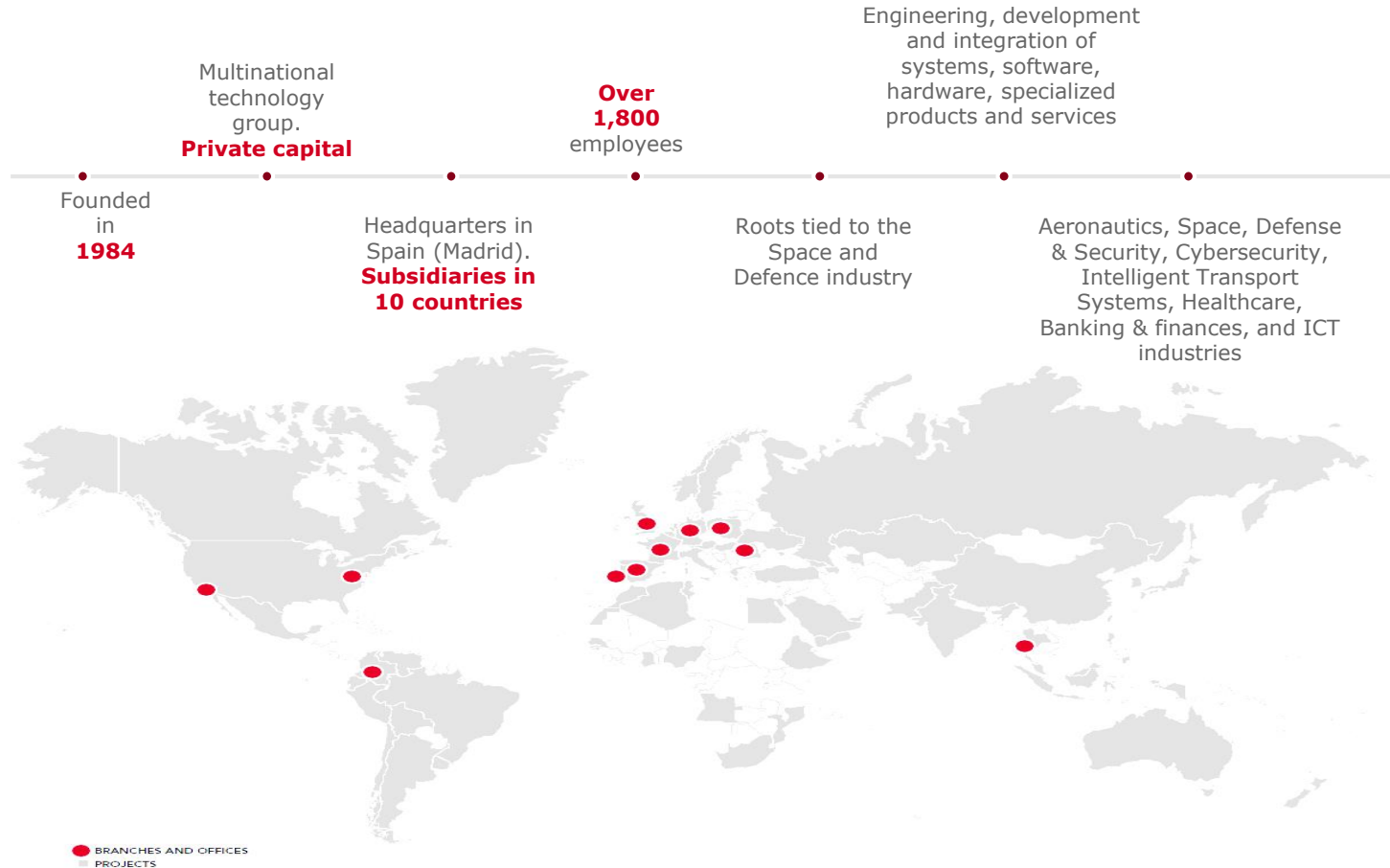


# SIMONS – GMV's SHIP MONITORING SERVICE



**gmV**<sup>®</sup>  
INNOVATING SOLUTIONS

# A global technology group



# International technology leadership



**#1 Worldwide**  
Satellite Control  
Center provider to  
commercial  
telecom operators  
(+300 Satellite  
missions  
worldwide)



**First** ever  
**worldwide**  
intraoperative  
radiotherapy  
planning system



**Responsible** of  
safety critical  
systems of  
European GNSS  
systems (EGNOS  
and Galileo)



**Leader** of  
Intelligent  
Transportation  
Systems for the  
**public  
transport  
sector** (+100  
cities in Europe,  
Asia and  
America)



GMV's **checker  
ATM security** is  
the worldwide  
leader as  
multivendor cyber  
security  
protection for  
ATMs

# GMV: Remote sensing services and applications

**GMV Copernicus services with already 5 framework contracts in the security and emergency thematic areas**



## **SUPPORT TO EU EXTERNAL ACTIONS**

- Overview/Detailed topo-information
- Identify belligerent actions
- Tracking exodus
- Contingency plans
- Evacuation & rapid reaction
- Post conflict recovery



## **LAND BORDER SURVEILLANCE**

Overview/Detailed topo-information  
Identify treaties transgressors  
Illegal human trafficking  
Illegal infrastructures  
Automatic intrusion detection



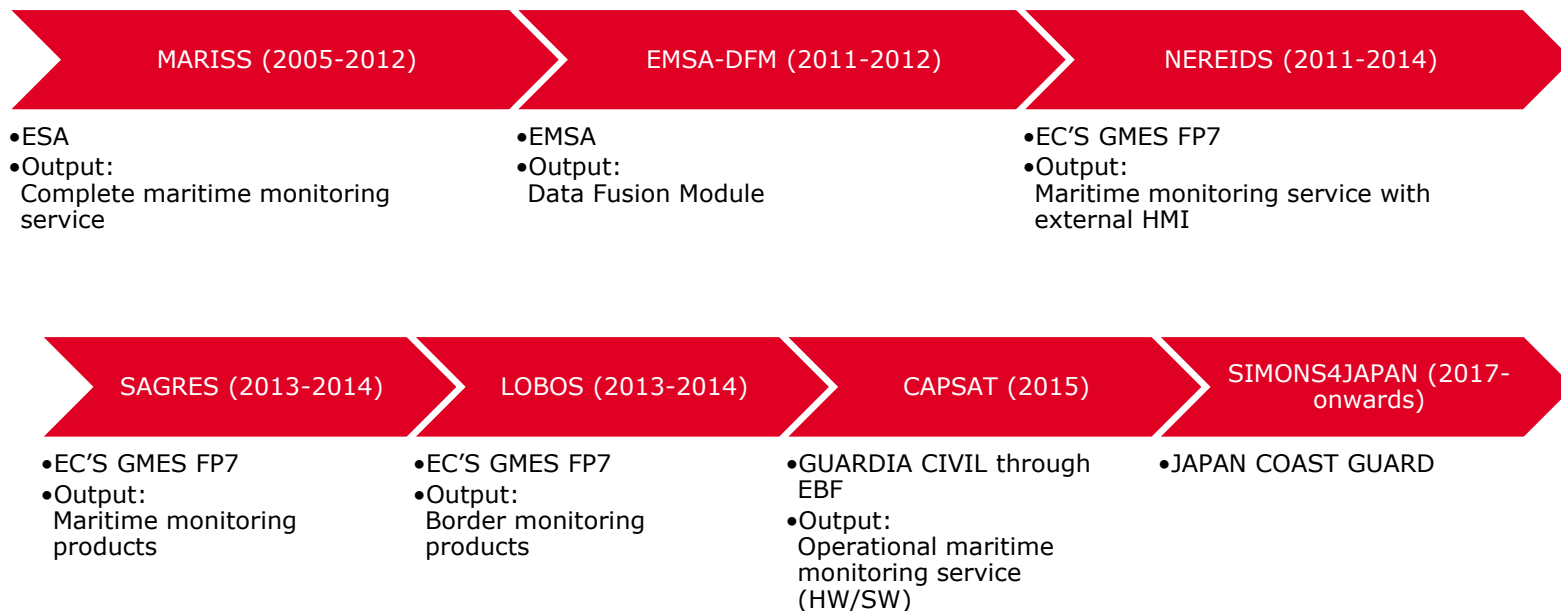
## **EMERGENCY MANAGEMENT SERVICE**

Support of European emergency response in case disasters (Fires, Floods, Earthquakes, ,etc.)  
Rapid mapping  
Damage assessment  
Risk and recovery analysis

# SIMONS – Ship Monitoring Service

# Maritime background

**GMV experience in the maritime security domain ongoing for almost 15 years**



# SIMONS....What is?

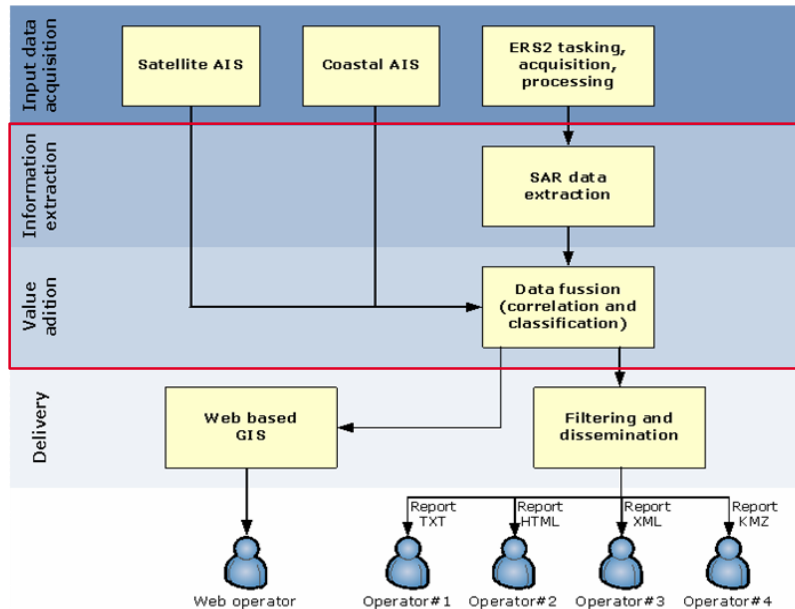
## Ship Monitoring Service (SIMONS)

Where EO data (SAR/Optical) and collaborative polls (e.g. AIS, LRIT, VMS, etc.) are merged together to provide advanced ship detection and categorization.



### MARITIME SURVEILLANCE

- Vessel detection & categorization
- Integrate EO+AIS
- NRT <3h
- Coastal mapping
- Oil spill mapping
- Port monitoring
- Ship tracking



Data acquisition

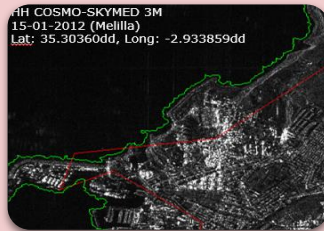
EO data processing

Data fusion

Visualization and report

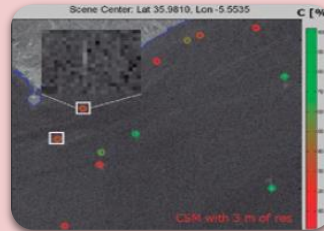
# SIMONS core.... What is inside?

## Processing capabilities



### Land Mask

- SAR: using wavelets and Geodesic Active Contours



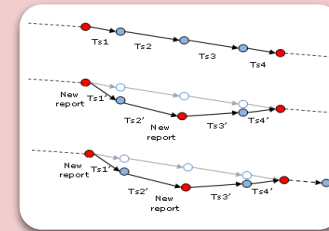
### Ship Detection

- SAR + Optical: Wavelets / Segmentation;
- Capable of detecting small boats (>4m)



### Ship Categorization

- SAR: 9 categories using fuzzy logic

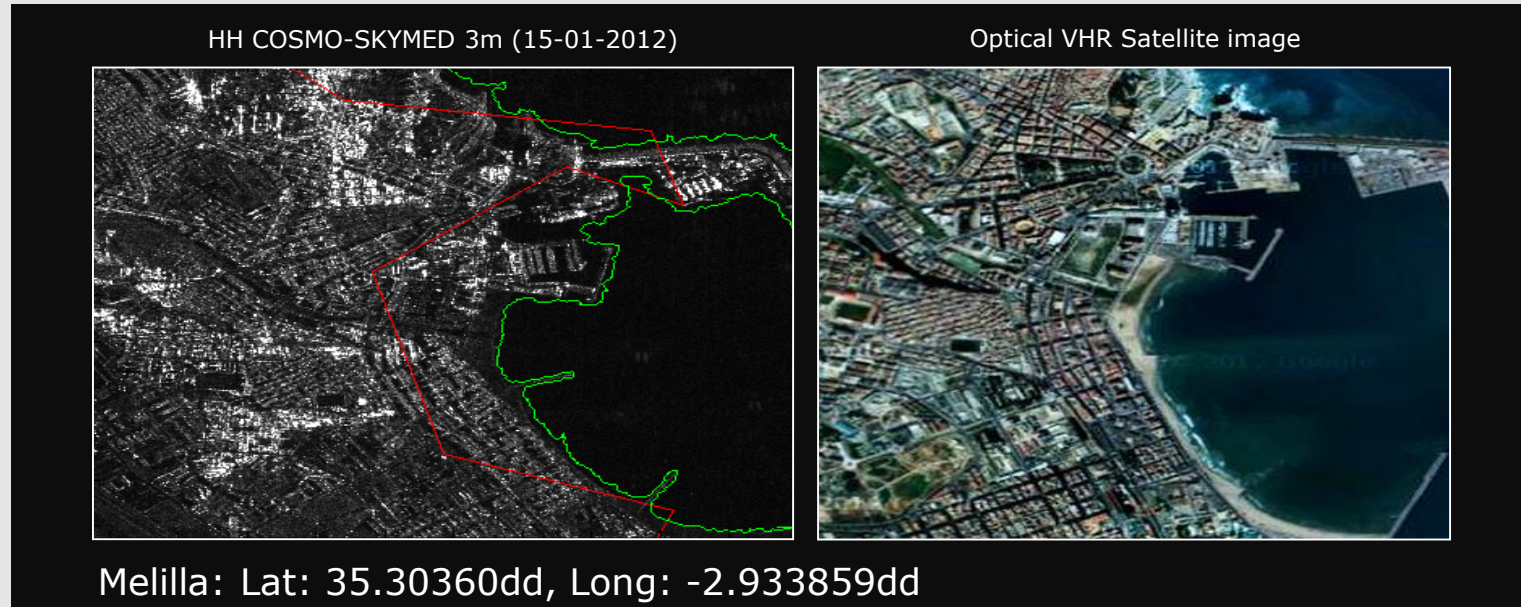


### Ship Tracking

- SAR: Fuzzy logic; AIS+VDS



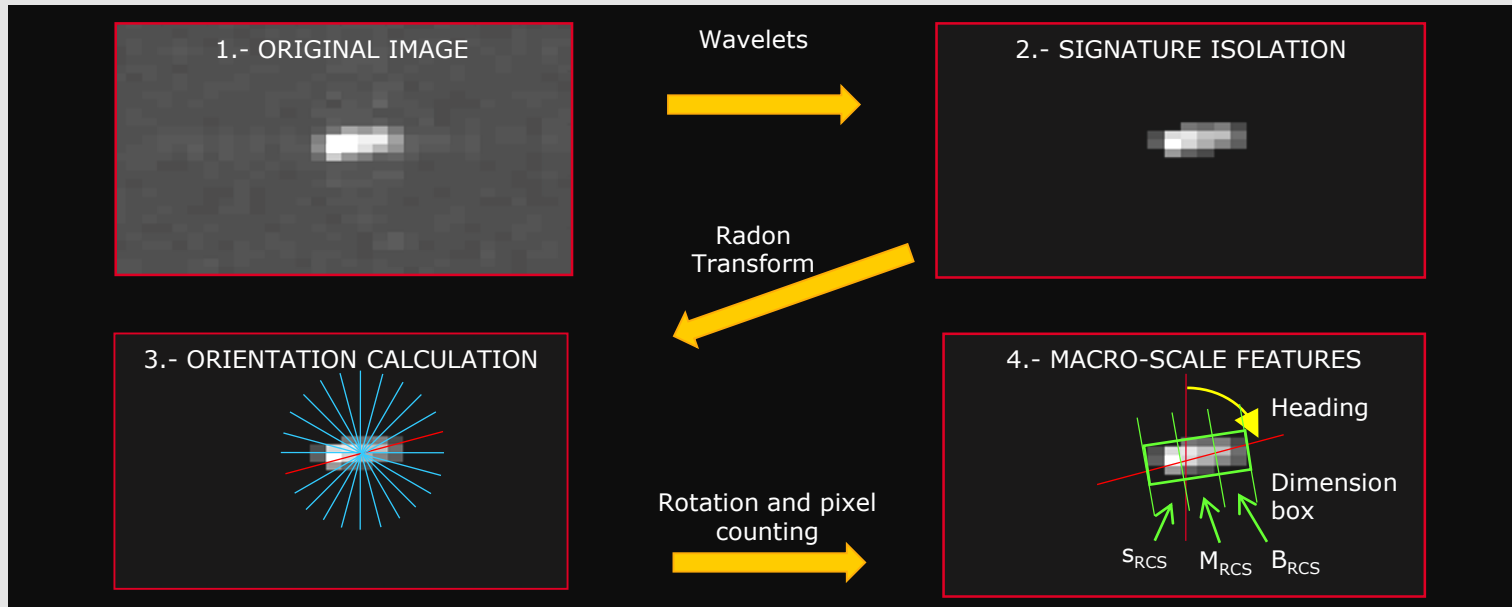
# Processing capabilities: land masking



Land Masking generation using:

- Wavelet + Geodesic Active Contours
- Usage of external coastline vector file (if properly accurate).

# Processing capabilities: ship categorization



## Confidence to quantitatively measure detection reliability:

$C < 0.4 \rightarrow$  ship-alike sea features (wave crests)

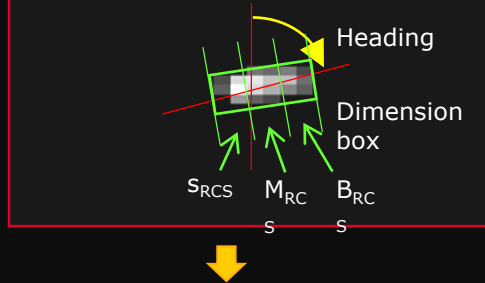
$0.4 < C < 0.7 \rightarrow$  less dispersive ships (smaller and made of less reflective materials)

$C > 0.7 \rightarrow$  ships visible by eye inspection.

# Processing capabilities: ship categorization

## SHIP CLASSIFICATION

### 4.- MACRO-SCALE FEATURES



Category	$S_{RCS}$	$M_{RCS}$	$B_{RCS}$	Length [m]	Breadth [m]
Oil Tanker	High	Low	Low	300	45
Chemical	High	Low	Medium	200	35
Coaster	High	Medium	Low	100	25
Goods Cargo	High	Low	Medium	150	25
Gas Cargo	High	High	Low	200	35
Bulk	High	Medium	Low	200	35
Container	High	High	High	225	45
Car Ferry	Medium	High	Low	150	25
Fishing vessel	Medium	High	Low	90	25
Small targets	Low	Medium	Low	40	10

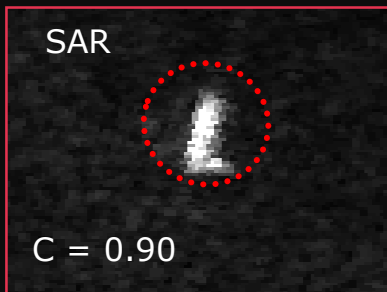
5.- PARAMETRIZATION ->  $P = \{B_{RCS}, M_{RCS}, S_{RCS}, L, B\}$

6.- FUZZY LOGIC BASED RULE APPLIANCE

Quality descriptor	Value
Processing Time	<ul style="list-style-type: none"> <li>5-6 min for a 40x40 km stripmap image</li> <li>7 min for a 10x10 km spotlight image</li> <li>10 min for a 100x100 km ScanSAR image</li> </ul>
Probability of Detection	> 95 % for ships with length > 4 x image resolution
Categorization rate	~70 % for ships with length > 12 x image resolution

# Processing capabilities: ship categorization

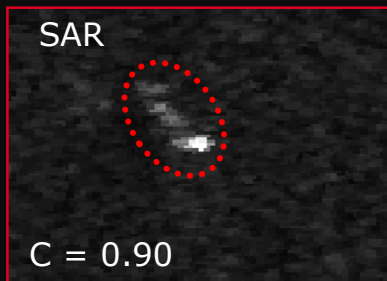
✓ Ship classification validated with AIS polls



Ship: Container  
Length: 260 m  
Beam: 40 m  
Bearing: 010



Ship: Container  
Length: 277 m  
Beam: 40 m  
Bearing: 010

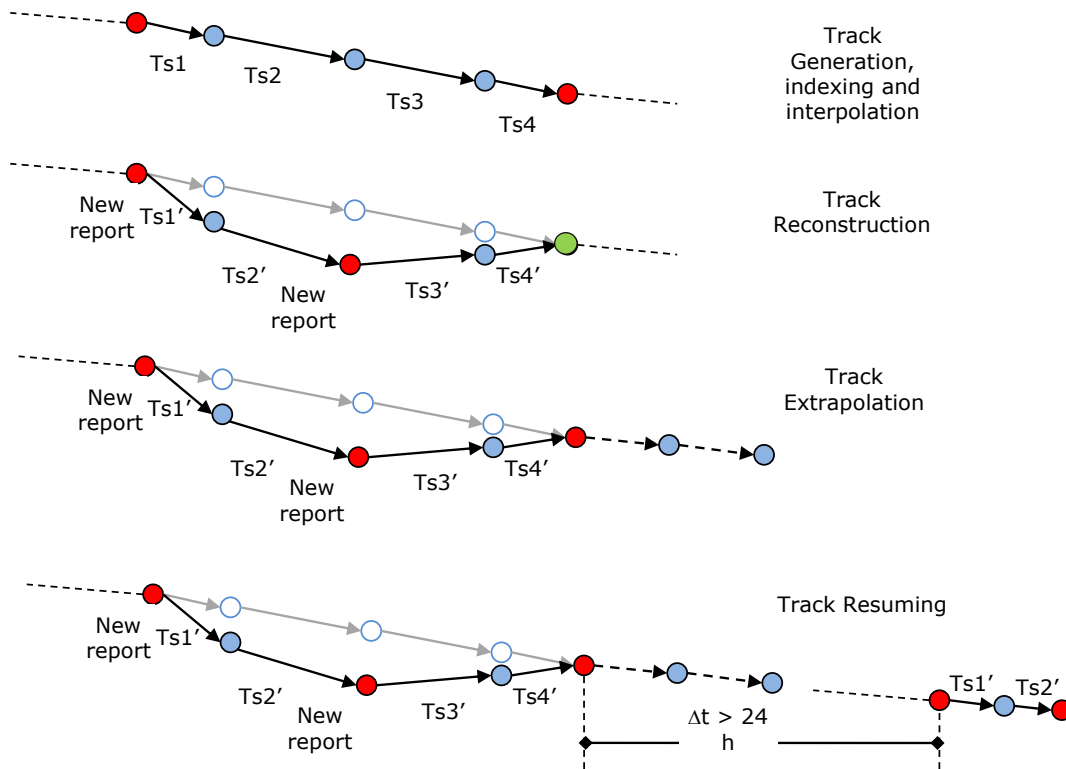


Ship: Oil tanker  
Length: 228 m  
Beam: 32 m  
Bearing: 340



Ship: Oil tanker  
Length: 228 m  
Beam: 32 m  
Bearing: 340

# Processing capabilities: ship tracking

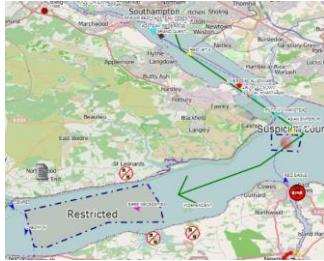


## Three main elements are used:

- Reported → come from collaborative sensors
- Detected → come from EO-based detection systems
- Calculated → calculated to meet constraints and time grid

# VISUALIZATION

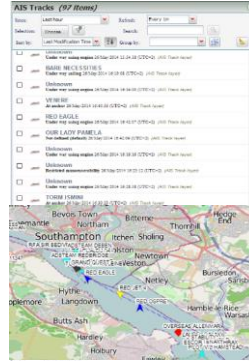
Integration of SIMONS with GMV's Control Centre or third party system to provide advanced visualization functionalities



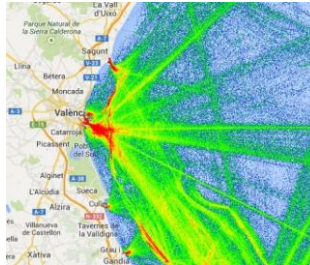
Rule-based alarms



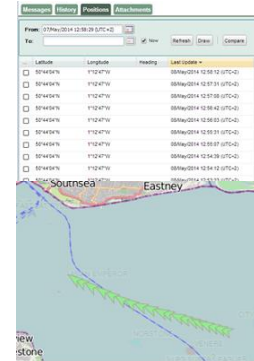
Alert handling



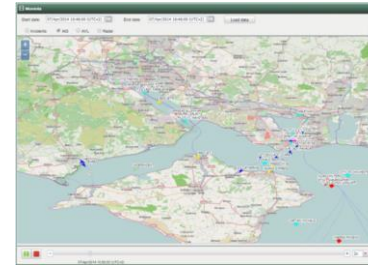
AIS track management



Statistics



Historic queries

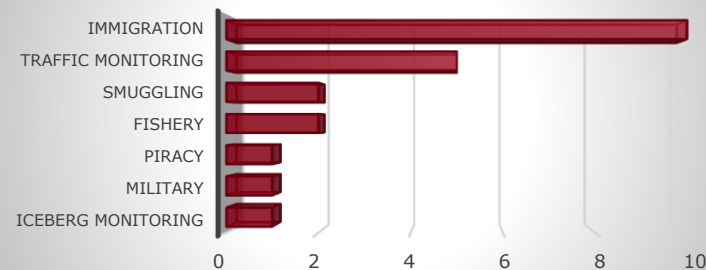


Mission replay

# SIMONS Campaings

## Maritime security - operational campaigns

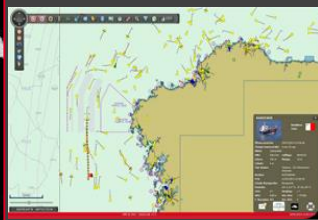
Number of operational campaigns performed



IMMIGRATION



TRAFFIC MONITORING



SMUGGLING



FISHERY



ICEBERG MONITORING



PIRACY





09/30/2014

On 17 September 38 sub-Saharan immigrants, including three babies and eight women, were rescued from a boat adrift on the high seas to the south of Motril (Granada, Spain).

According to Salvamento Marítimo (The Maritime Rescue Service) the search for the boat was "complicated" due to the huge area to be scanned. Nonetheless the SAGRES program, used in conjunction with satellite images, was decisive in finding the tiny boat with the immigrants in distress.

The GMV-coordinated, FP7, maritime safety project called SAGRES (Service Activations for Growing Euros Success) supports the pre-operational test and deployment of high-time critical, intelligence-driven maritime surveillance components.

This particular activation (as one of the last activations within the project) was planned in advance with cooperation with Frontex, the European Agency for the Management of Operational Cooperation at the External Borders, defining a limited area within the Mediterranean Sea for a limited period of time: 16-09-2014 evening. The activation defined a set of exercises with the aim to further tests the capability of Earth Observation (EO) imagery to support maritime surveillance within specific operational environments.

The challenging trial was organized with the cooperation of Spanish authorities where it was planned to involve a patrolling vessel in the West Mediterranean Sea. The goal was to detect a small target (non-metallic target with a length < 10 m) by combining the processing of EO images with cooperative reporting streams.

However, on 16.09.2014 afternoon an urgent call to search for a boat with migrants was received and the asset was forced to join the mission.

Luckily, the operational search zone was not far away from the area designed for the trial. Thus, SAGRES and Frontex decided to use the ordered image, a Synthetic Aperture Radar image acquired by the RADARSAT2 satellite sensor in Ultra Fine mode with 3 m of resolution, to support the mission.



The image was processed in less than 3 h from the acquisition time. The ship detection report pointed out the presence of a potential target of interest cruising to the North. The report was immediately passed to Frontex, who passed away to the Spanish Authorities. The coordinates of the detection were used to delimitate the search zone and this permitted the location of the boat on the morning of 09.17 ,5 NM far away from the position reported by the satellite image.

Thanks to the rapid intervention of the Spanish authorities, the 38 migrants (including 8 women and 3 babies) on-board were rescued and saved their lives.

The contribution of SAGRES has been essential as the EO-based ship detection permitted reducing the initial huge area and this eased the search mission. This success case shows how EO technology can support high time critical maritime surveillance and how this technology can be used to save lives at sea.

# Thank you

António Araújo

Email: antonio.araujo@gmv.com

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