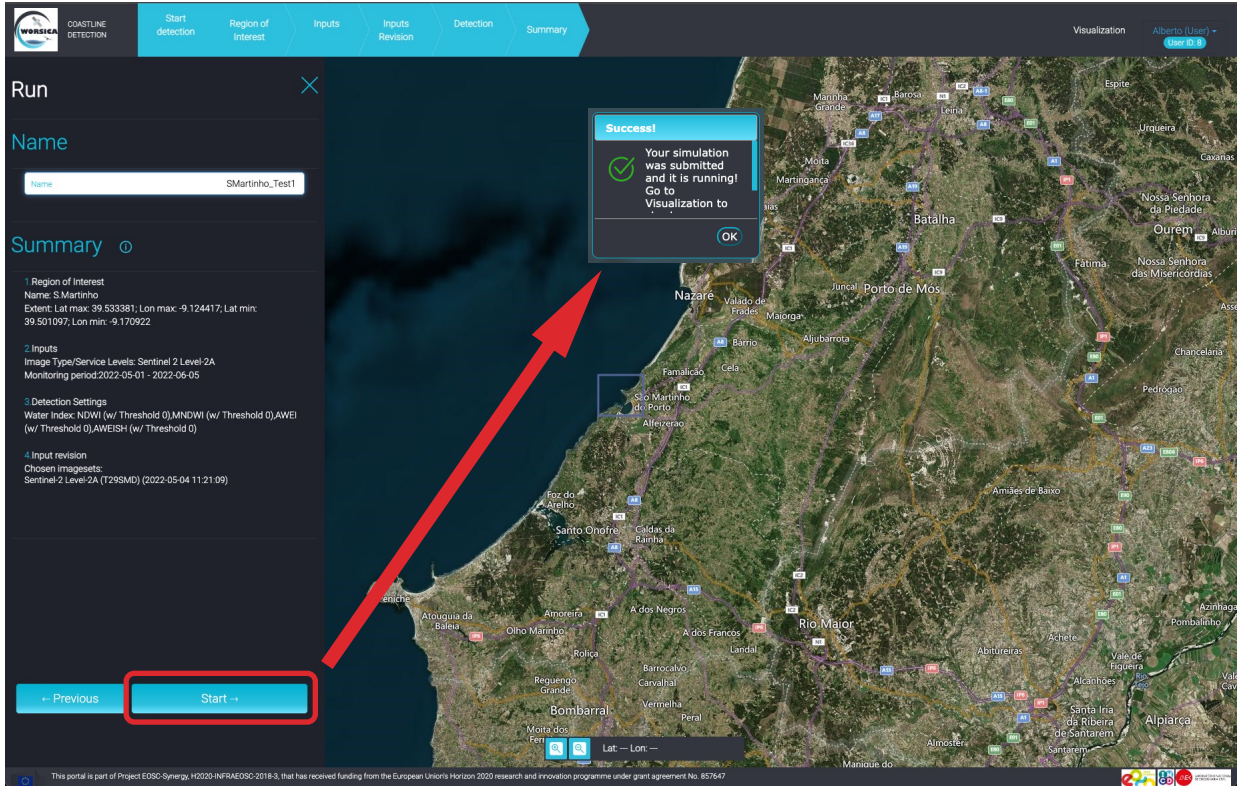

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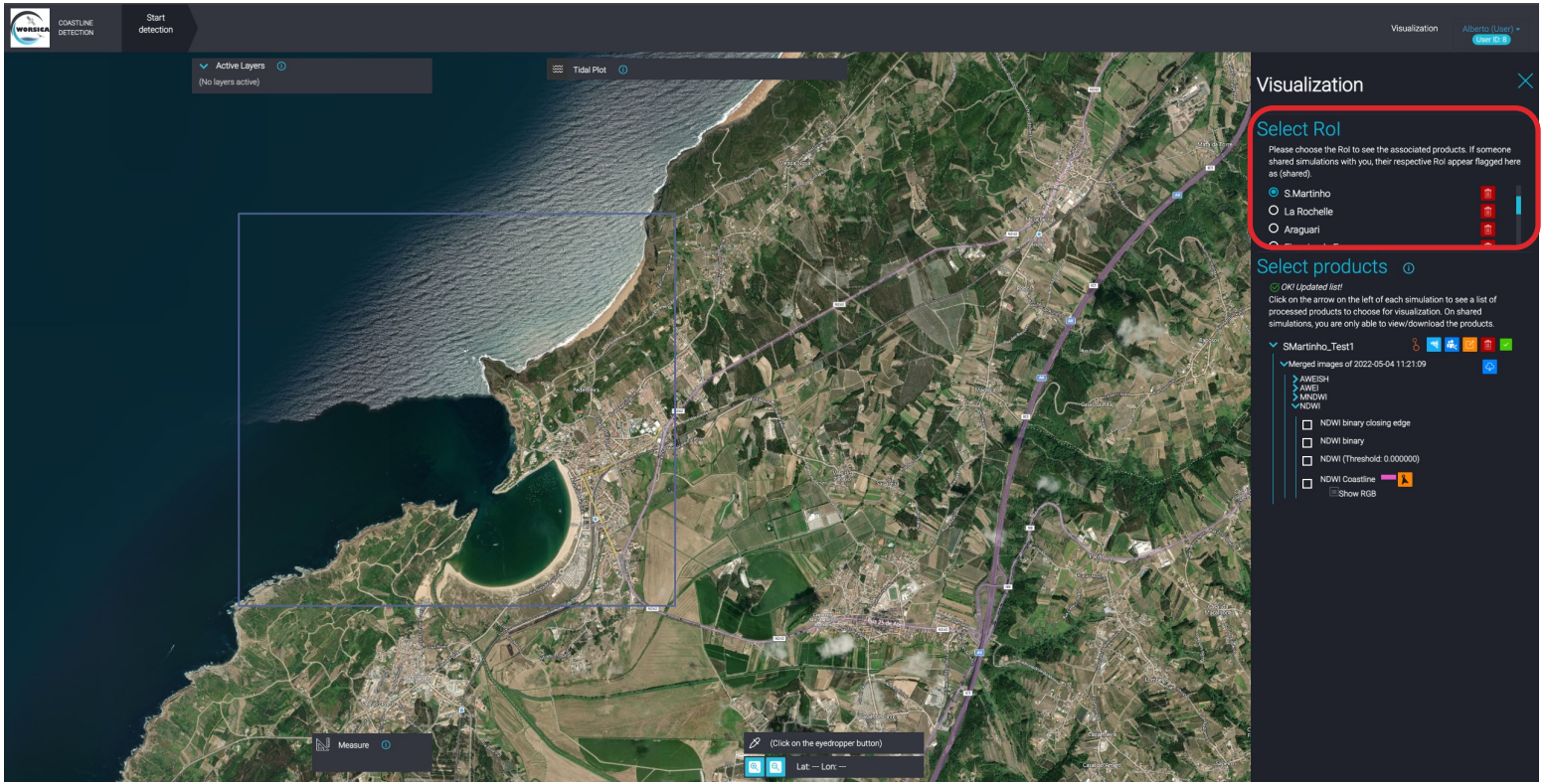
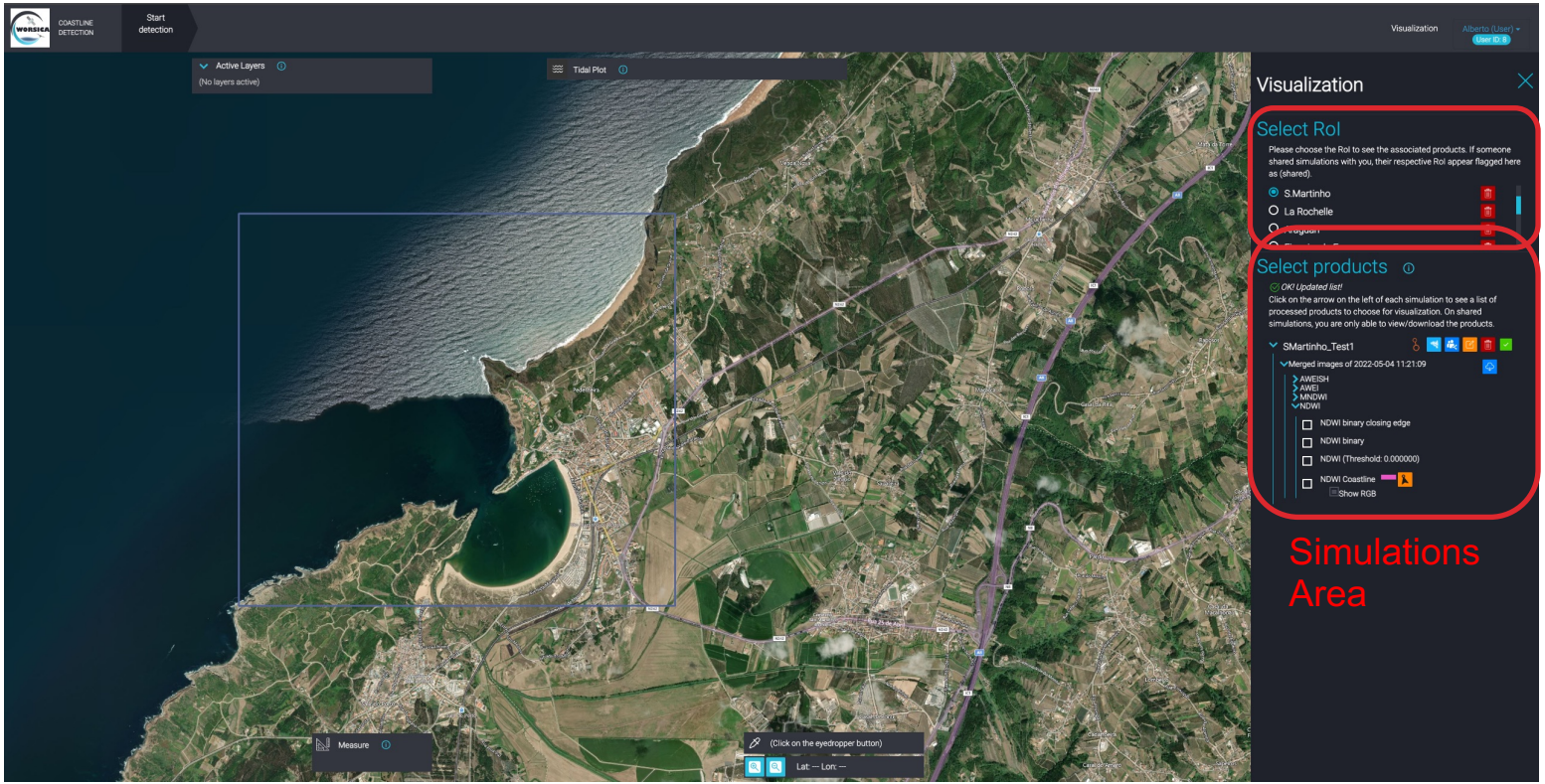


ROI Area

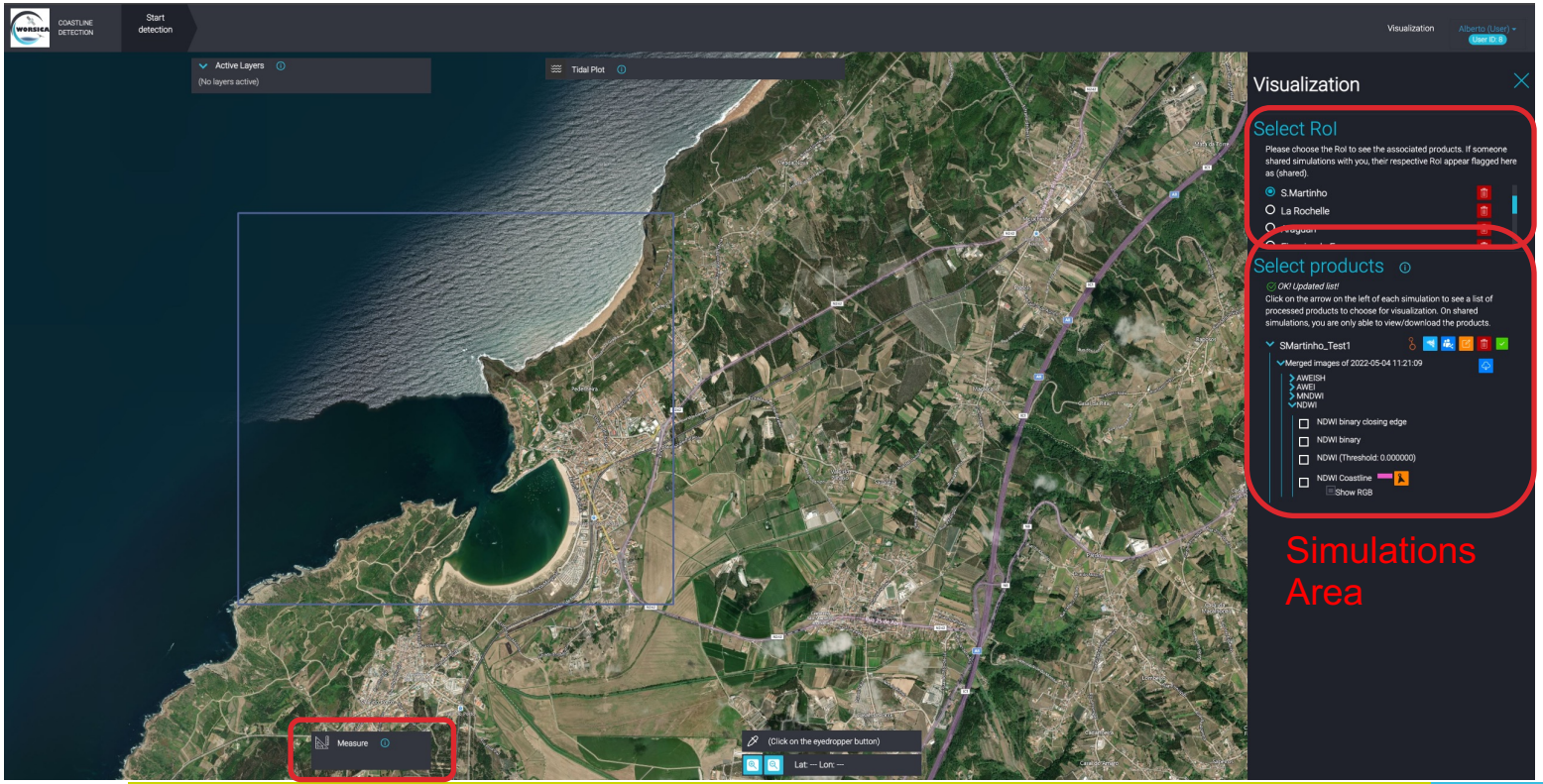
WORSICA Web Portal



ROI Area

Simulations Area

WORSICA Web Portal



ROI Area

Simulations Area

Measurements Tools

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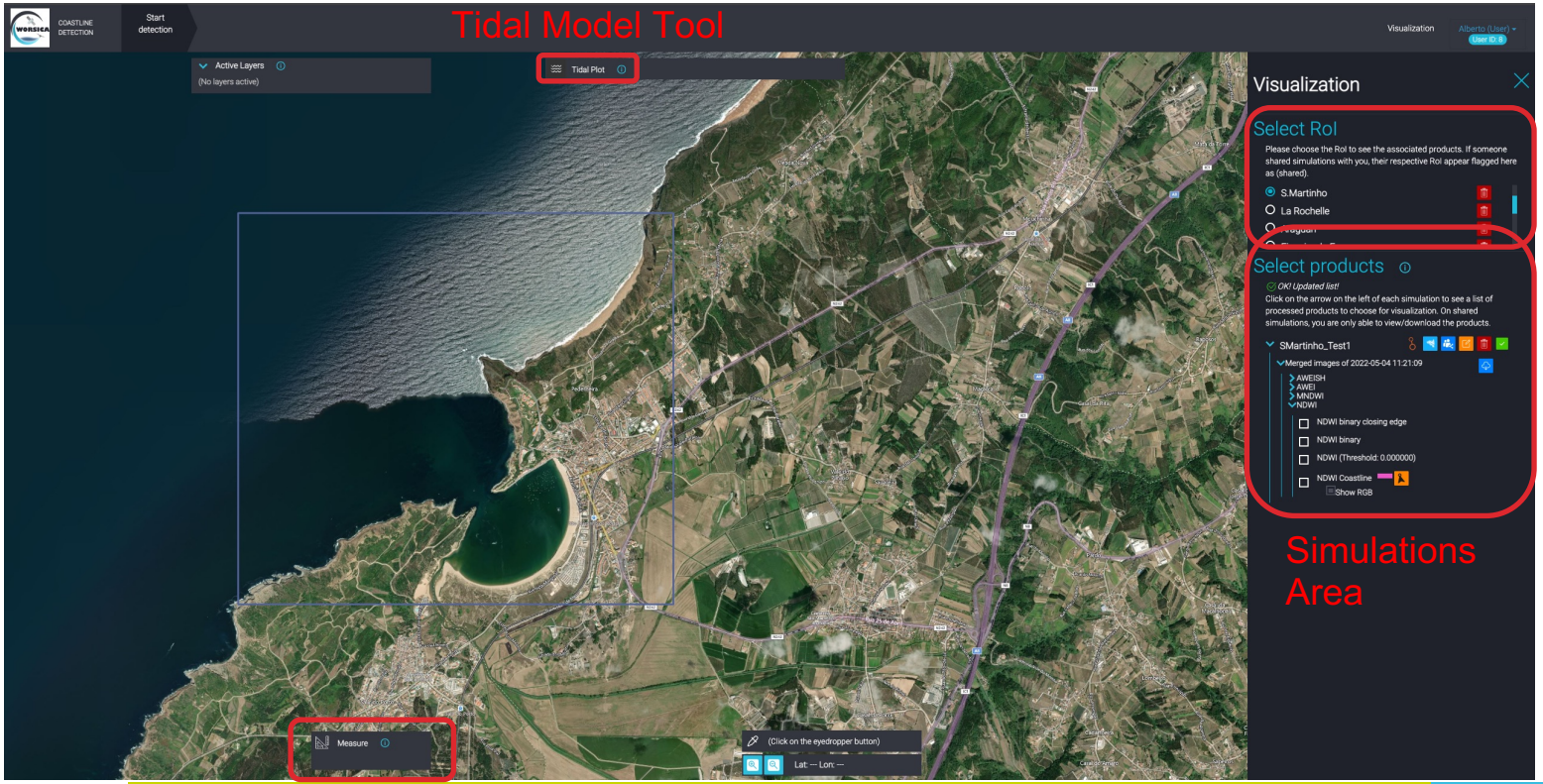

ROI Area

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Measurements Tools

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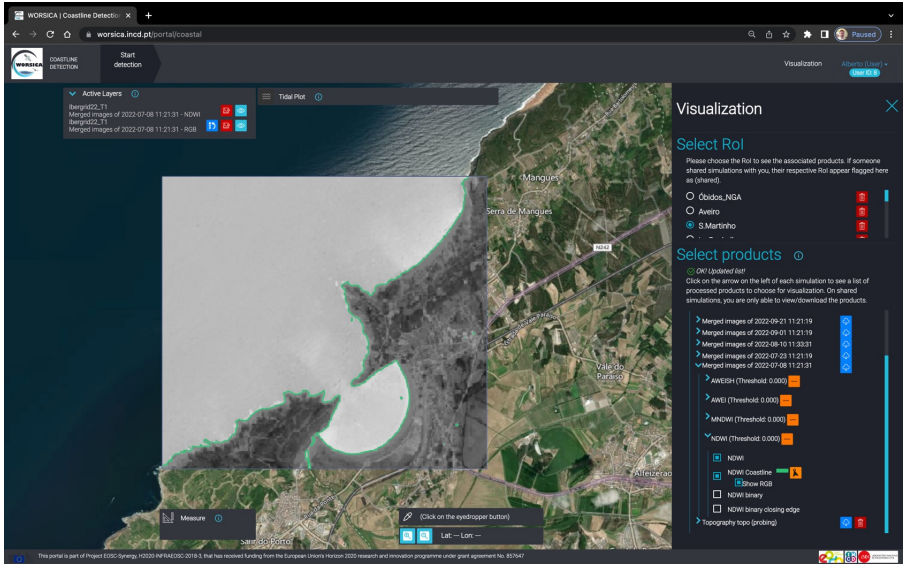
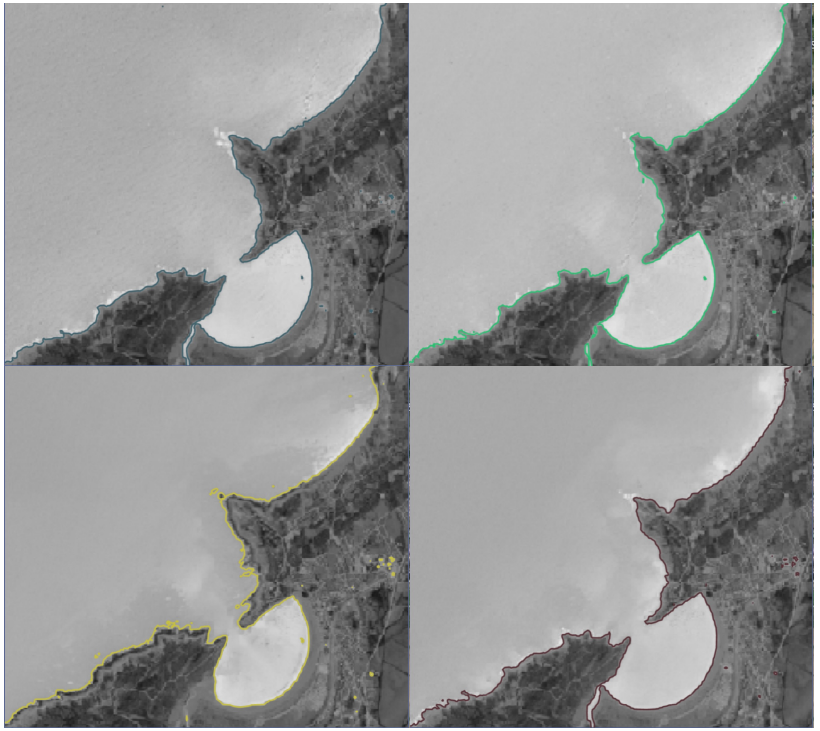




In the end, the water indexes and the coastline results are shown in the Navigation Area

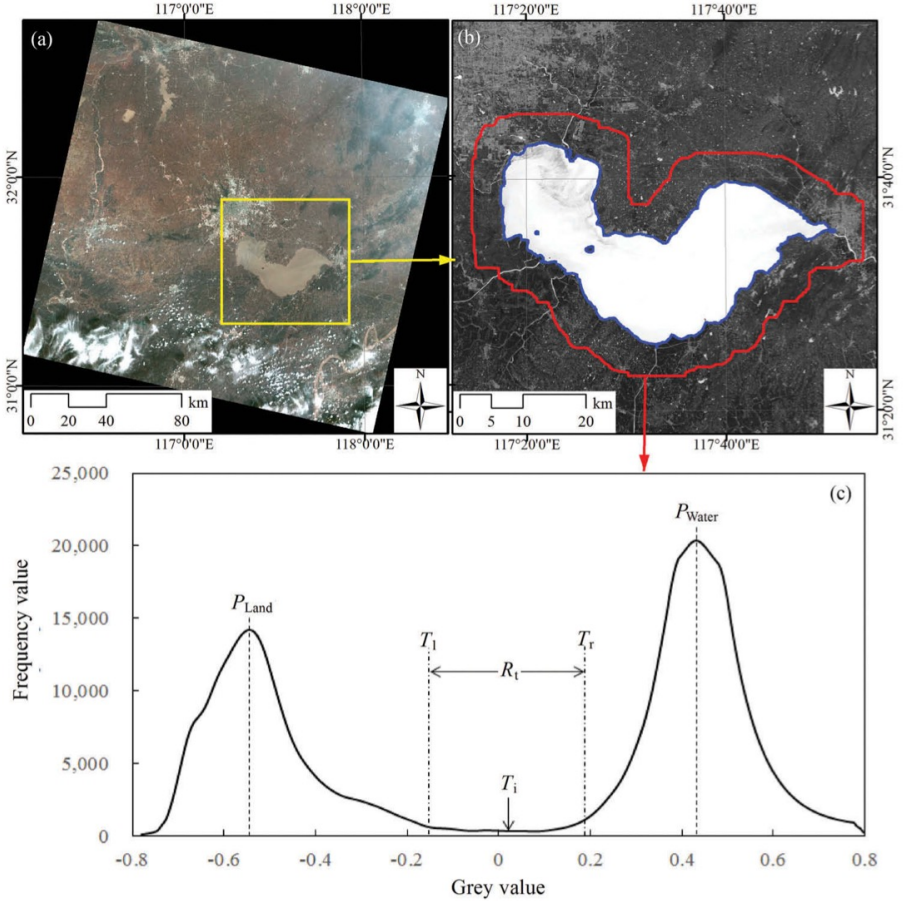
WORSICA Additional Features

- Automatic Threshold
- FES2014
- Flood2Topo
- Sub-Pixel coastline extraction
- Drone images using multispectral sensors

Automatic Threshold

Adaptation of the Modified Histogram Bimodal Method (MHBM)

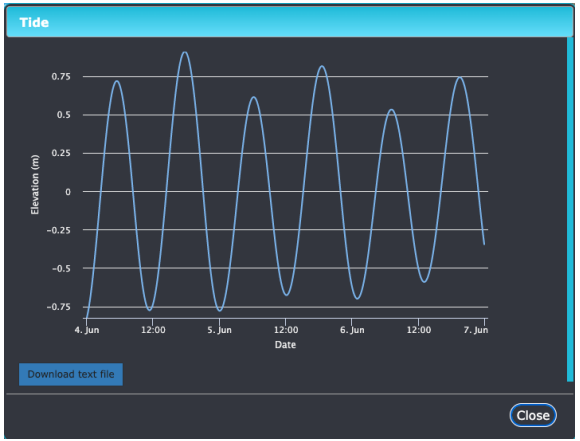
Automatic Threshold is the minimum value (T_i), between T_1 and T_r of the histogram region.



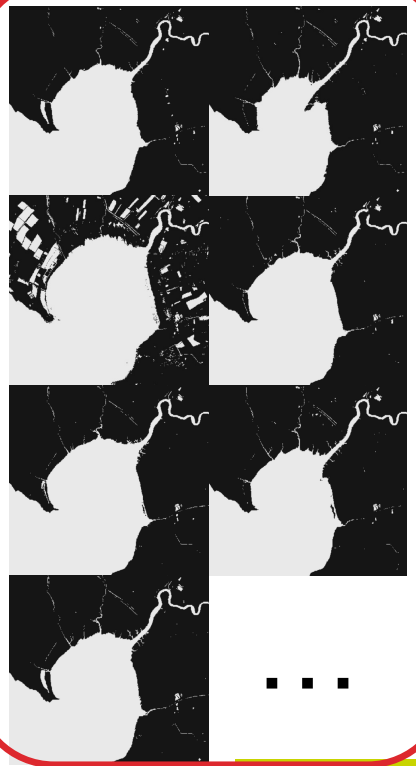
Zhang, Fangfang & Li, Junsheng & Shen, Qian & Ye, Huping & Wang, Shenglei & lu, Zoe. (2018). A simple automated dynamic threshold extraction method for the classification of large water bodies from landsat-8 OLI water index images. International Journal of Remote Sensing. 39. 3429-3451. DOI: 10.1080/01431161.2018.1444292

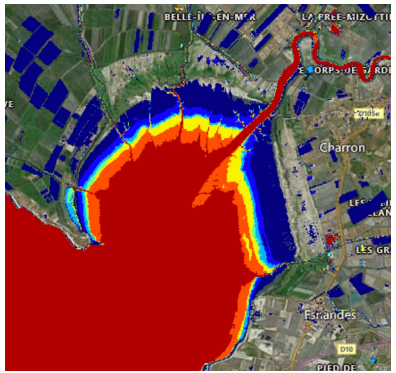
FES2014

- FES2014 is the last version of the FES (Finite Element Solution) tide model developed in 2014-2016.
- This model has been developed, implemented and validated by the LEGOS, NOVELTIS and CLS, within a CNES funded project.
- FES2014 is a combined product based on a hydrodynamic model, resulting from the resolution of the tidal barotropic equations using T-UGO model, and also assimilating altimeter data (Topex/ Poseidon, Jason-1, Jason-2, TP interleaved -J1 interleaved, ERS-1, ERS-2, and Envisat).
- The tide elevations, the tide currents and the tide loading grids are available for download.
- 34 tidal constituents are distributed on 1/16° grids (amplitude and phase) for each tidal product: 2N2, EPS2, J1, K1, K2, L2, La2, M2, M3, M4, M6, M8, Mf, MKS2, Mm, MN4, MS4, MSf, MSqm, Mtm, Mu2, N2, N4, Nu2, O1, P1, Q1, R2, S1, S2, S4, Sa, Ssa, T2.
- URL: https://www.aviso.altimetry.fr/en/data/products/auxiliary-products/global-tide-fes.html

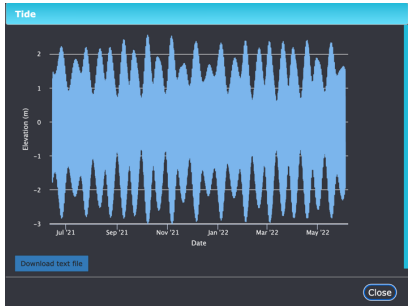


Flood2Topo in WORSICA

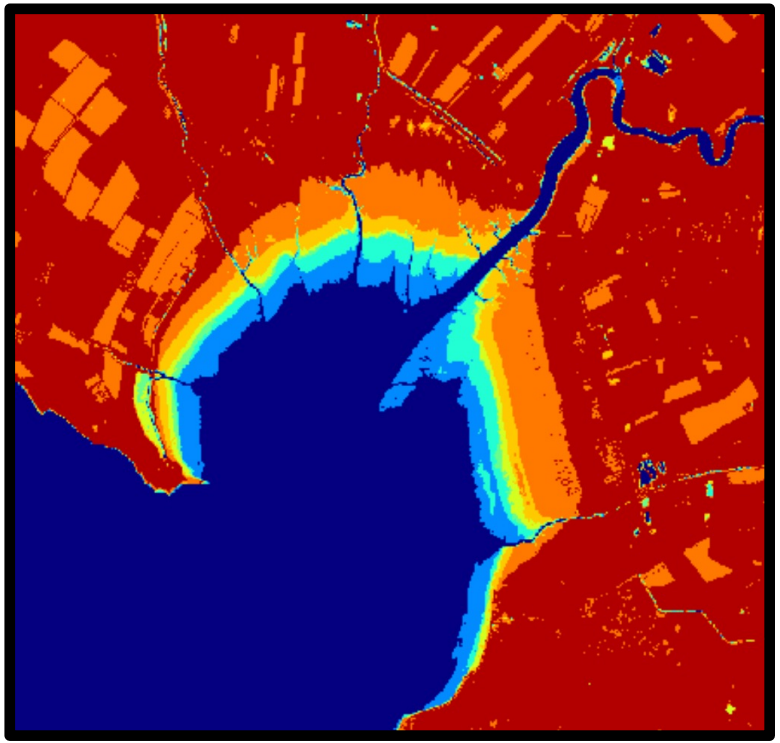




Flood Frequency

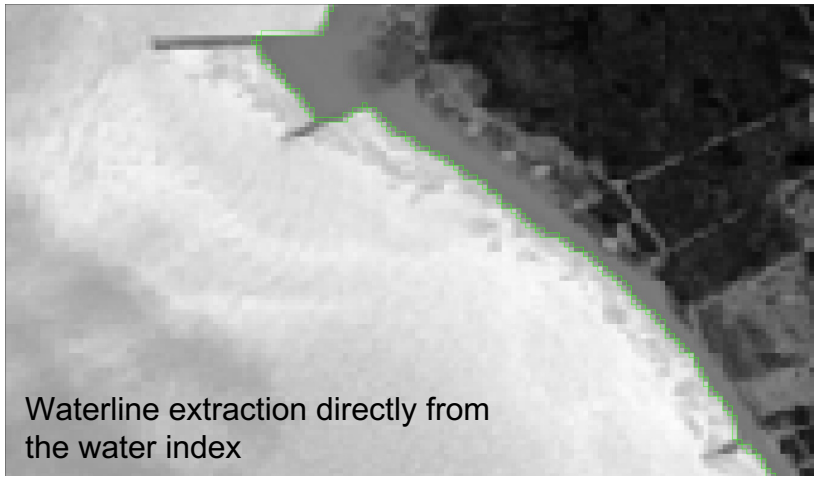


Tidal data



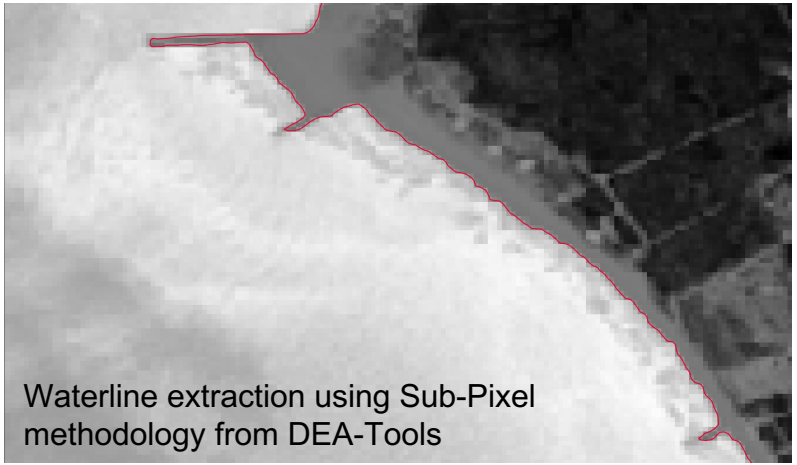
Topography

Sub-Pixel Coastline Extraction



Waterline extraction directly from the water index

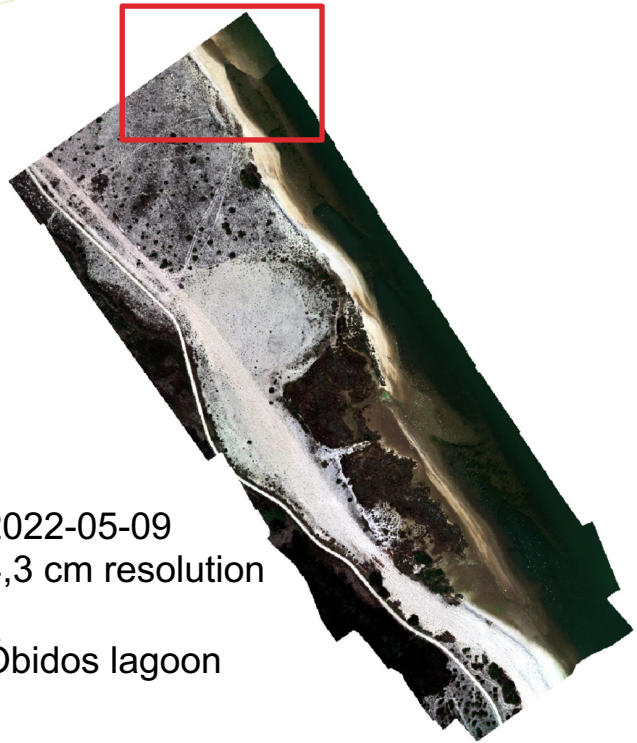
The sub-pixel methodology uses the threshold value obtained from the AutoThreshold method and the corrected height of the waterline obtained in the previous method.



Waterline extraction using Sub-Pixel methodology from DEA-Tools

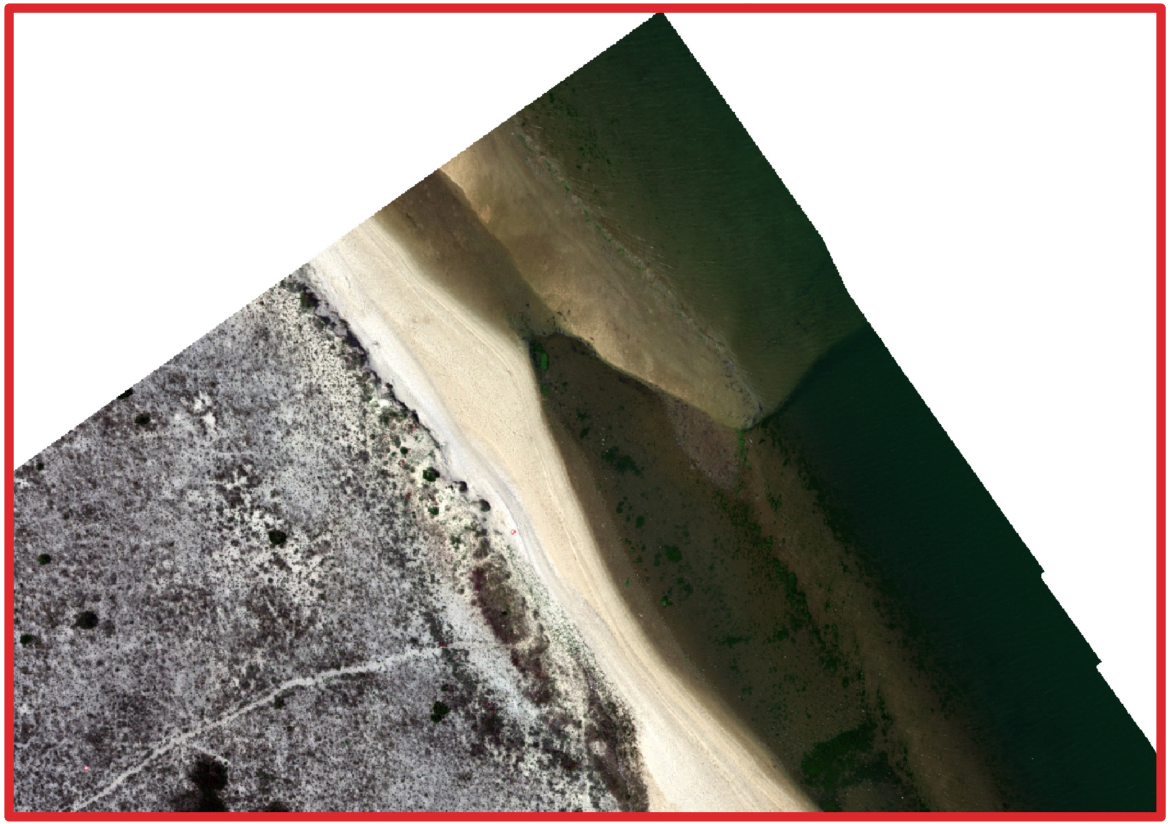
Therefore, the resulting waterline will be smoother (instead of pixelated) and will have an updated elevation/height.

Drone imagery



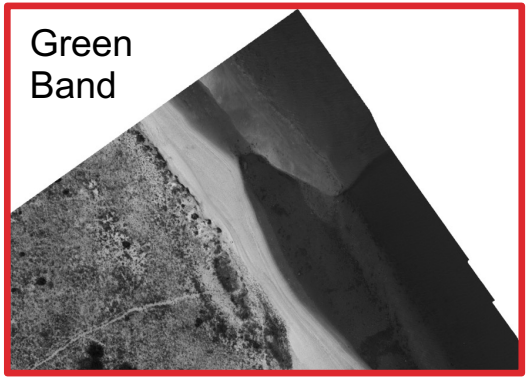
2022-05-09
4,3 cm resolution

Óbidos lagoon

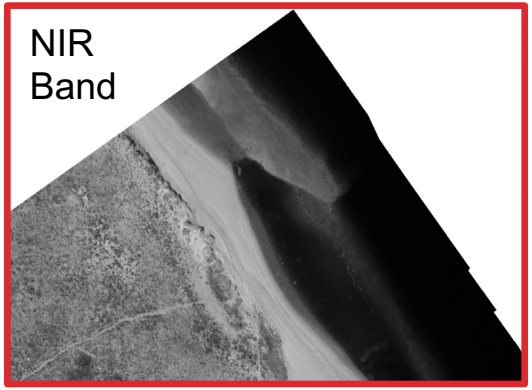


Drone

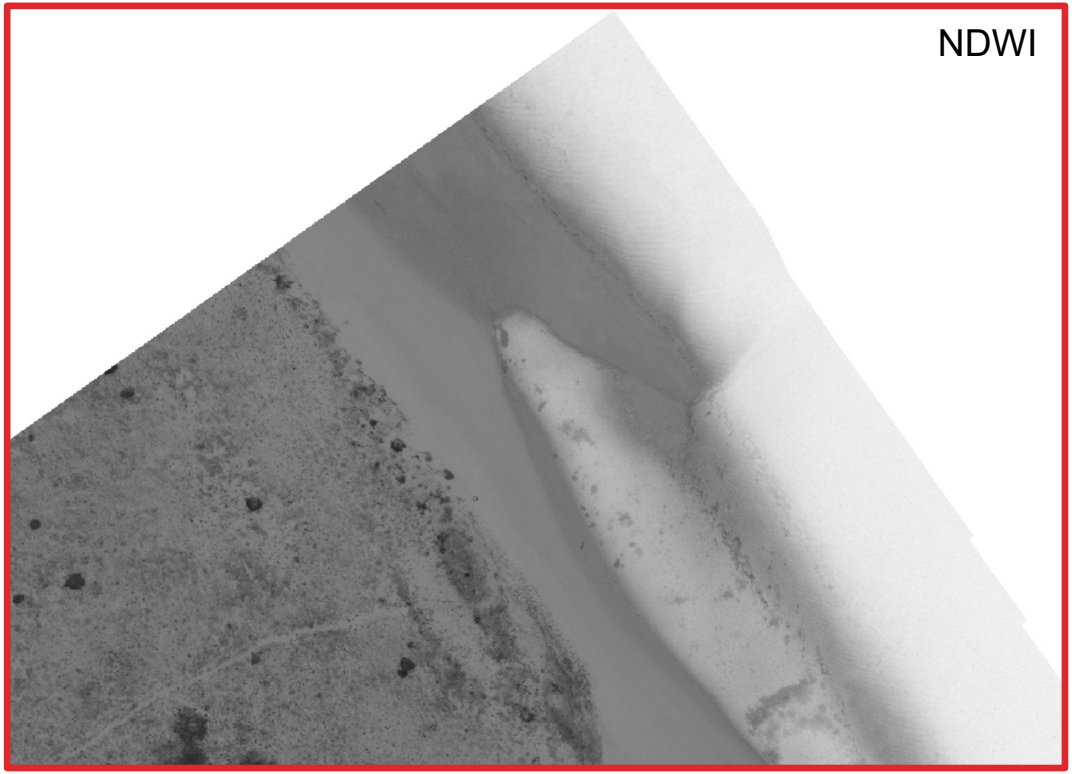
Green Band



NIR Band



NDWI



Drone

NDWI

Sentinel-2
Vs
Drone

Drone

NDWI

Sentinel-2
Vs
Drone

Future work

- Improve existing water processing algorithms
- Addition of more feature indexes (NDWI2, MNDWI2, …)
- Implementation of additional satellites and sensors (e.g., Landsat, Sentinel-1-SAR, TerraSarX, Pleiades and Drone-Multispectral)
- Improve user interaction with the portal.
- Improve interoperability with other thematic services (OPENCoastS, G-CORE, Mosaic.pt, EMODnet, Programa COSMO)
- Continuous improvement/update of the IT services implemented in the WORSICA service

Acknowledgements

- LNEC team
  - Ricardo Martins, André Fortunato, Anabela Oliveira, Américo Louro, Alphonse Nahon, Jules Buquen, Paula Freire, Maria João Henriques and Hugo Silva

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