



25ο Συνέδριο
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Greece,
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Dark Vessels Monitoring: The use of Downstream Space Applications for Maritime Security



Vasiliki (Betty) Charalampopoulou
CEO at Geosystems Hellas, Greece

01

Company

Geosystems Hellas S.A. was established in 2009 and is based in Athens with a branch in Heraklion, Greece



02

Partners

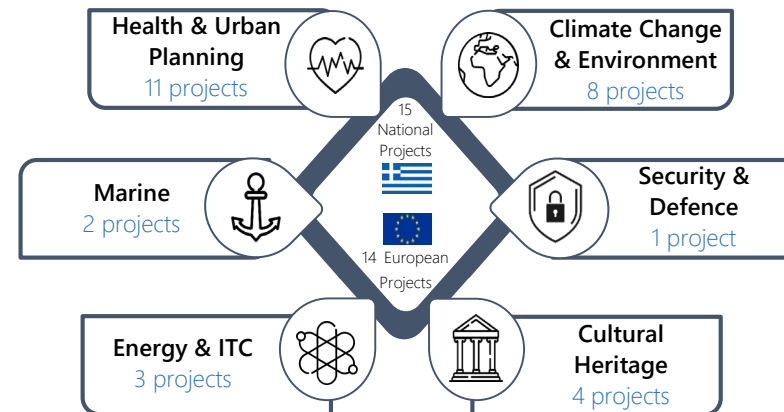
Nowadays a Greek SME with a German minority shareholder from **OHB SE (24%)**



03

International Collaborations

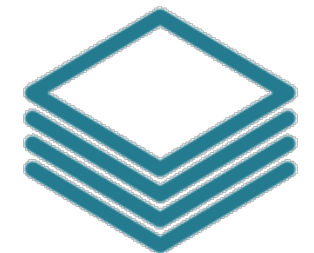
Participates in numerous commercial and R&D national and European projects

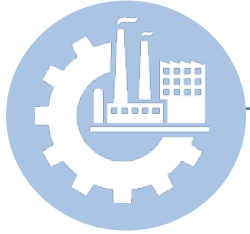


04

Qualifications

ISO 9001:2015
ISO 27001:2013
ISO 22301:2019
ISO 14001:2015
NATO SECRET-EU SECRET

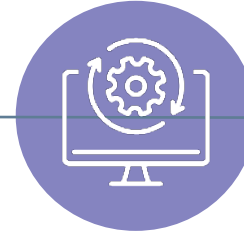




COMMERCIAL & INDUSTRIAL PROJECTS

Provision of added value services in the Downstream Space Market including Earth Observation and Navigation Applications

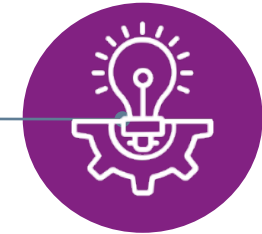
Consultant in Greece and Cyprus on complex subjects' integration on Earth Observation, IoT, and 5/6G



SOFTWARE DEVELOPMENT AND SUPPORT

Reseller & Consultant in Greece, Cyprus for Hexagon Geospatial & Hexagon Airborne Solutions

Subjects: Photogrammetry, Remote Sensing, Coastal & Marine, Geodetic & Environmental Monitoring projects



PROVIDES INNOVATION TO THE PROJECTS

R&D projects more than 15 ongoing projects (HORIZON, ESA, National)

Commercial projects : Earth Observation, Big Data – Data Fusion – Machine Learning/Deep Learning techniques

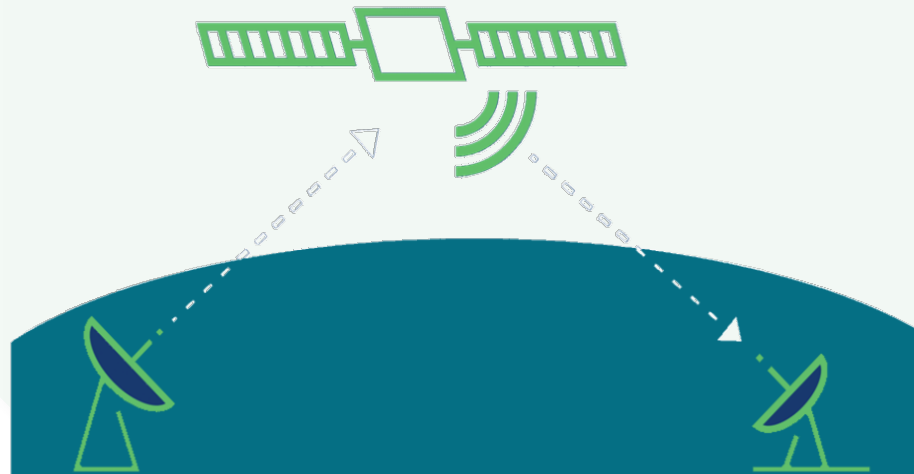


Robust satellite connectivity forms the backbone of secure communication. Uninterrupted and encrypted data flow for safeguarding sensitive information

Security in communication is reinforced by the robustness of satellite connectivity, ensuring uninterrupted and encrypted data flow. The decentralized architecture of satellite networks, enhanced by technologies like Low Earth Orbit (LEO) constellations, minimizes vulnerabilities to disruptions and cyber threats. Virtual Private Networks (VPNs) create secure tunnels for data transmission, crucial in border security applications.

Satellite communications ensure swift data transmission: real-time updates are critical for timely responses & enhanced decision-making

Satellite communications deliver unparalleled speed in information transmission, crucial for scenarios where timely responses are imperative, such as in border security. High-frequency bands like (Ka/Ku-band), coupled with advanced modulation techniques and adaptive coding schemes, enable swift and efficient data transfer. This adaptability is crucial in dynamic and challenging environments encountered in operations like dark vessel detection, enabling authorities to make informed decisions promptly and respond to evolving situations with agility.



Advanced threat detection systems ensure early identification & mitigation of cyber threats

Satellite communications prioritize cybersecurity with advanced threat detection systems, ensuring early identification and mitigation of cyber threats. Robust measures like encryption protocols, secure key exchange, and Intrusion Detection Systems guarantee the integrity and security of data transmitted through satellite channels.

Utilization of Satellite Imagery for Enhanced Maritime Security

In the digital age, secure connectivity, fast information delivery, and accurate communication are paramount, especially in the security sector.

Role of Satellite Technology: Fast and secure

Satellite technology is a game-changer in maritime security and preventing illegal activities in the sea.

It offers fast and secure communication, which is key for real-time responses and decision-making.

Additional Aspect: Global Coverage and Accessibility

Satellite communications offer global coverage, reaching even the most remote and inaccessible regions. This global accessibility is a strategic advantage for maritime security, enabling authorities to establish communication infrastructure in areas where traditional networks might be challenging to implement. The ubiquity of satellite coverage ensures that no region is beyond the reach of secure and fast communication.

Detecting Dark Vessels

'Dark vessels' refer to ships that engage in illegal activities while remaining undetected by turning off their tracking systems. Satellite imagery can play a crucial role in detecting these vessels, even in the vast expanse of the ocean.

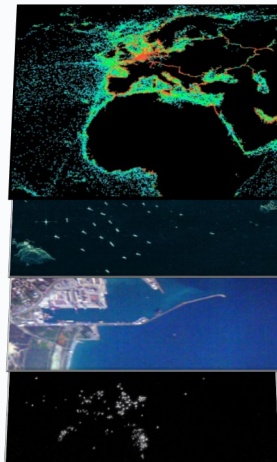
These images provide a wealth of data for the maritime security sector, with real-time insights which aid in the detection and prevention of illegal activities.





ESA's ARTES 4.0 strategic programme line 'Space Systems for Safety & Security'

MAGINet leverages satellite imagery for dark vessel detection, showcasing the broad applications of satellite technology. By integrating various EO data with AIS data, MAGINet enhances surveillance capabilities, offering a **comprehensive solution for maritime security**.




Various supplementary EO datasets

All validated with AIS and RF data

Improve the detection rate, identification and tracking capabilities

 ESA satellites and Copernicus Contributing Missions

 Micro- and Nano-satellite optical and SAR missions

 Night-lights data

Validated with

AIS & RF data

Combined with

Geolocation data & FRAs polygon exclusion



Complete maritime picture

- Daily & Nightly
- General dark vessels
 - Illegal fishing vessels

MAGINet capabilities

- integrating various data sources (including optical & SAR imagery, AIS and RF data fusion)
- achieving vessel detection through day and night
- employing state-of-the-art AI algorithms

Benefits

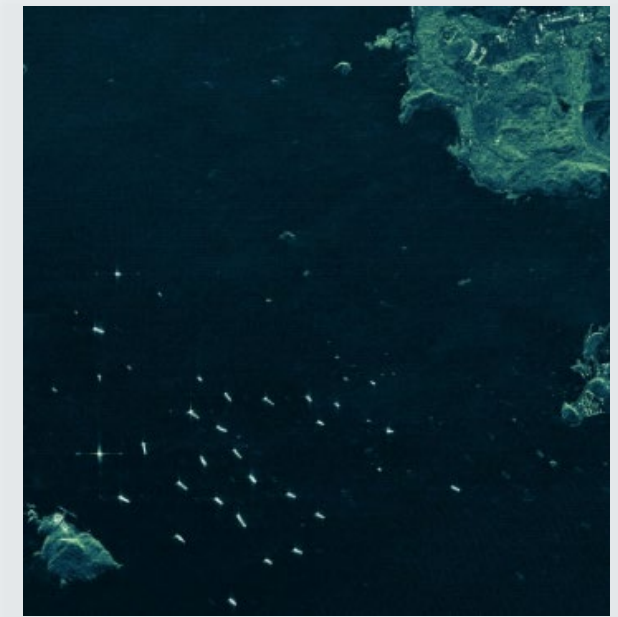
- Enhances the customer's maritime situational awareness
- Improved vessel detection rate & identification accuracy
- User-centric approach
- Easy-to-use service with intuitive information products



VHR Optical Imagery e.g. Worldview



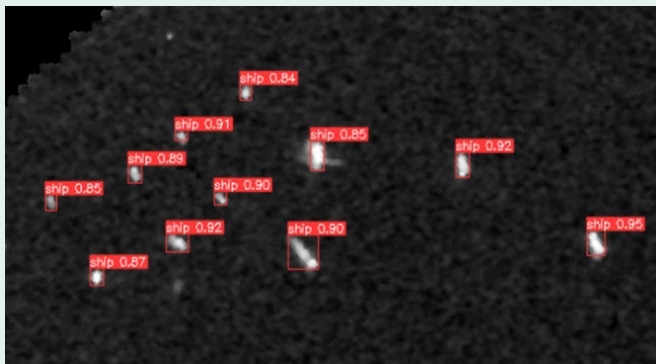
Video data e.g. NEMO-HD



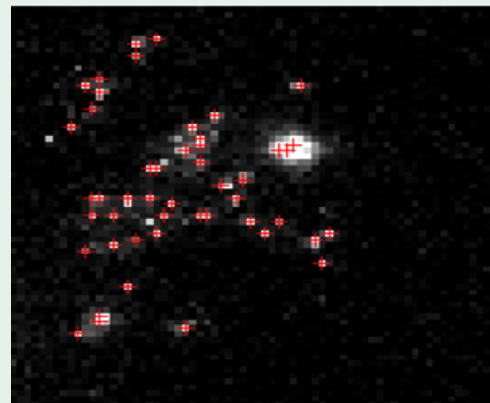
VHR SAR imagery
e.g. ICEYE



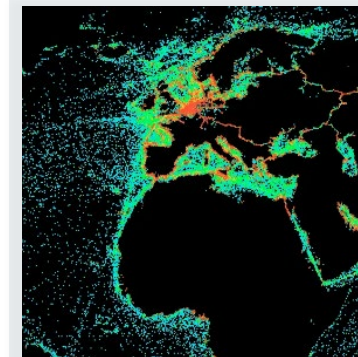
MAGINet



High-res SAR imagery e.g. Sentinel-1



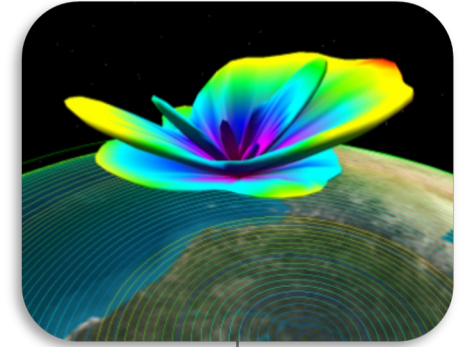
Nightlights radiance e.g. VIIRS-DNB



Each RF emitter has its own **unique "fingerprint"**, linked with a tracked ship

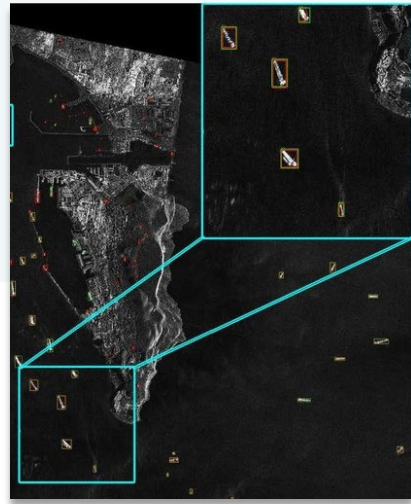
RF data provides valuable information for detecting targets. When RF data is overlaid with AIS, targets can be identified. Fusion with EO data allows providing other types of information not available in RF.

MAGINET PROJECT - WORK LOGIC



EO sources

Optical Data
MS HR/VHR imagery & video data
SAR Data



ML Model for high accuracy object detection

Detected targets
Optical products
SAR products

Daily MS/SAR data

Nightly SAR data

Nightlights Data

Vessels operating at night

Fusion with other data

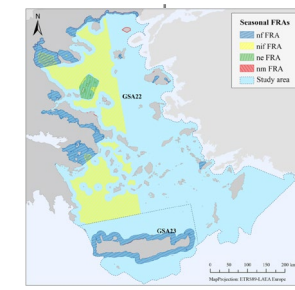
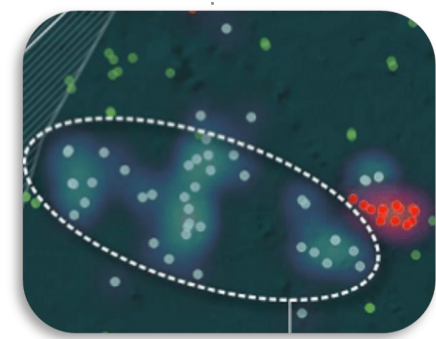
AIS & RF

Identified Dark Vessels

Geolocation data & FRAs polygon exclusion

Illegal fishing vessels (day)

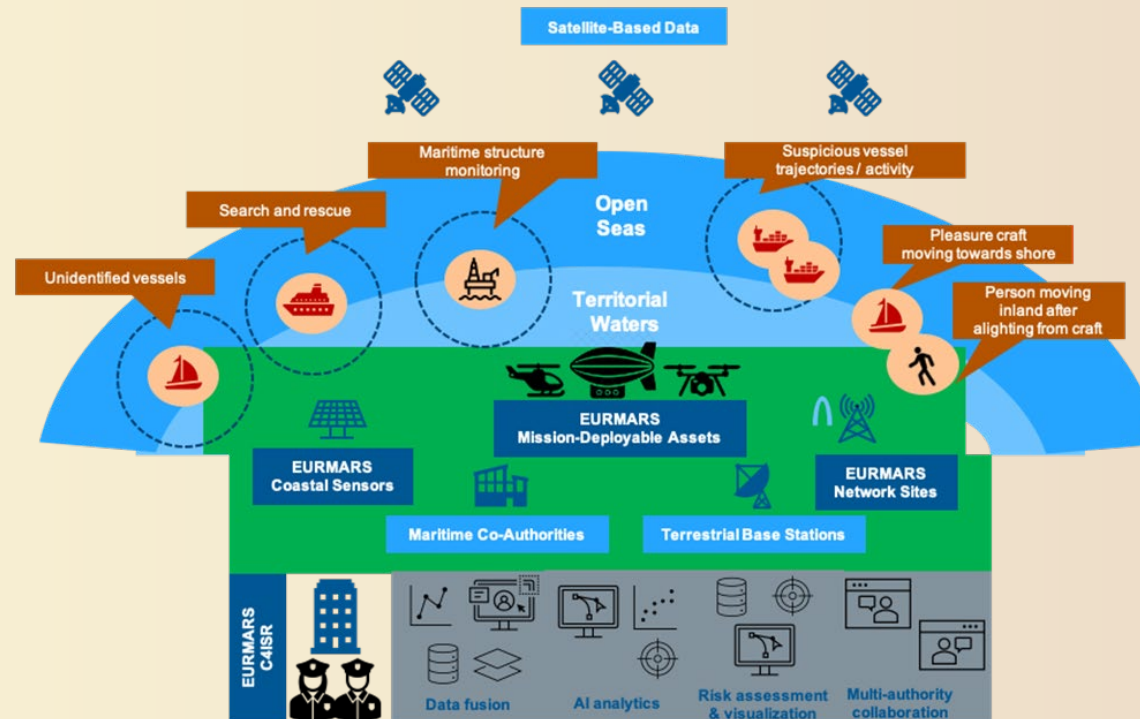
Illegal fishing vessels (night)



The **EURMARS** project aims to develop a **multifunctional monitoring platform** with the goal of enhancing and facilitating both the efficiency and cooperation of multiple European authorities responsible for border surveillance.



This project has received funding from the European Union's Horizon Europe research and innovation programme under Grant Agreement No. 101073985



The platform will contribute to improving **risk and threat management** encountered in wide border areas by **combining multiple technologies**, knowledge and experience of all interested parties through the deposit of previous related projects and initiatives,

in order to **mitigate problems such as illegal immigration, drug trafficking, and others.**

Enhancing Border Security in EUROPE

Border Security is of growing importance as the world faces new challenges.

The use of satellite imagery can significantly enhance border security. By providing real-time, accurate data, it can aid in proactive monitoring and addressing security threats. Fast and accurate communication is key in these scenarios, allowing for swift action to be taken.



Objectives

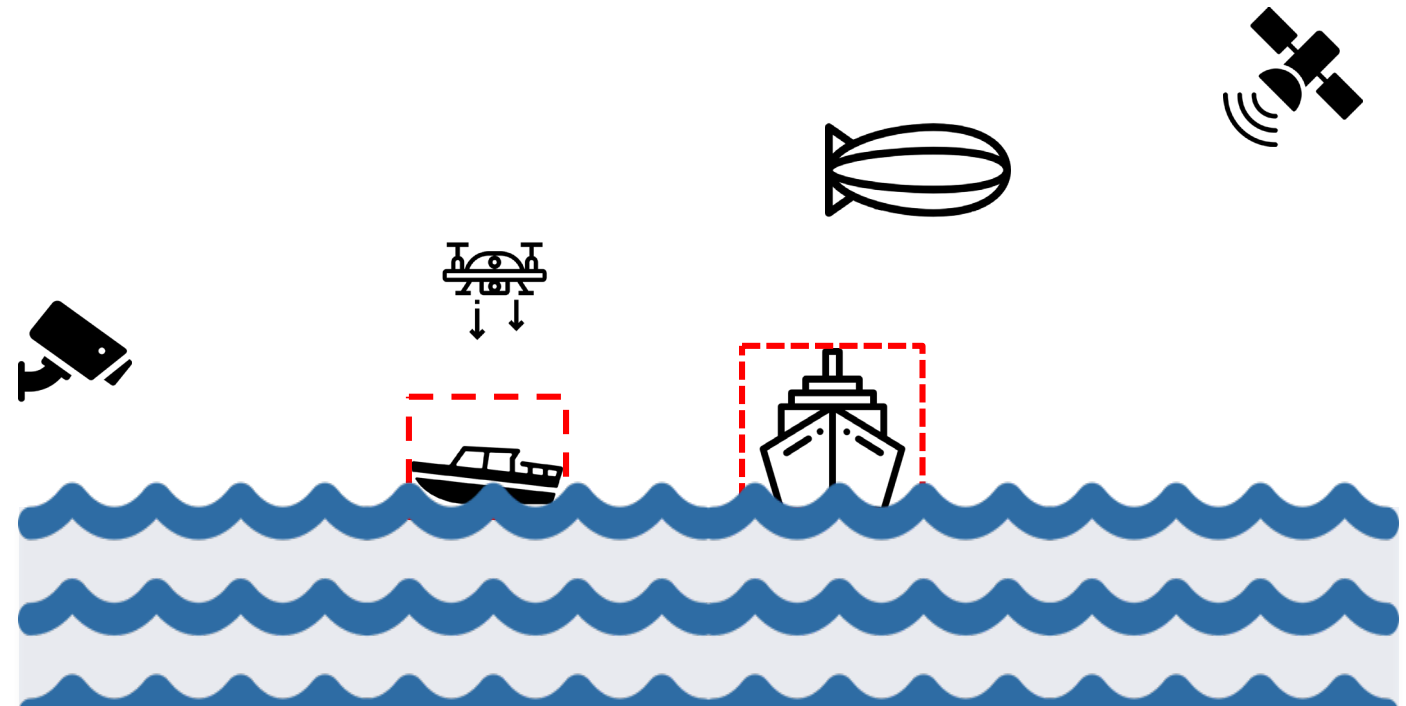
- **Improve border authority surveillance capabilities** by enhancing critical quality characteristics of aerial and ground-based sensor platforms
- **Enhance the security and risk assessment** performance of border surveillance solutions

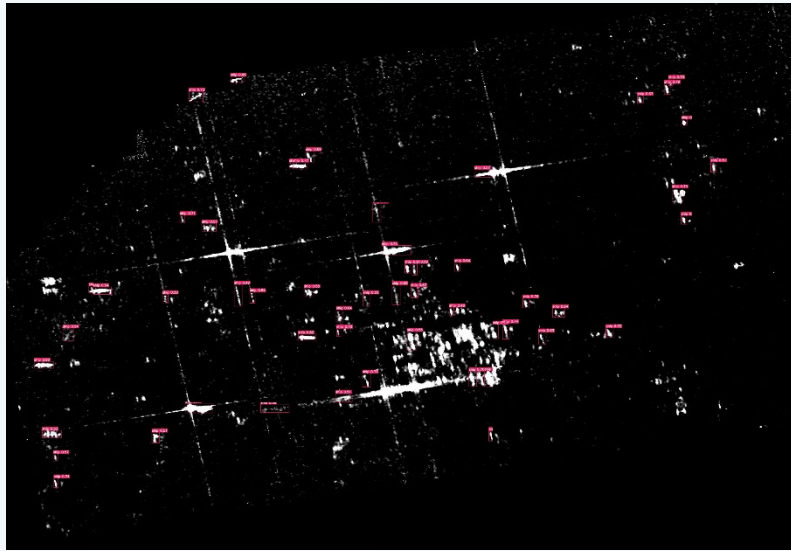
➤ Use of Digital Interfaces & Integration of Existing Infrastructures

➤ Multimodal Data Fusion

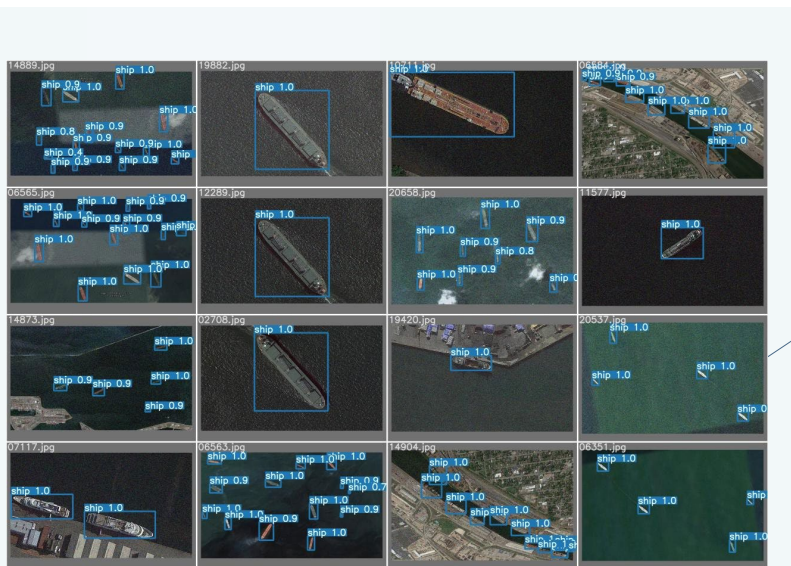
EURMARS consists of 4 sensing systems:

- Coastal Ground and
- Low Altitude Sensing Systems
- High Altitude Sensing Systems
- **Satellite Based Systems**





SAR image at 1 m spatial resolution (COSMO-SkyMed)



Predictions of test datasets for optical imagery

Ambition

- A flexible **interoperable surveillance platform** with verified easy-to-integrate potential for next generation platforms and systems
- A benchmark for adopting advanced **data fusion and AI-based analytics** in the production of maritime situational awareness
- Delivery of **advanced decision-making support tool** and enhanced user interface under a cyber-secure platform

EURMARS
Date Range
07/08/2023 - 25/09/2023
Port
limasol
Detection Type
ship

Detections

- Landsat9_limasol_20230807_176036_TIFF_S
- Landsat8_limasol_20230815_176036_TIFF_S
- Sentinel1_limasol_20230830T154957_050107_TIFF_S
- Sentinel1_limasol_20230831T035156_050114_TIFF_S
- Landsat8_limasol_20230831_176036_TIFF_S
- Sentinel2_limasol_20230811T082611_T36SVD_TIFF_S
- Sentinel2_limasol_20230811T082611_T36SWD_TIFF_S
- Sentinel2_limasol_20230831T082611_T36SVD_TIFF_S
- Sentinel2_limasol_20230905T082609_T36SVD_TIFF_S
- Sentinel2_limasol_20230905T082609_T36SWD_TIFF_S
- Sentinel1_limasol_20230912T035157_050289_TIFF_S
- Sentinel1_limasol_20230911T154958_050282_TIFF_S
- Landsat8_limasol_20230916_176036_TIFF_S
- Sentinel1_limasol_20230923T154958_050457_TIFF_S
- Sentinel1_limasol_20230924T035157_050464_TIFF_S
- Sentinel2_limasol_20230915T082609_T36SVD_TIFF_S

Demo platform of EURMARS's Satellite Based Systems



The utilization of satellite imagery can greatly enhance maritime security.

Satellite communications are poised to see significant advancements in the future. With improvements in secure connectivity and fast information delivery, the potential applications of this technology are vast.

The investments made today in this technology will lay the foundation for the Information Technology and Telecommunications landscape of tomorrow. The role of next-generation networks and their applications in satellite communications is certain to be further researched in the future, to harness its full potential.



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Thank you
Any questions?

