SECURITY DOMAIN

SERVICE PORTFOLIO

01-04-2016

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INNOVATING SOLUTIONS

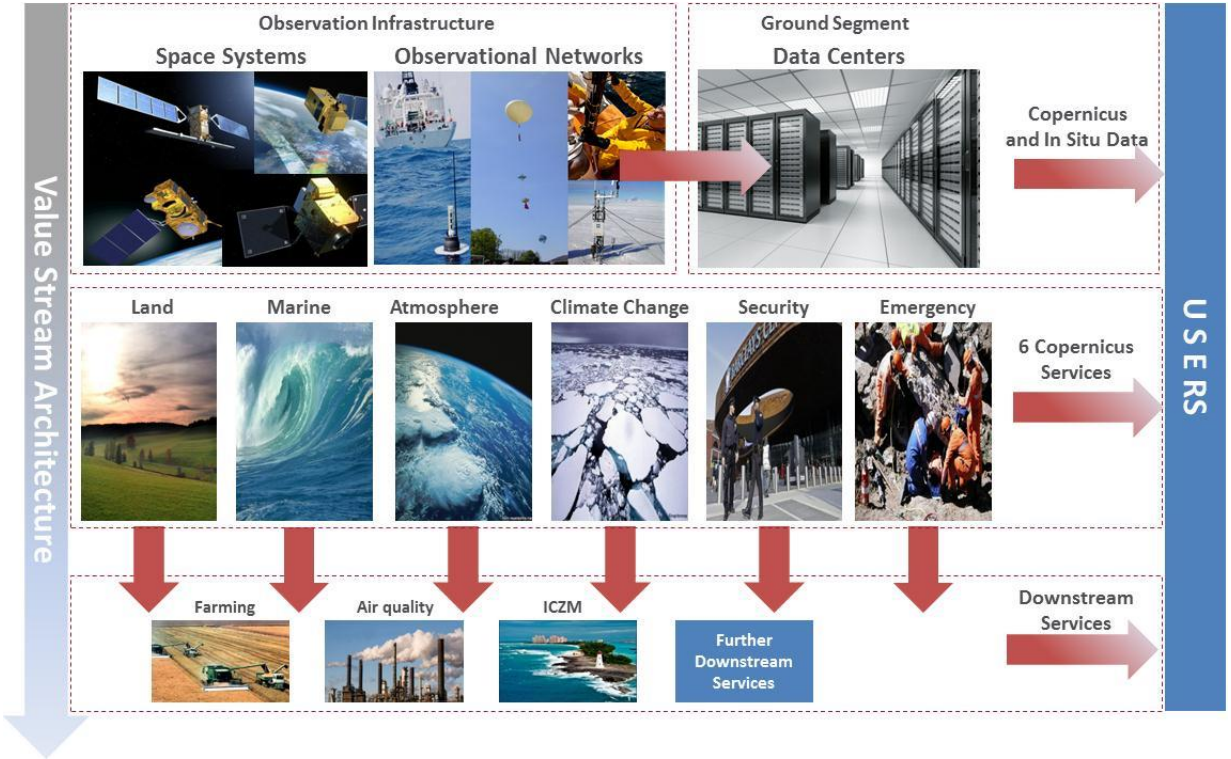
SECURITY DOMAIN

COPERNICUS PROGRAM

INNOVATING SOLUTIONS

COPERNICUS BACKGROUND

- EC, ESA, EEA and MS partnership
- Continuous and sustainable provision of reliable data and information services relating to environment and security.
- User-driven programme that is oriented to the users responsible for making, implementing and monitoring relevant policies in the EU and MS



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COPERNICUS BACKGROUND

6 service domains:

- **Land Monitoring**: geographical information on LULC and biogeophysical variables of land surface characteristics and biodiversity hotspots
- **Emergency Management**: provides mapping and early warning services for crisis management. On-demand rush (hours-days) and non-rush (weeks-months) service delivery is admitted
- **Marine Environment Monitoring:** Regular and systematic reference information and forecasts on the state and dynamics of the physical ocean (e.g. SST, currents, sea level) and marine ecosystems
- **Atmosphere Monitoring:** Continuous data (monitoring, forecasting and reanalysis) on atmospheric composition at global.
- **Services for Security applications**: Support to the related EU policies in three areas: Border Surveillance, Maritime Surveillance and Support to External Actions
- **Climate Change Monitoring**: Provision of ECVs climate analyses and projections at temporal and spatial scales relevant to adaptation and mitigation strategies.

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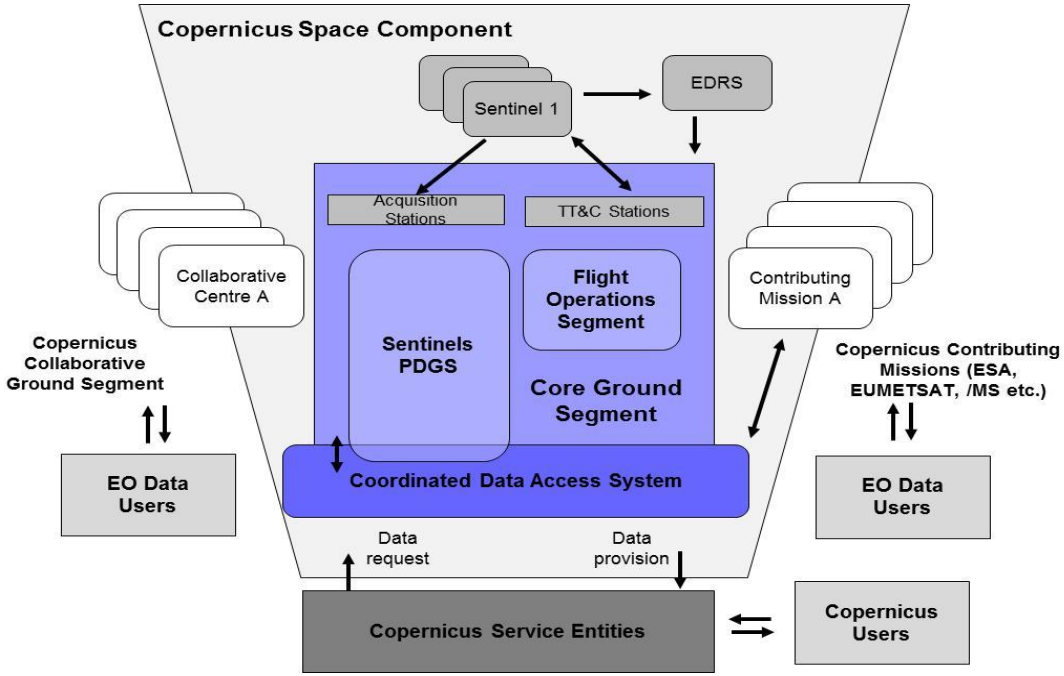
COPERNICUS BACKGROUND

Copernicus Space Components:

- ESA's dedicated Sentinels (S1a-b, S2, S3)
- Other European and international third party missions, referred to as Copernicus Contributing Missions (CM).



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SECURITY DOMAIN

GMV SECURITY EXPERIENCE

INNOVATING SOLUTIONS

GMV: SECURITY BACKGROUND

GMV experience in the security domain lasts for almost 10 years

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GMV: SECURITY BACKGROUND

EU EXTERNAL ACTIONS: Contingency planning during the Arab Spring 2011 in Benghazi, Libya

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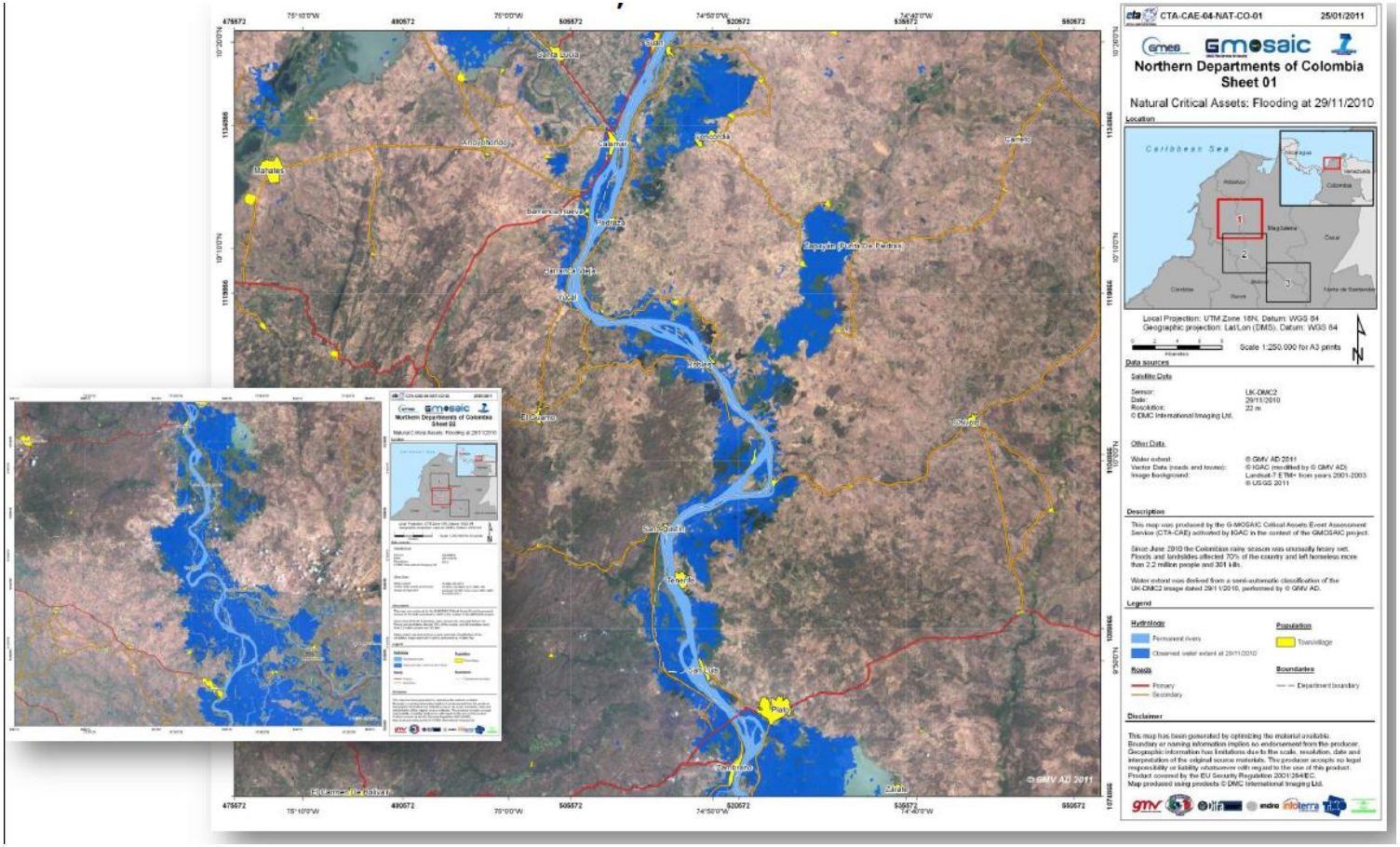
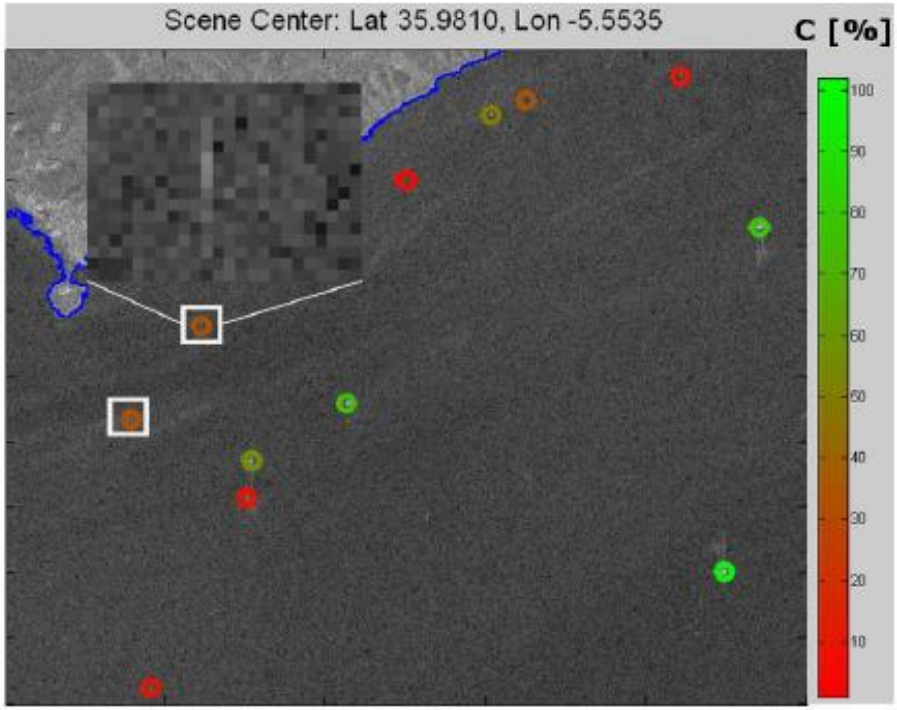
GMV: SECURITY BACKGROUND

INFRASTRUCTURE PROTECTION: La Niña induced flood events in Colombia



GMV: SECURITY BACKGROUND

MARITIME SURVEILLANCE: target monitoring based on SAR and optic image processing



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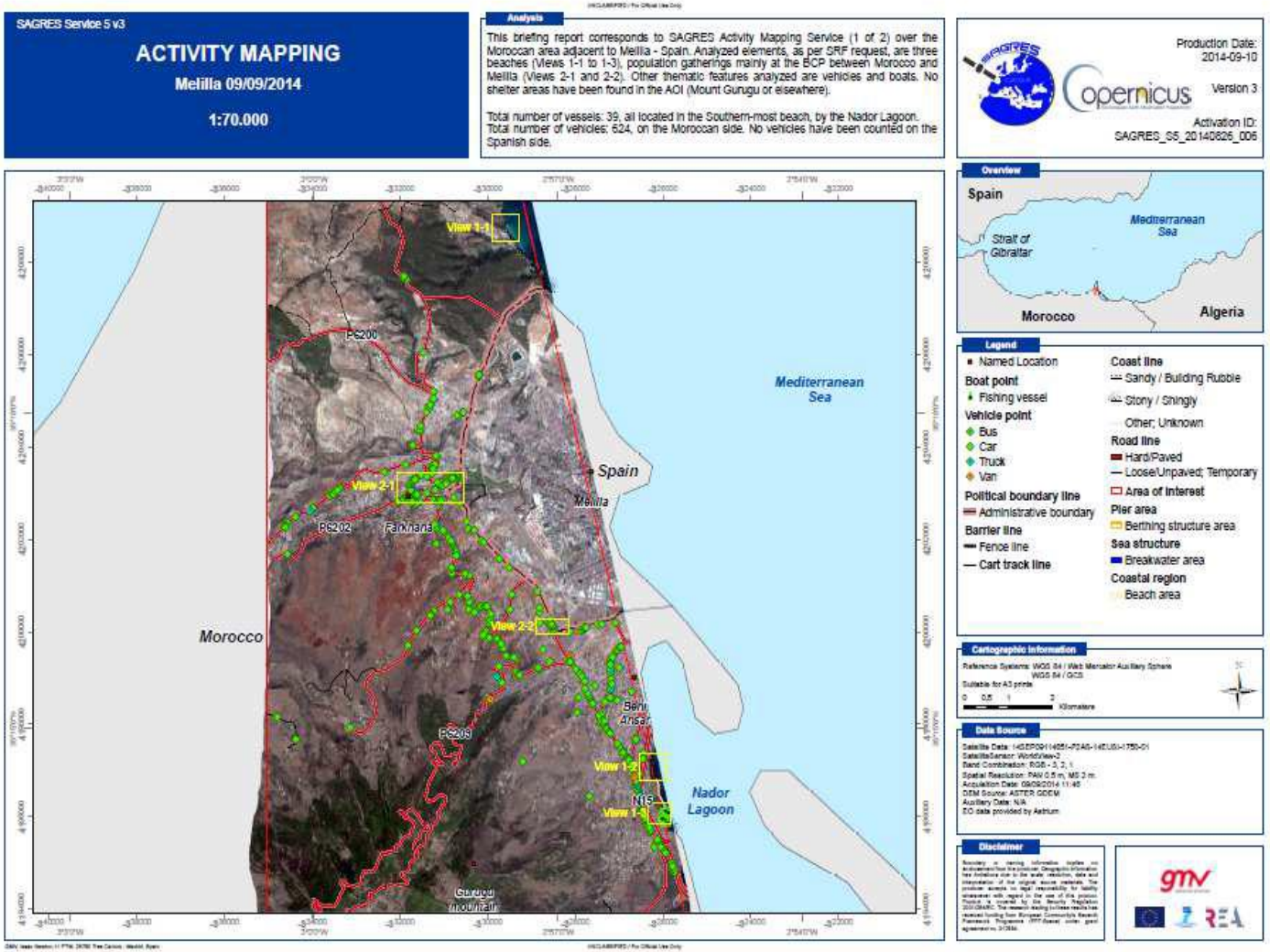
GMV: SECURITY BACKGROUND

LAND BORDER: Pre-frontier products



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GMV: SECURITY BACKGROUND

GMV extrapolates the security experience to emergency response

PREPAREDNES

- Support to emergency response units
- Reference digital maps
- Reference GDB

- Honduras
- Botswana
- Colombia
- Haiti
- Indonesia
- Philippines

CRISIS REACTION

- Rapid mapping

- Moscow pipeline explosion
- Haiti earthquake
- Chile earthquake
- Toxic cloud simulation Tunis
- Colombian floods
- Arab Spring movements

RELIEF

- Recovery follow up
- Verification of investments
- MGCP digital maps and eodatabases
- Support for emergency units, decision and policy makers

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GMV: SECURITY BACKGROUND

Main Customers

- EC
- Frontex
- SATCEN
- EMSA
- ESA
- Guardia Civil
- IHI (Japan)
- INTA
- Telespazio Ibérica
- C-CORE (Canada)

Main Users

- Guarda Nacional Republicana
- Italian Coast Guard
- EFCA
- Universities & Research Centres

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Security Domain

MARITIME SURVEILLANCE

INNOVATING SOLUTIONS

GMV: MARITIME BACKGROUND

GMV experience in the maritime domain lasts for almost 10 years

PROJECT	PRIME	FOUNDER	TIME	BUDGET
MARISS	NO	ESA'S GSE	2005-2012 distributed in 3 phases	~ 20 M€
EMSA-DFM	YES	EMSA	2011-2012	51k€+16,5 k€
NEREIDS	YES	EC'S GMES FP7	2011-2014	~ 6 M€
SAGRES	YES	EC'S GMES FP7	2013-2014	~ 4 M€
LOBOS	NO	EC'S GMES FP7	2013-2014	~ 4 M€
CAPSAT	YES	GUARDIA CIVIL through EBF	2015	~ 400 K€

Different collaborations with EU agencies and national authorities:

- MISA-EM project of MNE6 lead by US Joint Forces Command
- West Africa coast test with USCG
- INDALO with EMSA and Guardia Civil

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GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- MARISS: MARitime Security Service funded by ESA's GMES Service Element (GSE) from 2005 to 2012.
  - Prime: Telespazio with 16 partners distributes across Europe
  - Pan-European service network
  - 3 phases: Phase 3 from 2009-2012 for fully operational service provision
  - GMV was the national service provider of Spain. Users:
    - Spanish Army
    - Guardia Civil

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ EMSA-DFM: Data Fusion Module founded by EMSA from 2011 to 2012.
  - ✓ Prime: GMV
  - ✓ Develop a data fusion module to complement the services available in IMDATE
  - ✓ 2 phases: Phase 1 at 2011 and Phase 2 (CCN) at 2012
  - ✓ GMV was the service developed and provider:
    - ✓ Capability to process single entries in < 1 s
    - ✓ Integration into IMDATE

GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ NEREIDS: New Service Capabilities for Integrated and Advanced Maritime Surveillance
  - ✓ Prime: GMV with 16 partners distributes across Europe
  - ✓ R+D tasks to improve current performance of MSA
  - ✓ Fully operational campaigns involving user assets
  - ✓ Users:
    - ✓ Spanish Army, Guardia Civil, GNR, ITCG, EFCA, Spanish tax agency
  - ✓ GMV developed tasks of campaign coordinator and service provider in ship detection and categorization, data fusion, track generation, system implementation and maintenance

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GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ SAGRES: Service Activations for GRowing Eurosur Success funded by EC's GMES (Copernicus) FP7 program from 2013 to 2014.
  - ✓ Prime: GMV with 16 partners distributes across Europe
  - ✓ Pre-operational validation of high-time critical CONOPS
  - ✓ Fully operational campaigns involving user assets
  - ✓ Users:
    - ✓ Frontex gathering NCC requests
  - ✓ GMV developed tasks of campaign coordinator and service provider in ship detection, ship categorization, track generation, system implementation and maintenance

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GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- ✓ LOBOS: LOw time critical BOrder Surveillance funded by EC's GMES (Copernicus) FP7 program from 2013 to 2014.
  - ✓ Prime: AIRBUS with 16 partners distributes across Europe
  - ✓ Pre-operational validation of low-time critical CONOPS
  - ✓ Fully operational campaigns involving image analysis
  - ✓ Users:
    - ✓ Frontex gathering NCC requests
  - ✓ GMV developed tasks of requirement coordinator and service provider in image analysis and interpretation

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GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

- CAPSAT: Providing Satellite-based surveillance capabilities through EC's EBF (European Border Funds) program at 2015.
  - Prime: GMV is the unique contractor
  - Installation of an operational system (HW and SW) providing EO-based ship surveillance services
  - Prepared to support the INDALO campaigns in the Mediterranean Sea
  - Users:
    - Guardia Civil, GNR, ITCG
  - GMV developed tasks of system implementation and maintenance, and of service provider in ship detection, ship categorization, track generation

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GMV: MARITIME BACKGROUND

GMV has participated in several projects / initiatives within the maritime domain

PROJECT	PRIME	TASK	OUTPUT
MARISS	NO	Service provider Campaign coordin.	Complete maritime monitoring service
EMSA-DFM	YES	Service Developer	Data Fusion Module
NEREIDS	YES	Service Provider Campaign coordin.	Maritime monitoring service with external HMI
SAGRES	YES	Service provider Campaign coordin.	Maritime monitoring products
LOBOS	NO	Service provider	Border monitoring products
CAPSAT	YES	System and service provider	Operational maritime monitoring service (HW/SW)

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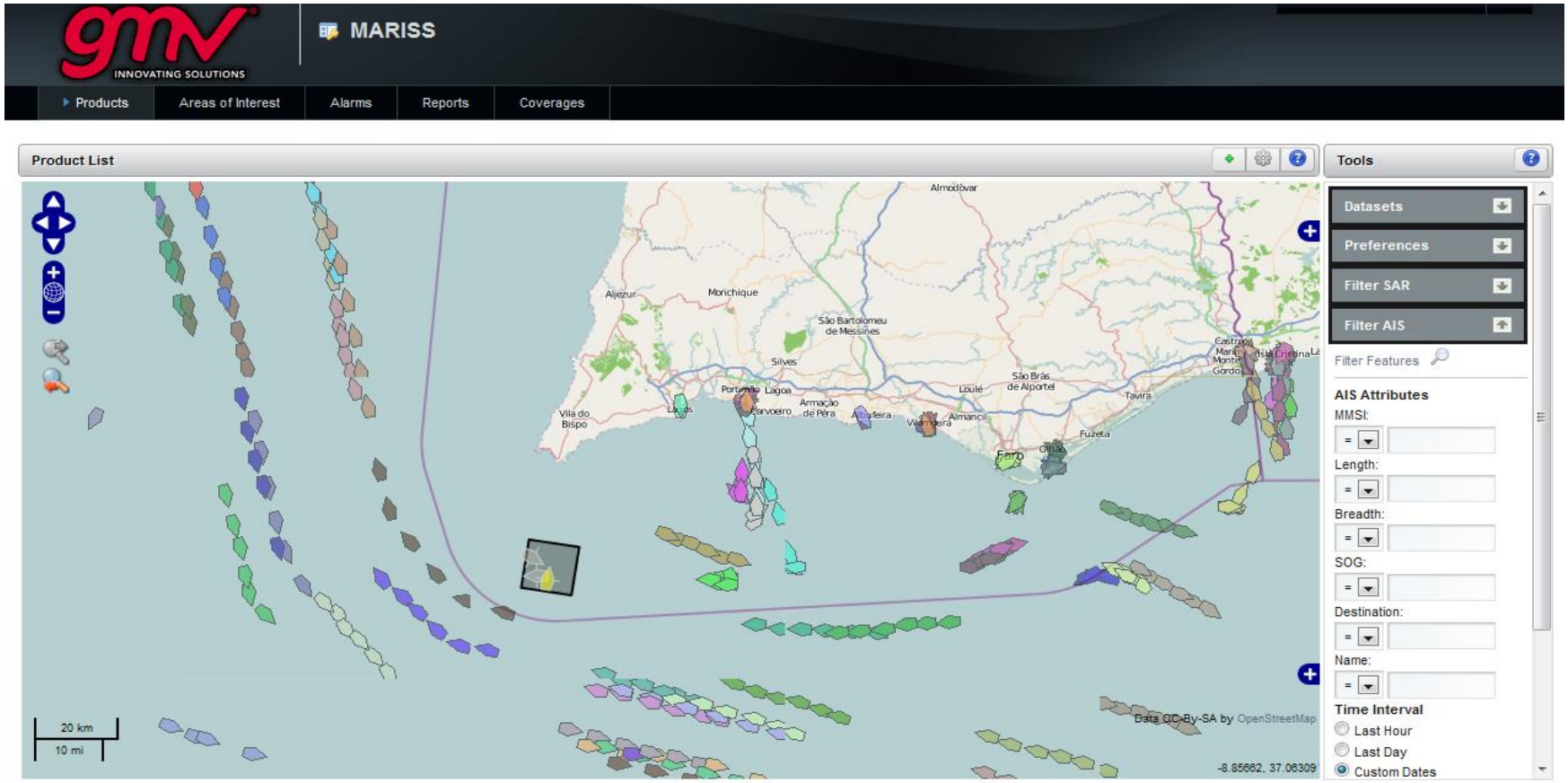
GMV: MARITIME BACKGROUND

MARISS:

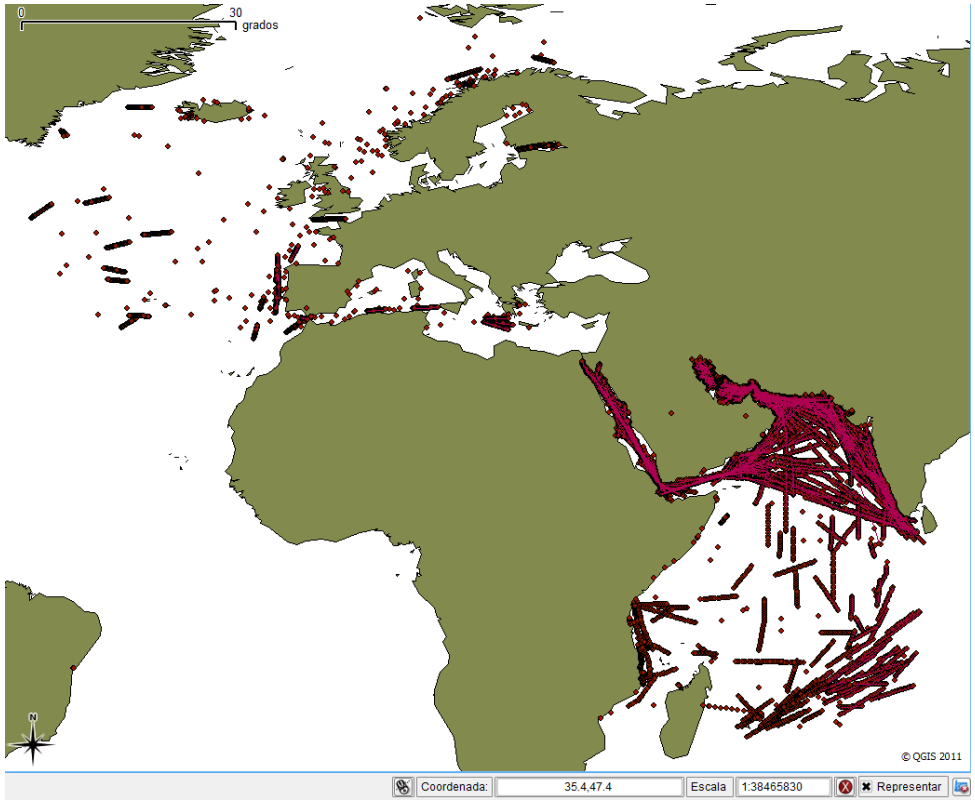
- Fully system design and implementation from dB to HMI
- Ship detection and categorization, Ship tracking and alarm triggering



GMV: MARITIME BACKGROUND

EMSA-DFM:

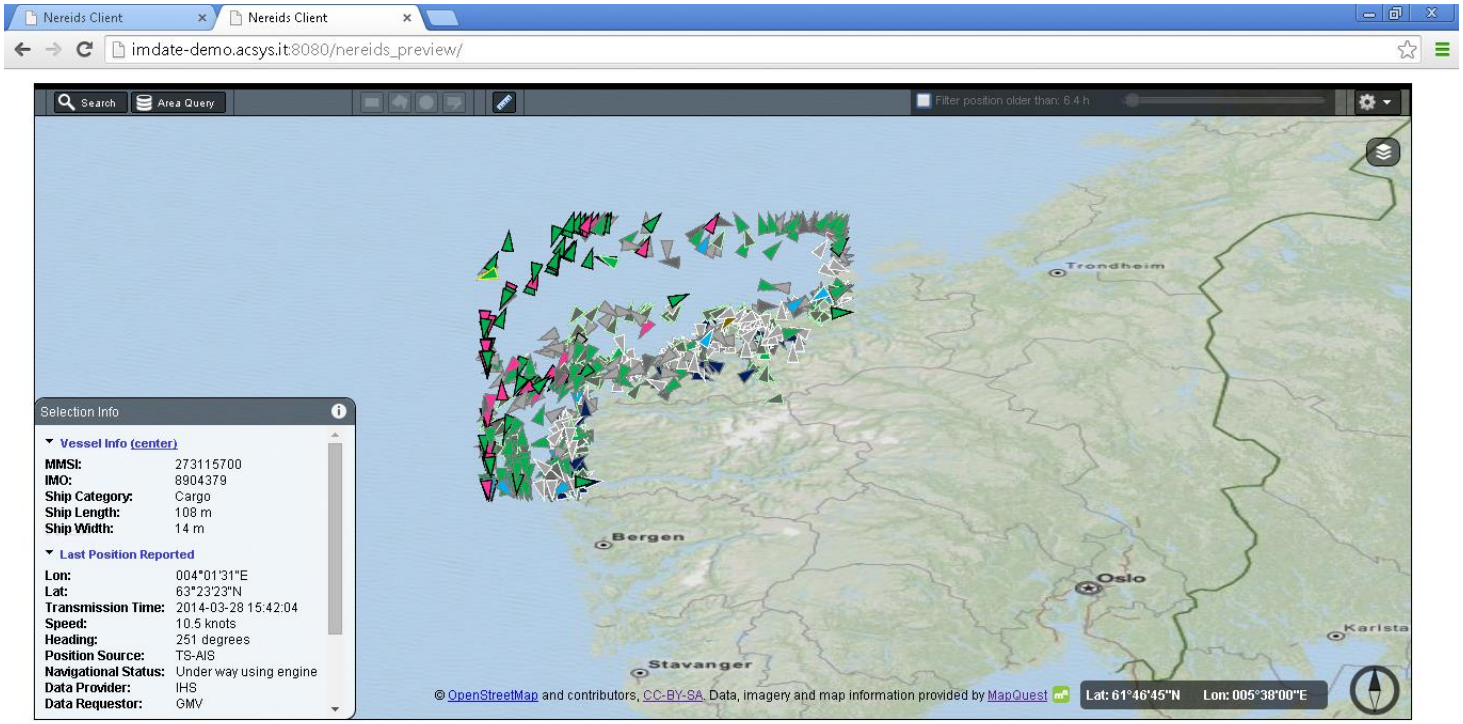
- Fully design and implementation of DFM
- Successful tests in pre-operational environment with the real IMDATE feed



GMV: MARITIME BACKGROUND

NEREIDS:

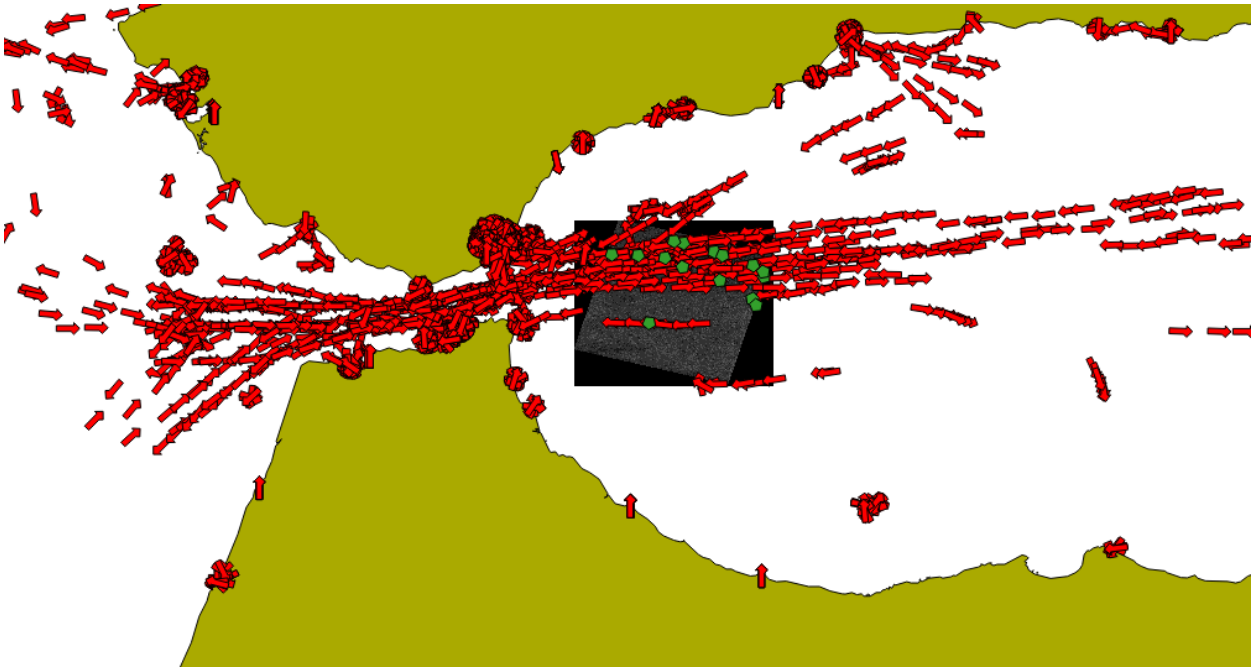
- Fully system design. Implementation from dB to data publication
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



GMV: MARITIME BACKGROUND

SAGRES:

- Fully system design. Implementation from dB to data publication
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



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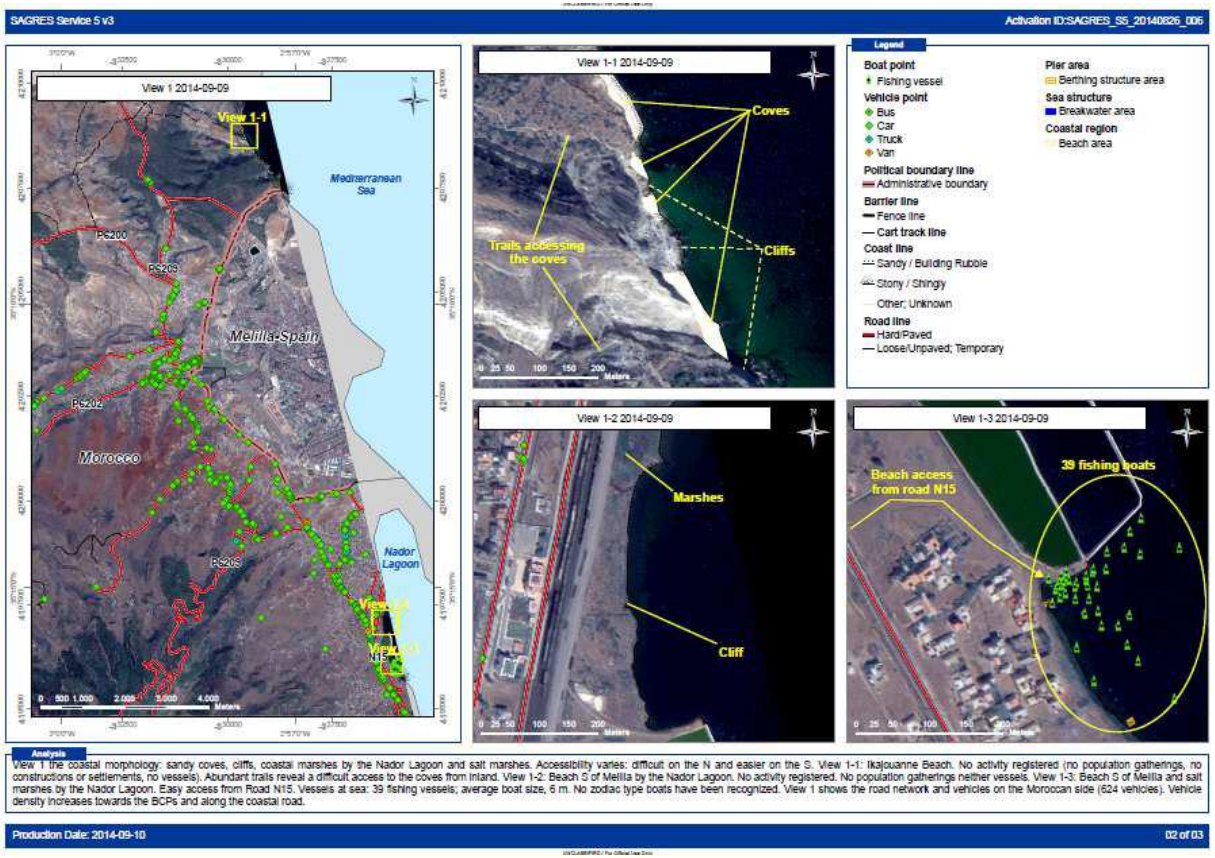
GMV: MARITIME BACKGROUND

LOBOS:

- Fully design of the processing chain
- Manual interpretation of data in high-time critical conditions
- Pre-frontier products and emergency / security assessment



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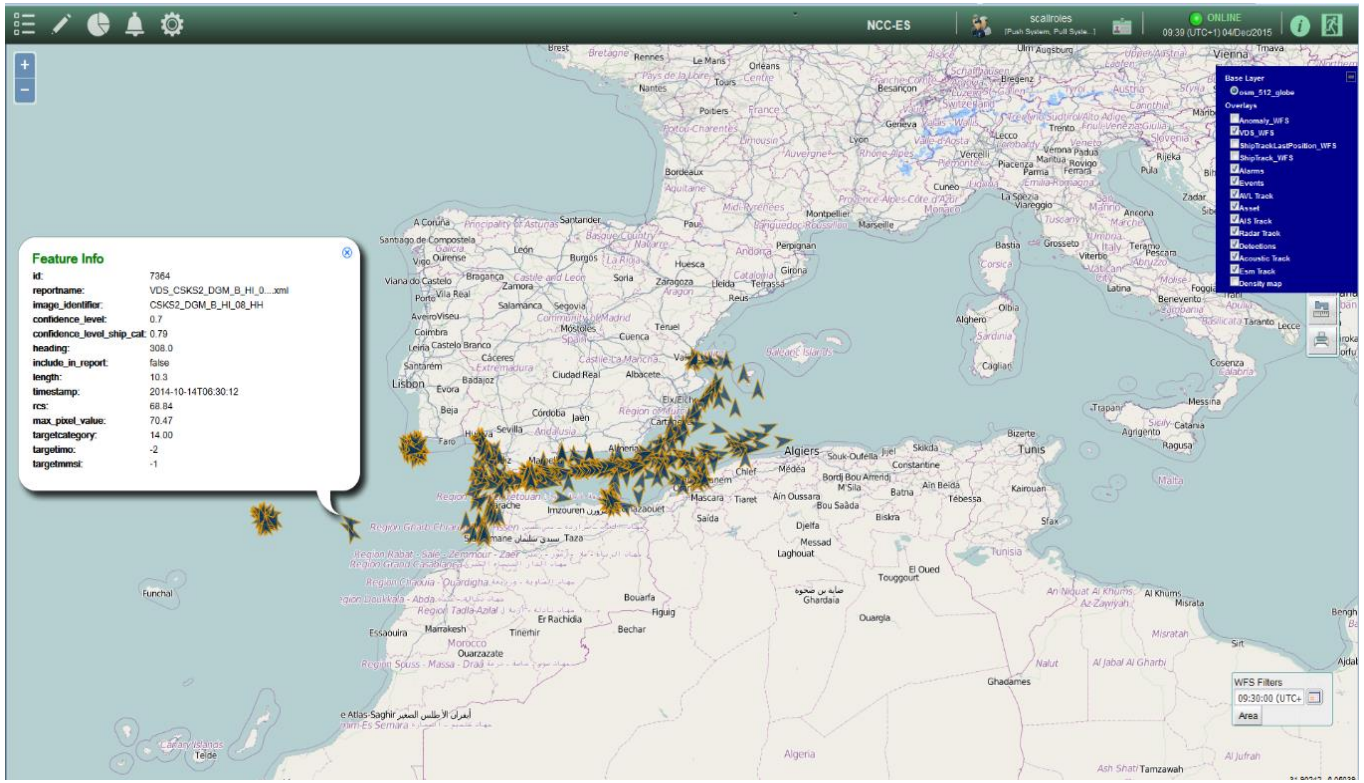
GMV: MARITIME BACKGROUND

CAPSAT:

- Fully system design and implementation (HW, SW)
- Geographically distributed processing modules
- Ship detection and categorization, Ship tracking, anomaly detection



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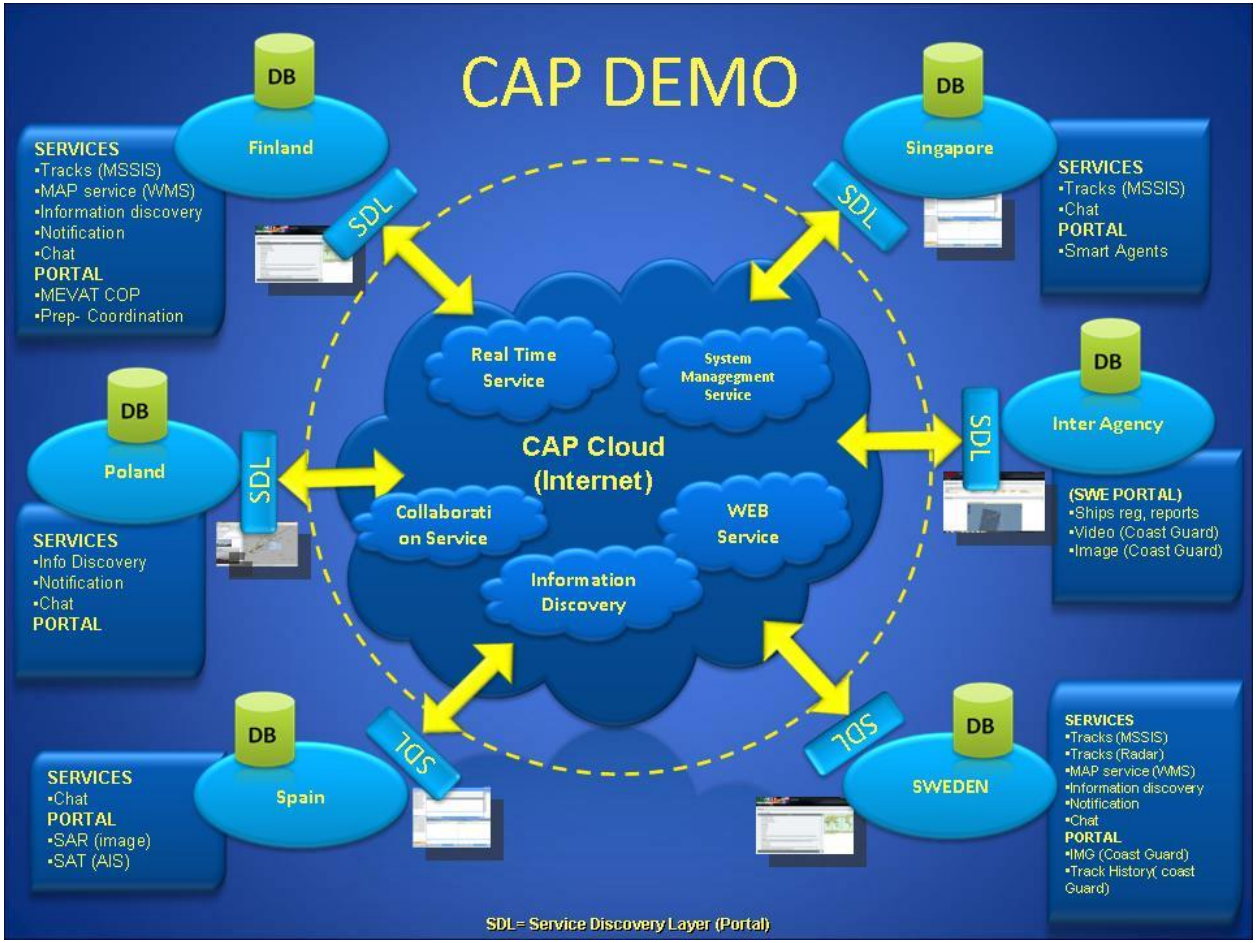
GMV: MARITIME BACKGROUND

MISA-EM from MNE6:

- Inter-country experiment emulating an emergency situation
- GMV provides SAT imagery based ship detection through SN



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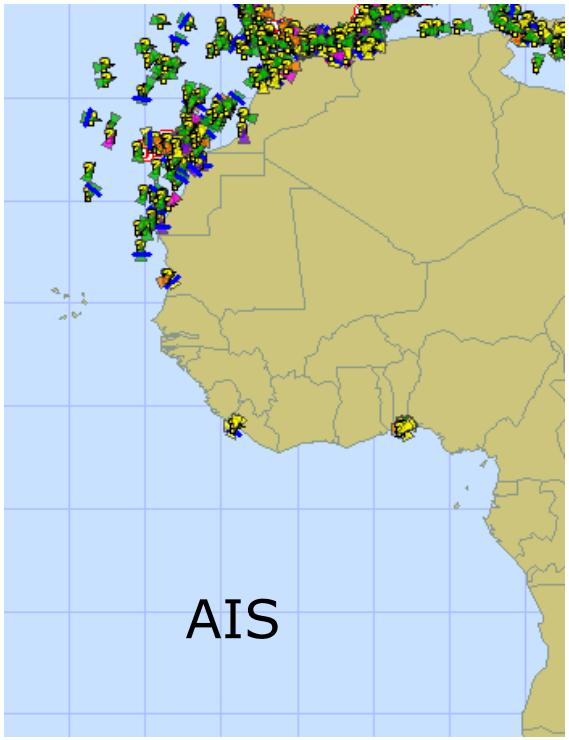
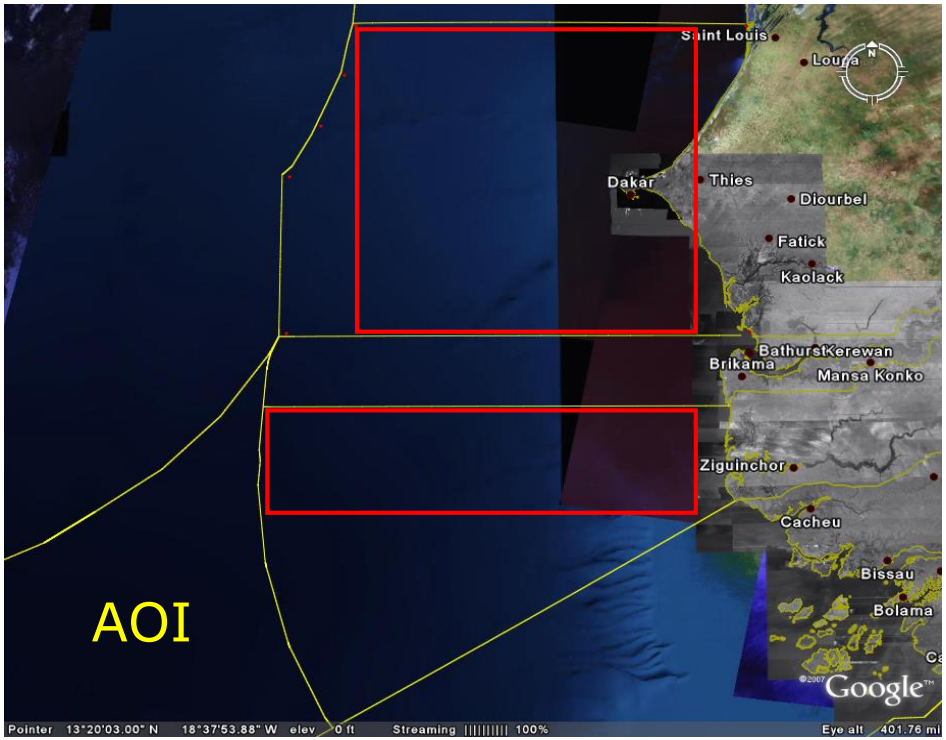
GMV: MARITIME BACKGROUND

West Africa Coast USCG experiment:

- Europe-US collaboration through MARISS
- GMV coordinated the experiment and was a service provider jointly with DLR and EGEOS. Service delivery to USCG ship was tricky





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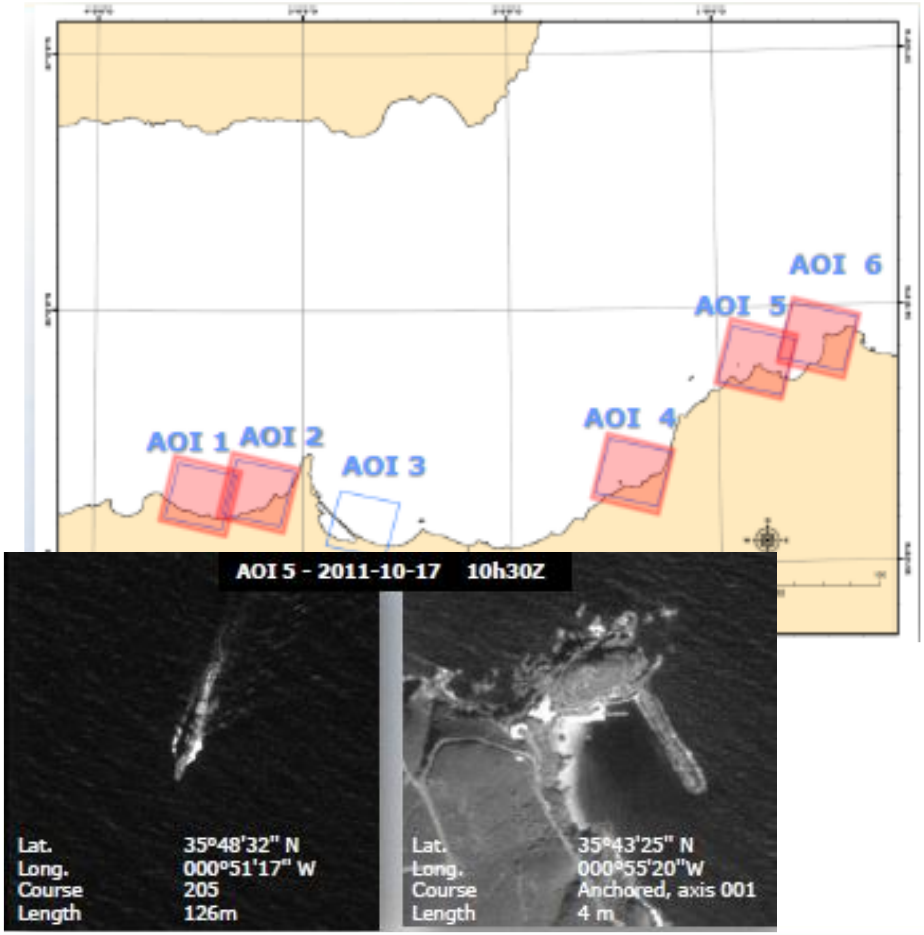
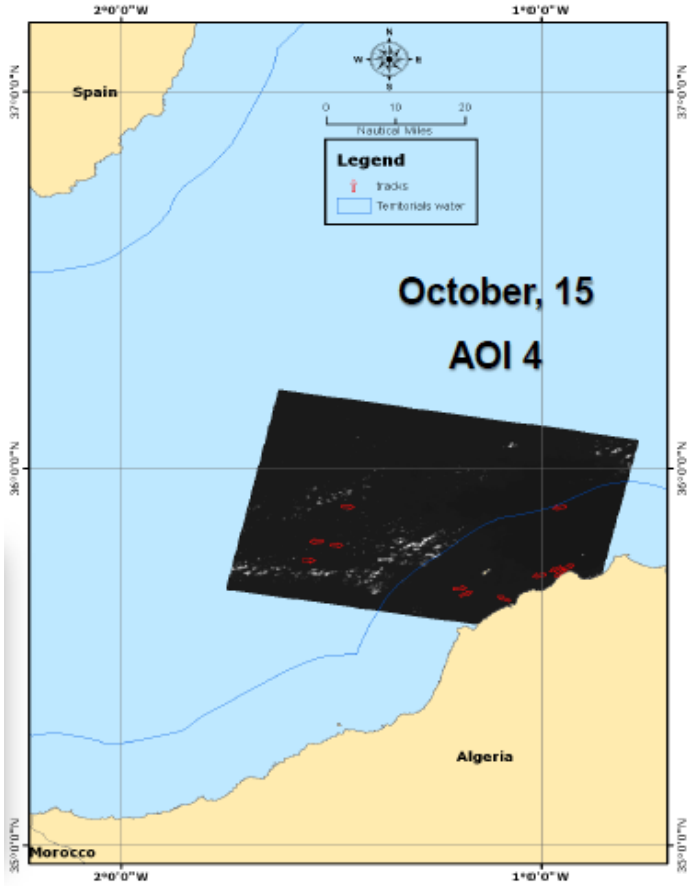
GMV: MARITIME BACKGROUND

INDALO experiment:

- EMSA-MARISS collaboration through MARISS
- GMV was a optic-based service provider





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GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The detection of potential Targets of Interest (ToI) derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

Time	Place	User	Domain	Results
2007-2009	Strait of Gibraltar	Spanish Navy Guardia Civil	Fishery Immigration	Pattern monitoring
2009	West Africa	USCG	Piracy	Monitoring of ToI
2010	Baltic Sea	MNE6, ≠ navy forces	Smuggling	Monitoring of a test exercise
2010	Alboran Sea	Guardia Civil (INDALO)	Immigration	Operational mission support
2011-2012	Strait of Gibraltar	Spanish Navy	Traffic monitoring	Pattern monitoring Detection of ToI*

GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

*ToI was a 4 m rubber boat moving at different speeds. Detection rate > 70%

** The detection of potential ToI derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

Time	Place	User	Domain	Results
2013	West Africa	ITCG, Spanish Navy	Piracy Traffic Mon.	Detection of ToI Pattern Mon.
2013	Central Med	ITCG, Spanish Fishing Agency	Immigration Fishery	Traffic monitoring Pattern detection
2013	Algarve, PT	GNR	Validation	Detection of ToI*
2013	Morocco	Guardia Civil	Immigration	Border monitoring of immigration camps
2013	Atlantic Spanish coast	Agencia Tributaria	Smuggling	Detection of ToI
2013	Strait of Gibraltar	Spanish Navy	Traffic monitoring	Pattern monitoring Detection of ToI**

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GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The results of this campaign based the definition of a service portfolio that Frontex has adopted in the operational phase that will start during 2015

Time	Place	User	Domain	Results
2013	Morocco	Guardia Civil Frontex	Immigration	Border immigration monitoring
2013	Eastern Med	Frontex	Immigration	Pattern detection*

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GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The information was used to start investigations for law verification

**ToI was a 4 m rubber boat moving at different speeds. Detection rate > 70%

*** The detection of potential ToI derived on operational missions of patrolling means to confirm SIMONS results and/or to intercept / rescue the ToI

Time	Place	User	Domain	Results
2014	Alesund, NO	EFCA	Traffic Mon. Fishery	Pattern Detection*
2014	Central Med	ITCG, Spanish Fishing Agency	Immigration Fishery	Traffic monitoring Pattern detection
2014	Algarve, PT	GNR	Validation	Detection of ToI**
2014	NAFO (without AIS)	EFCA	Fishery	Iceberg monitoring Law verification
2014	Strait of Gibraltar	Spanish Navy	Traffic monitoring	Pattern monitoring Detection of ToI***

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GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* The results of this campaign based the definition of a service portfolio that Frontex has adopted in the operational phase that will start during 2015

** A ship with 38 in-stress immigrants was detected with SIMONS. The ship was under Search and Rescue operation after an emergency call. EO imagery + SIMONS permitted a notably reduction of the searching area easing the work of the in-situ patrolling means. The ship was 7 m long and the engines were out of order. The ship was detected 14,5 NM away from the reported position, which was delivered to authorities 2h 30 min after image acquisition

Time	Place	User	Domain	Results
2014	Greek-Turkey border	Frontex	Immigration	Detection of ToI Border immigration monitoring Pattern detection*
2014	Alboran Sea	Frontex	Immigration	Detection of ToI**
2014	Strait of Malacca	Singapur Government	Traffic monitoring	Traffic monitoring and validation results

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GMV REFERENCES ON MARITIME SURVEILLANCE

Main campaigns where SIMONS has been used

* Blind categorization exercise executed with TerraSAR-X and Cosmo-Skymed images over the Tokyo Bay area. GMV processed images with no further information about the scene and the final customer validated the results with AIS and in-situ surveillance video-camera. The results showed a detection rate larger than 90% and a categorization rate close to 86% for a 3 m stripmap. The categorization rate scaled up to close to 100% for a 1m spotlight image.

Time	Place	User	Domain	Results
2015	Tokyo Bay	Japanese Partner	Military	Categorization of ToI Detection of ToI*

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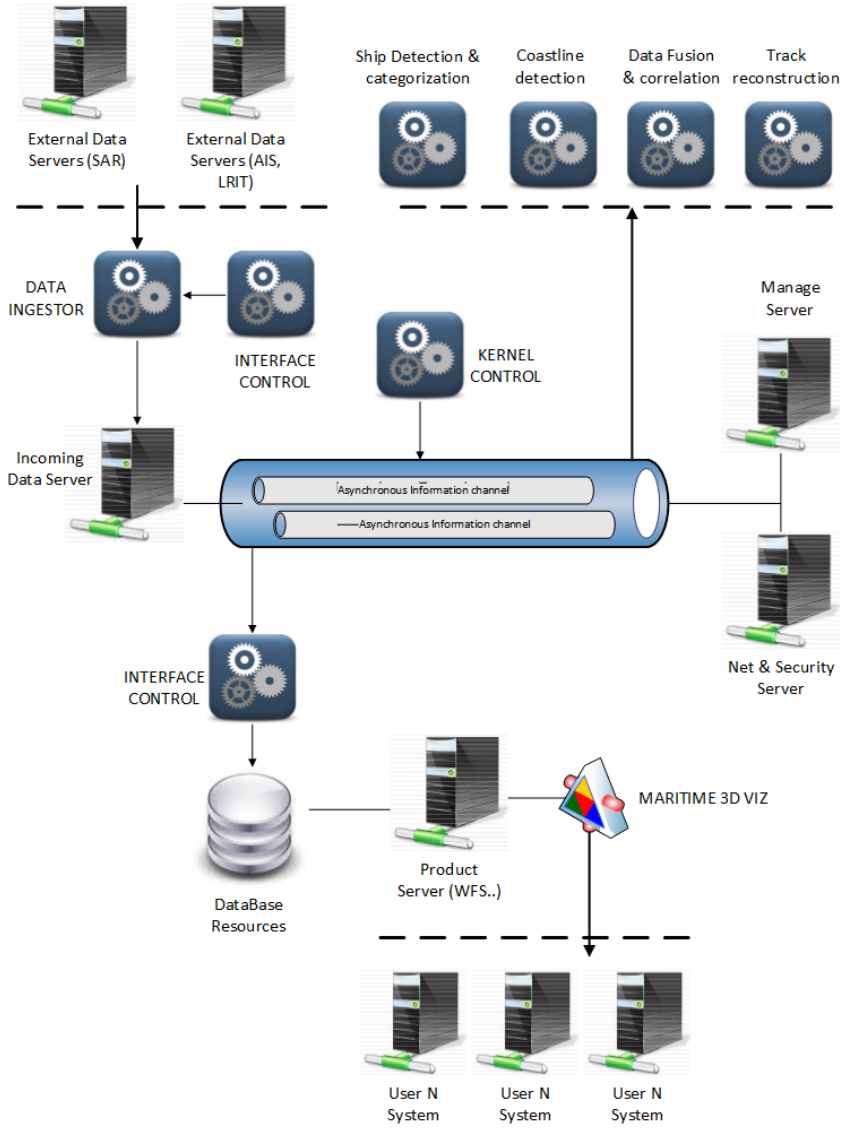
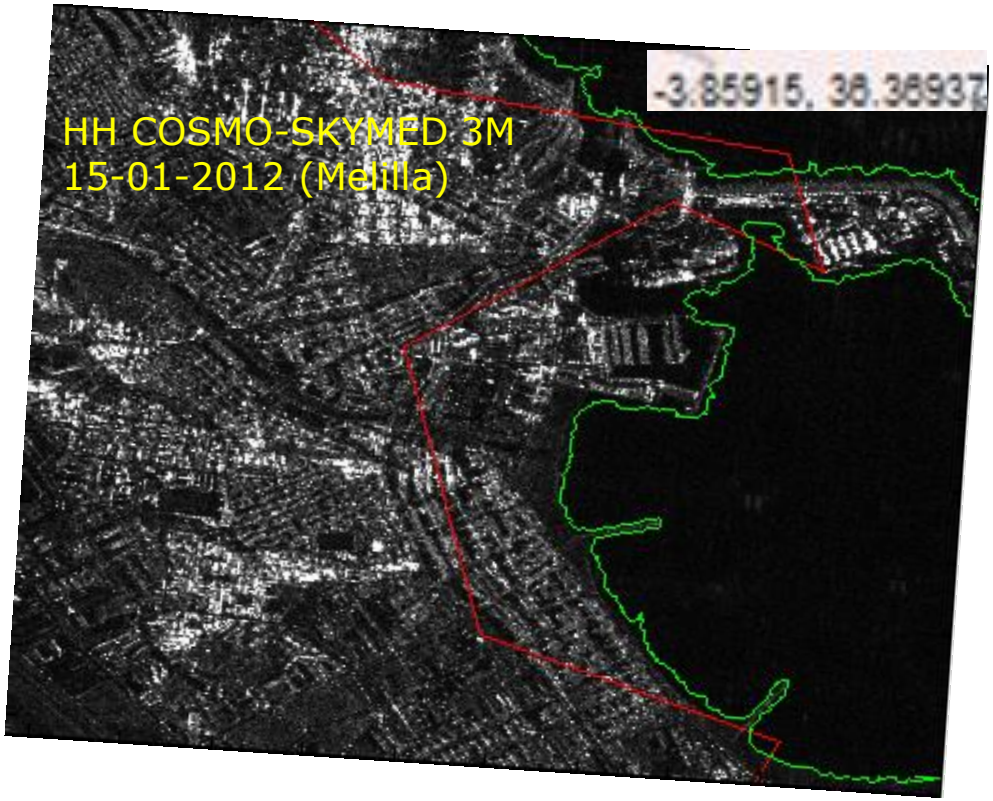
MARITIME SURVEILLANCE: SIMONS

SERVICE ORIENTED ARCHITECTURE (SOA) CONCEPTS

- ✓ Geographically distributed modules;
- ✓ Kernel with DB, management and security functions;
- ✓ Visualisation and publication outside the platform;
- ✓ Automatic update of all the information.

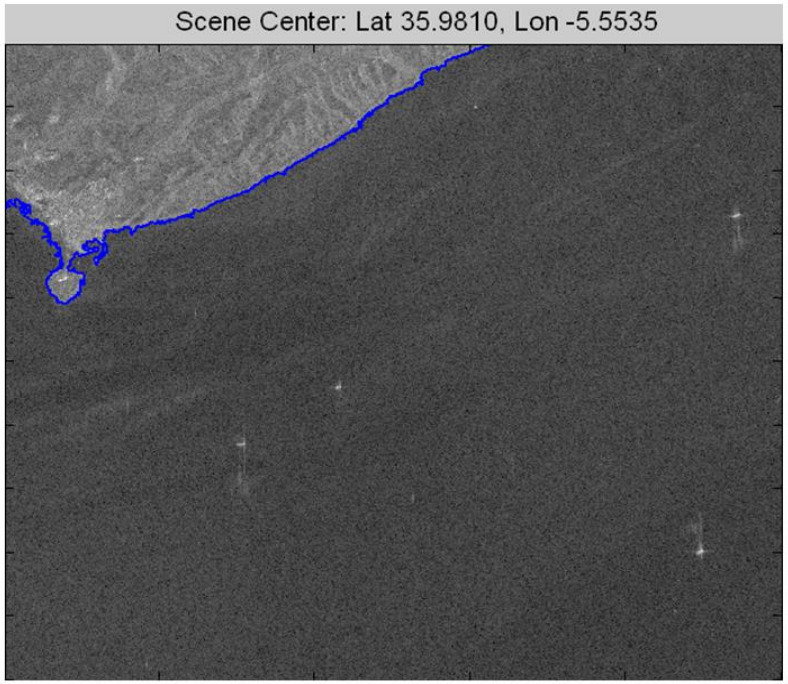


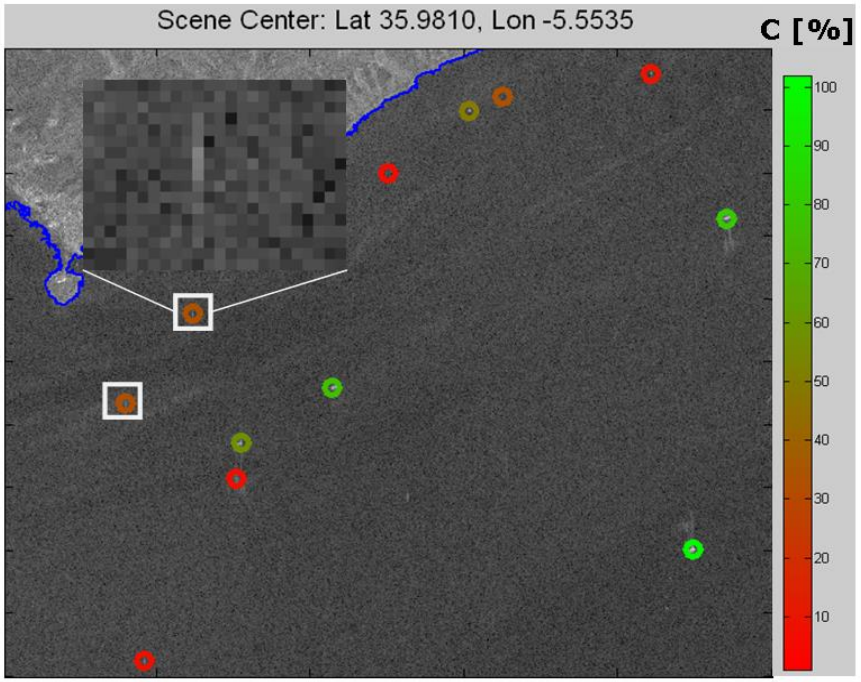
MARITIME SURVEILLANCE: SIMONS



- LAND MASKING
  - Wavelet + Geodesic Active Contours
  - Usage of external shape files (if properly accurate).

MARITIME SURVEILLANCE: SIMONS





- SHIP DETECTION
  - Wavelet analysis for SAR and Segmentation for Optical
  - Confidence to quantitatively measure detection reliability.
    - C < 0.4 → ship-alike sea features (wave crests)
    - 0.4 < C < 0.7 → less dispersive ships
    - C > 0.7 → ships visible by eye inspection.

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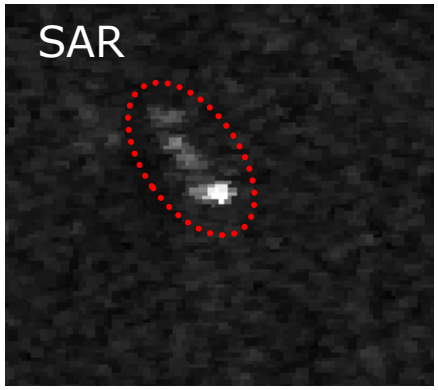
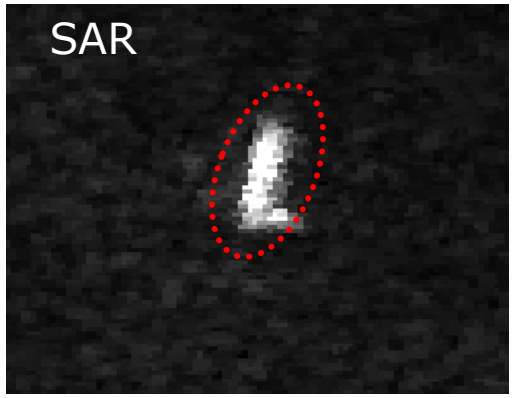
MARITIME SURVEILLANCE: SIMONS

Omega Theodore (Oil Tanker)



Stena Poseidon (Bulk)



- SHIP CLASSIFICATION
  - Validation with AIS polls

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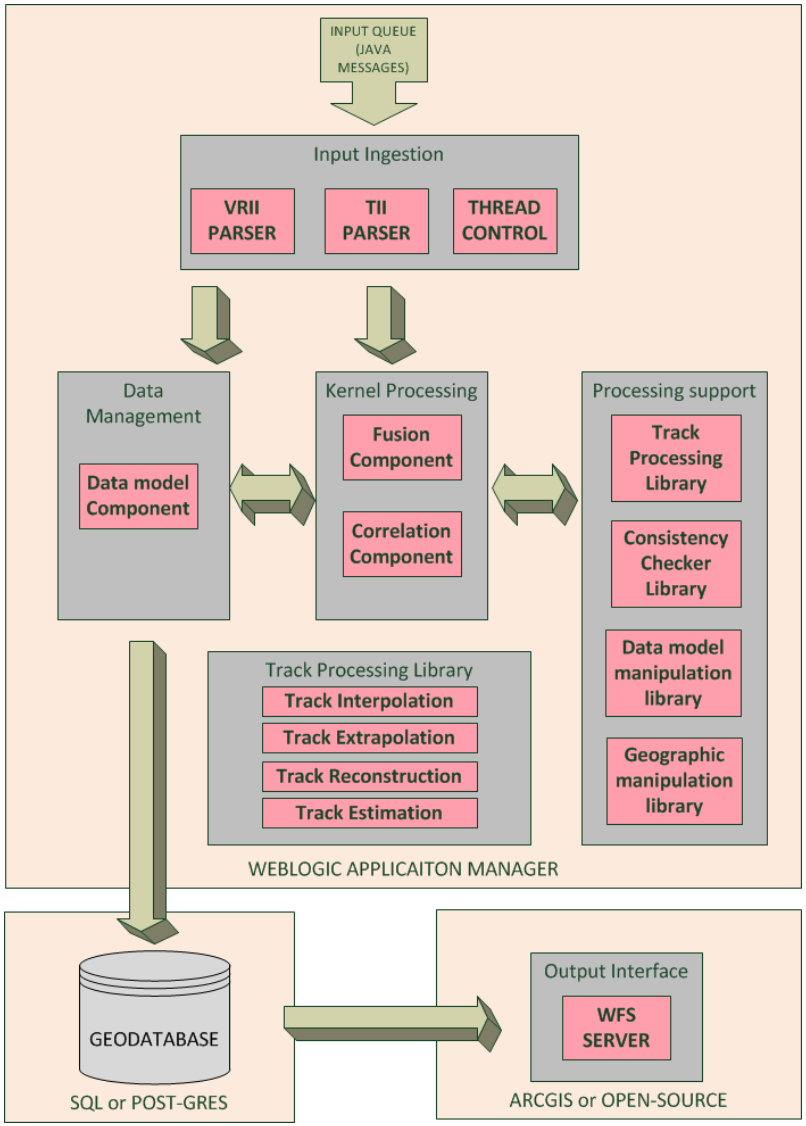
MARITIME SURVEILLANCE: SIMONS

A Data Fusion Module (DFM) has been developed for European Maritime Safety Agency (EMSA):

- Fully programmed in Java
- Independent libraries available for specific features
  - Target AIS-VDS Correlation
  - Consistency Checker
  - Track reconstruction with constraint avoidance (coastline, corridor…)
  - Track Interpolation
  - Track Extrapolation
- Environment flexibility
  - PostGres (PostGIS) + MapServer / GeoServer
  - Oracle + ArcGIS



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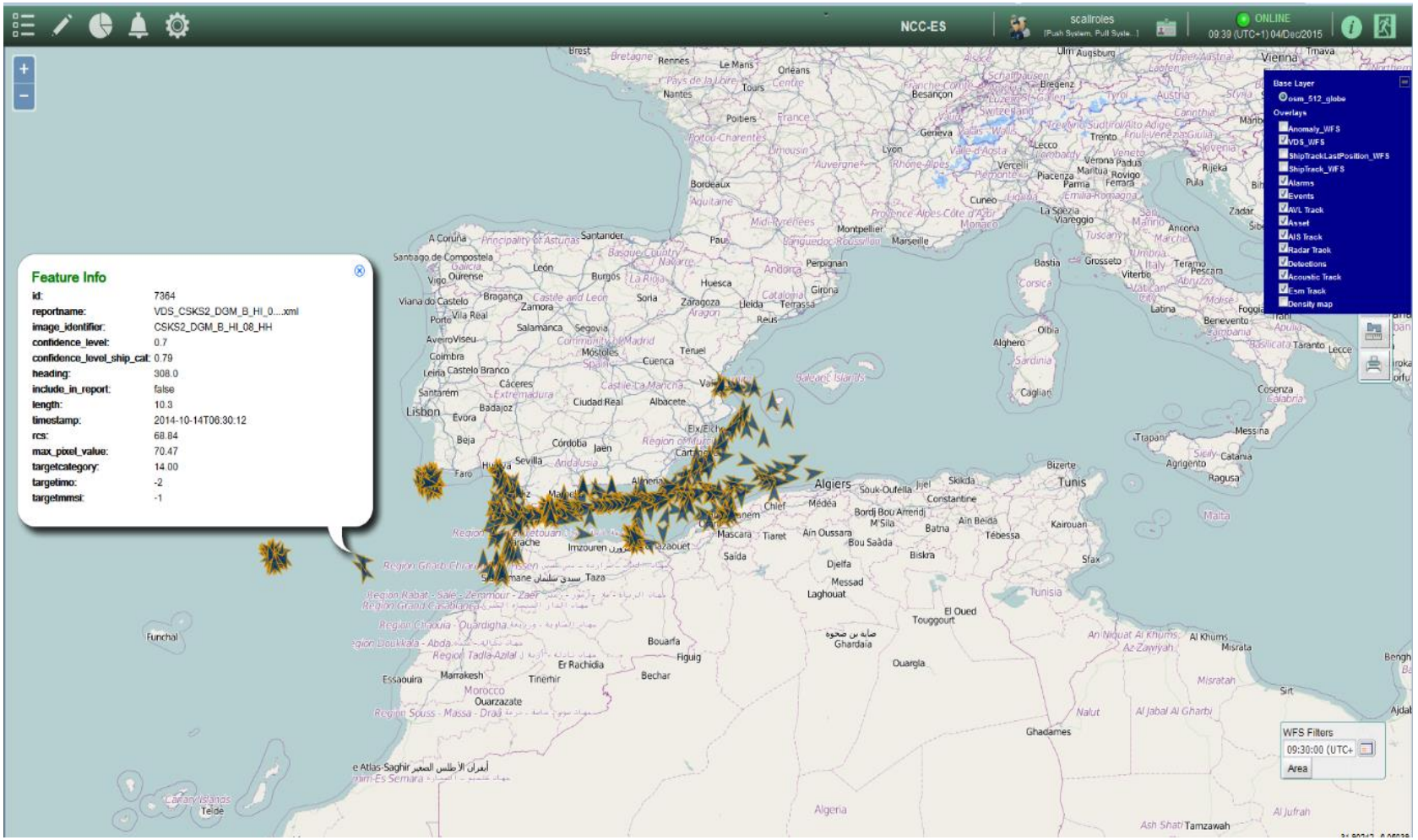
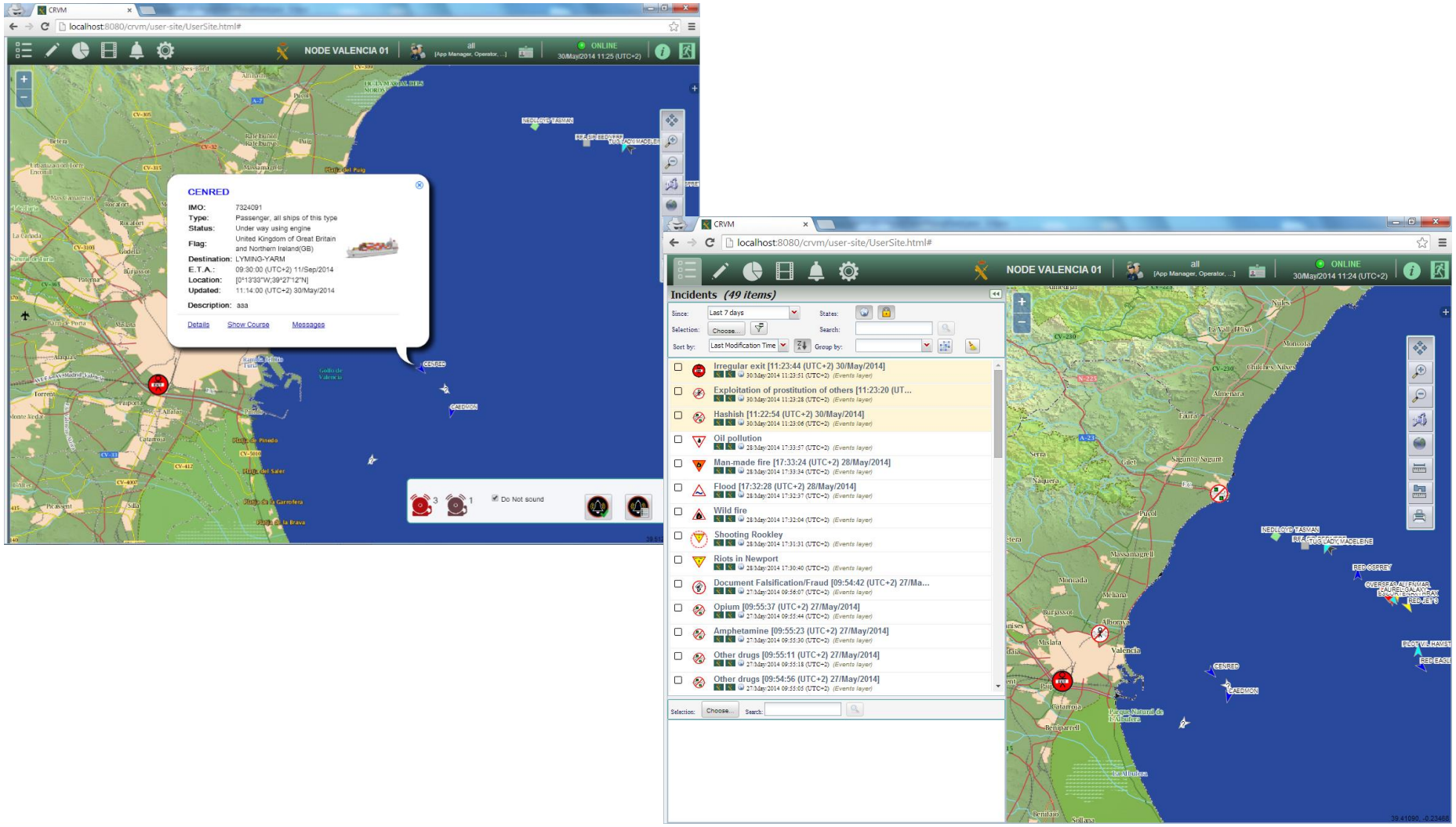
MARITIME SURVEILLANCE: SIMONS

Integration of a complete HMI suite with advanced functionalities



MARITIME SURVEILLANCE: SIMONS

Integration of a complete HMI suite with advanced functionalities



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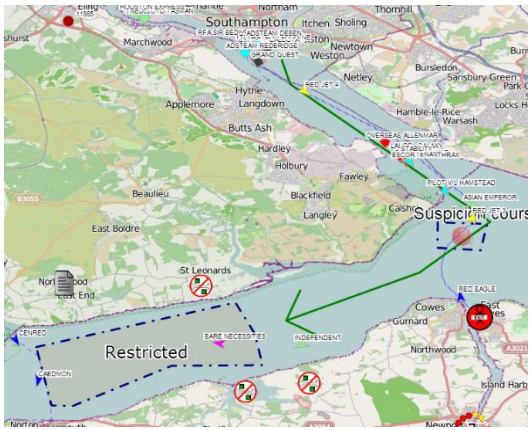
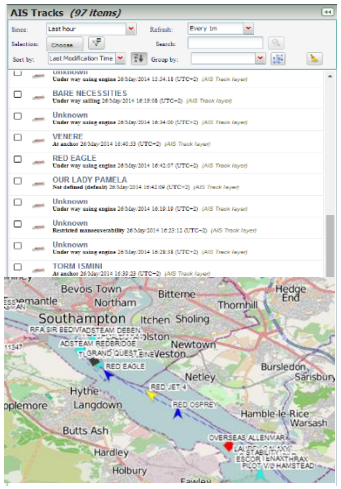
MARITIME SURVEILLANCE: SIMONS

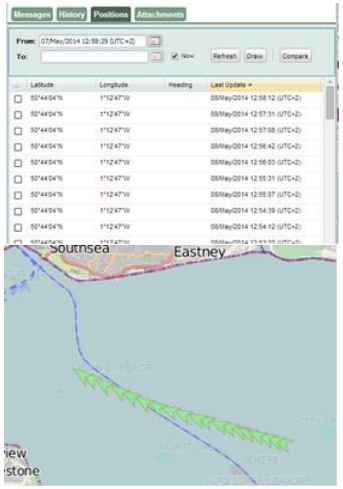
Integration of a complete HMI suite with advanced functionalities



Rule-based alarms & Anomaly handling

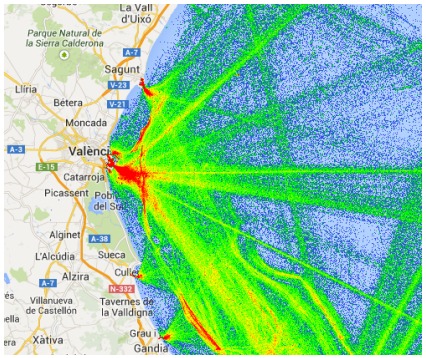


AIS track management

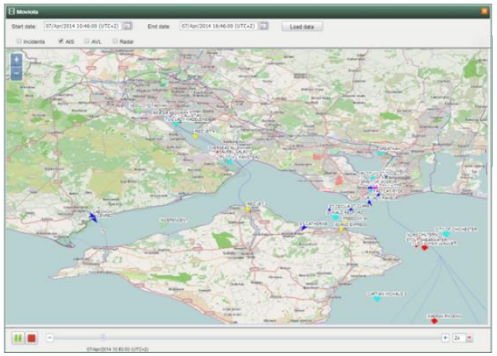


Historic queries

Alert handling



Statistics



Mission replay

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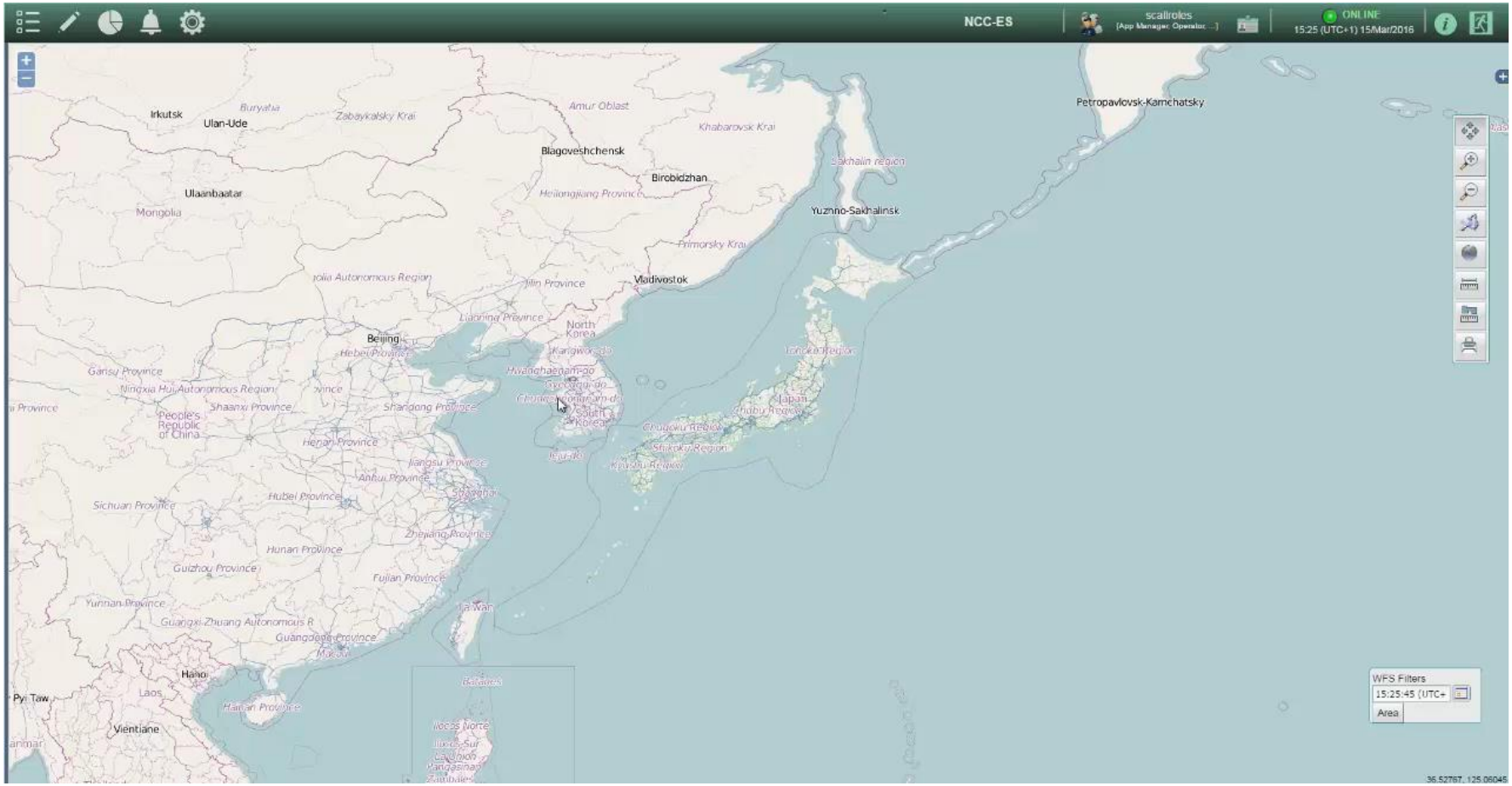
MARITIME SURVEILLANCE: SIMONS

Demo Video



MARITIME SURVEILLANCE: SIMONS

SIMONS quality specifications

* Real length vs estimated length

** Real length vs estimated length with factorization of resolution cell

Quality descriptor	Value
Processing Time	• 5-6 min for a 40x40 km stripmap image • 7 min for a 10x10 km spotlight image • 10 min for a 100x100 km scansar image
Probability of Detection	> 95 % for ships with length > 4*image res.
Absolute Length accuracy*	~75 %
Relative Length accuracy*	~90 %
Categorization rate	~70 % for ships with length > 12*image res.
AIS Fusion	Yes → large range of formats admitted
Band restrictions	No → any band and sensor is admitted
Area restrictions	No → any area (coastal, harbour, open sea…) can be processed

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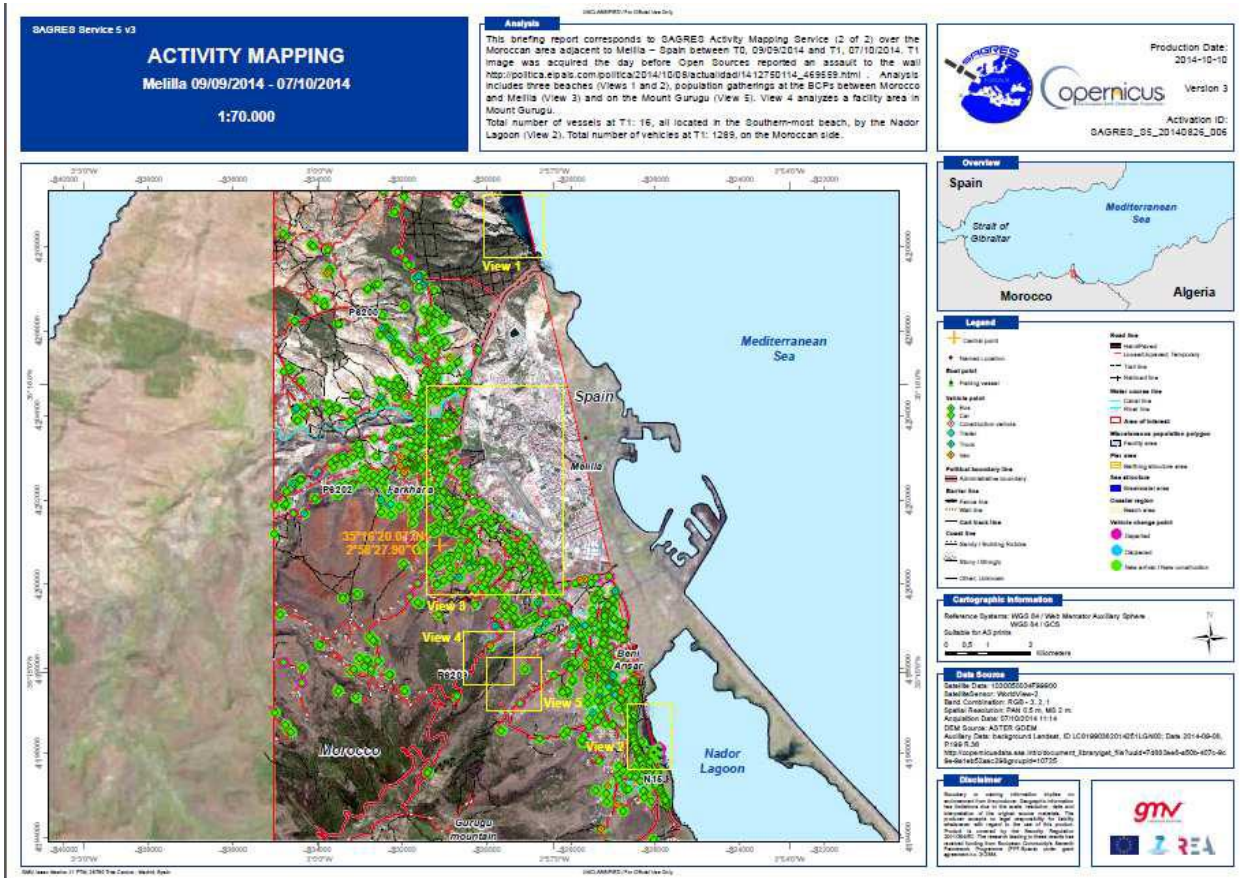
Security Domain

BORDER SURVEILLANCE

INNOVATING SOLUTIONS

BORDER SURVEILLANCE:

- 2h for delivering fast reports*
- Natural 24 h for delivering complete products*
- Pre-frontier products and emergency / security assessment



*(from image availability)

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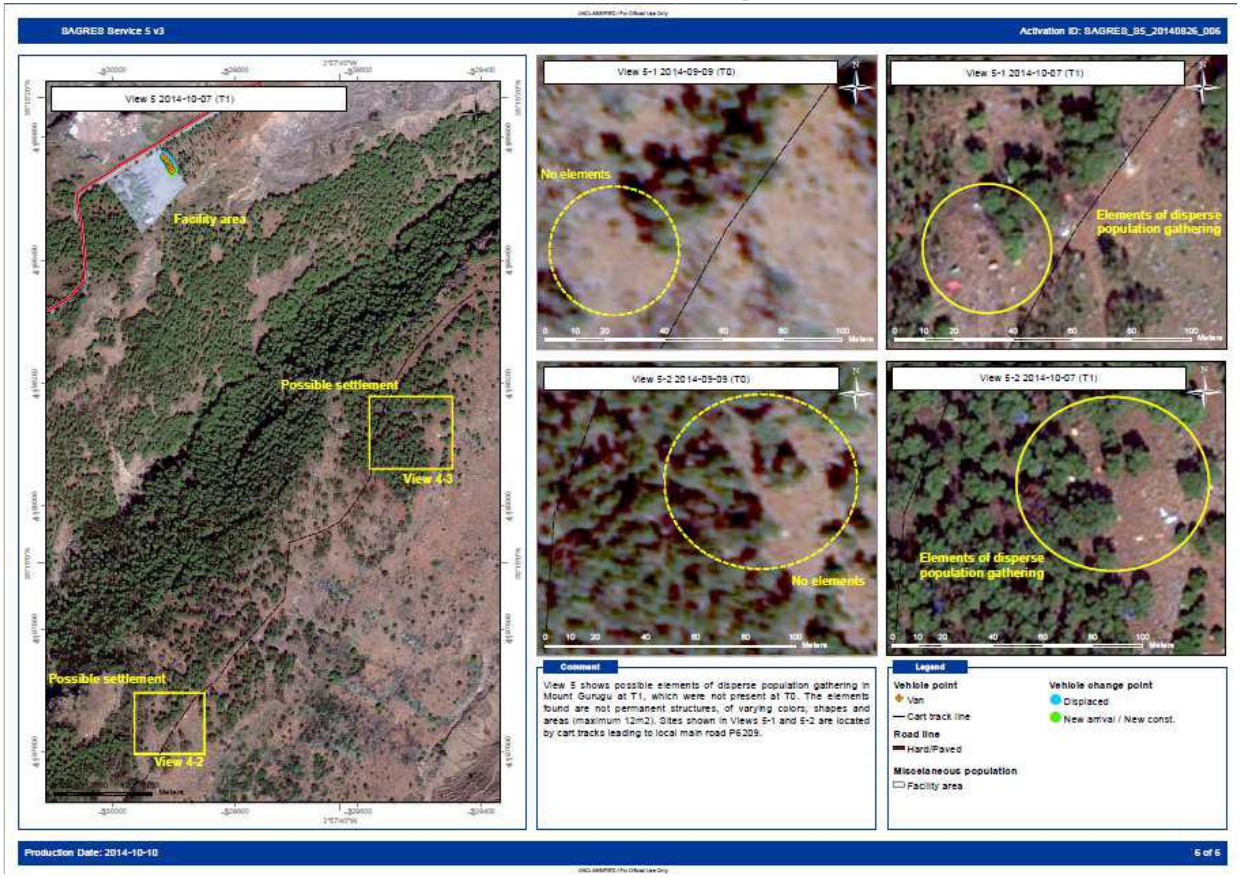

*(from image availability)

BORDER SURVEILLANCE:

- 2h for delivering fast reports*
- Natural 24 h for delivering complete products*
- Pre-frontier products and emergency / security assessment

Figure A: Beach A North of Melilla (Ikajouanne Beach, OS)

*(from image availability)

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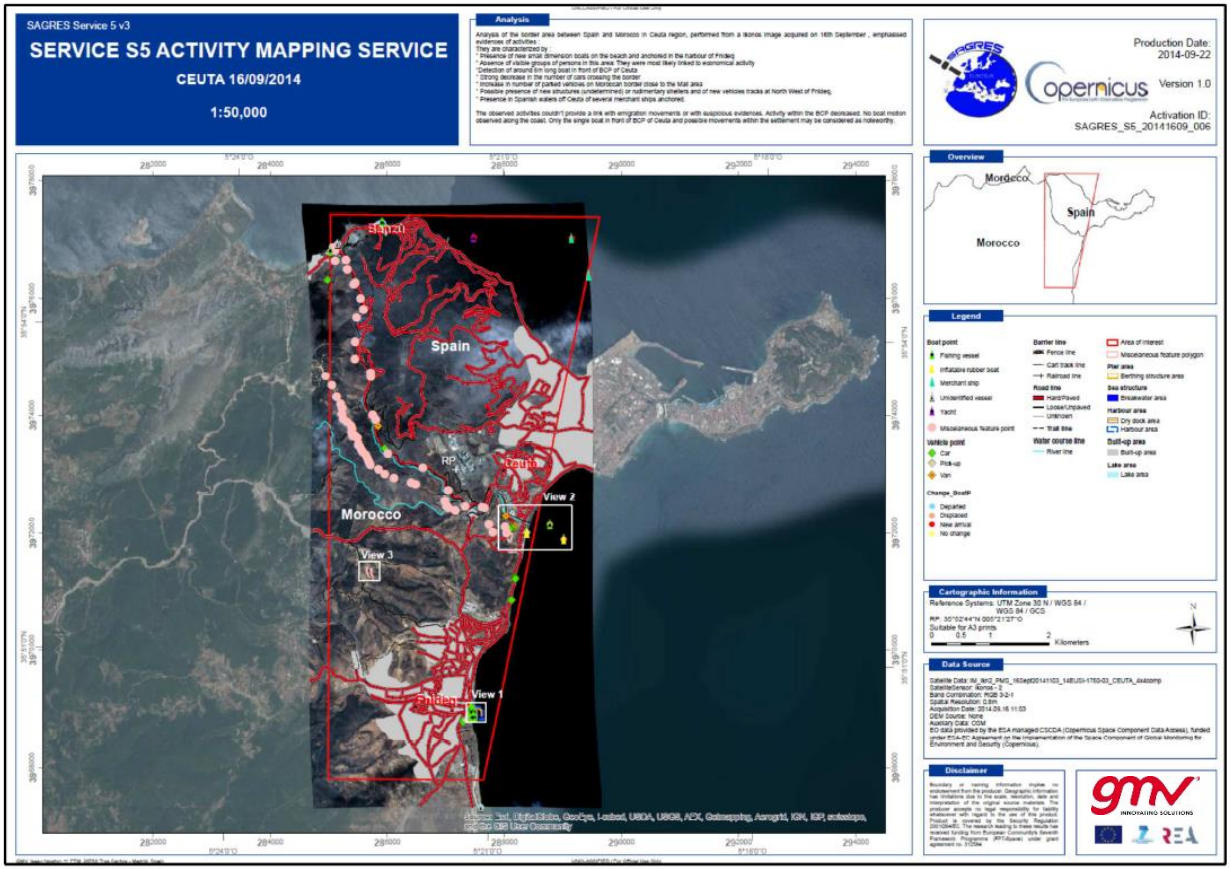
- Natural 24 h for delivering complete products*
- Pre-frontier products and emergency / security assessment



*(from image availability)

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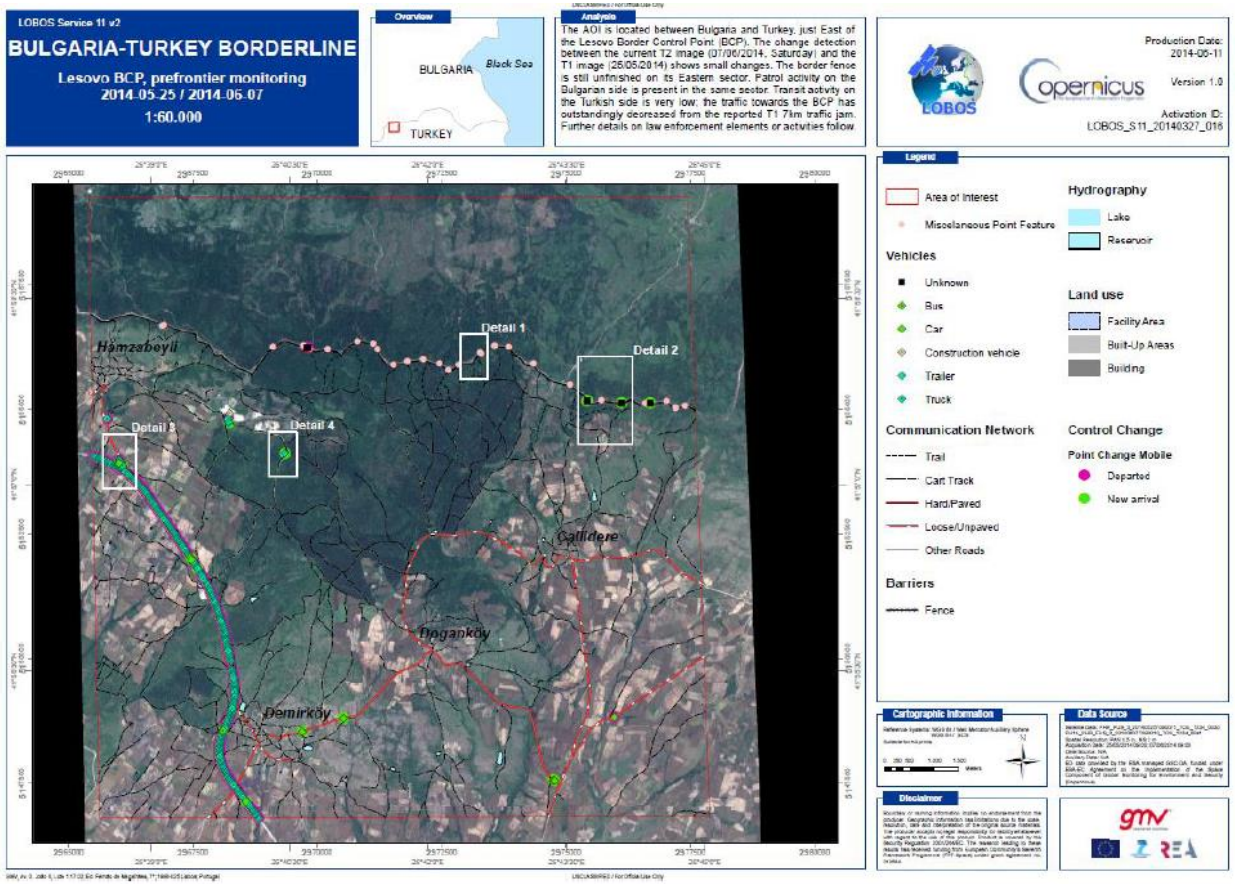

*(from image availability)

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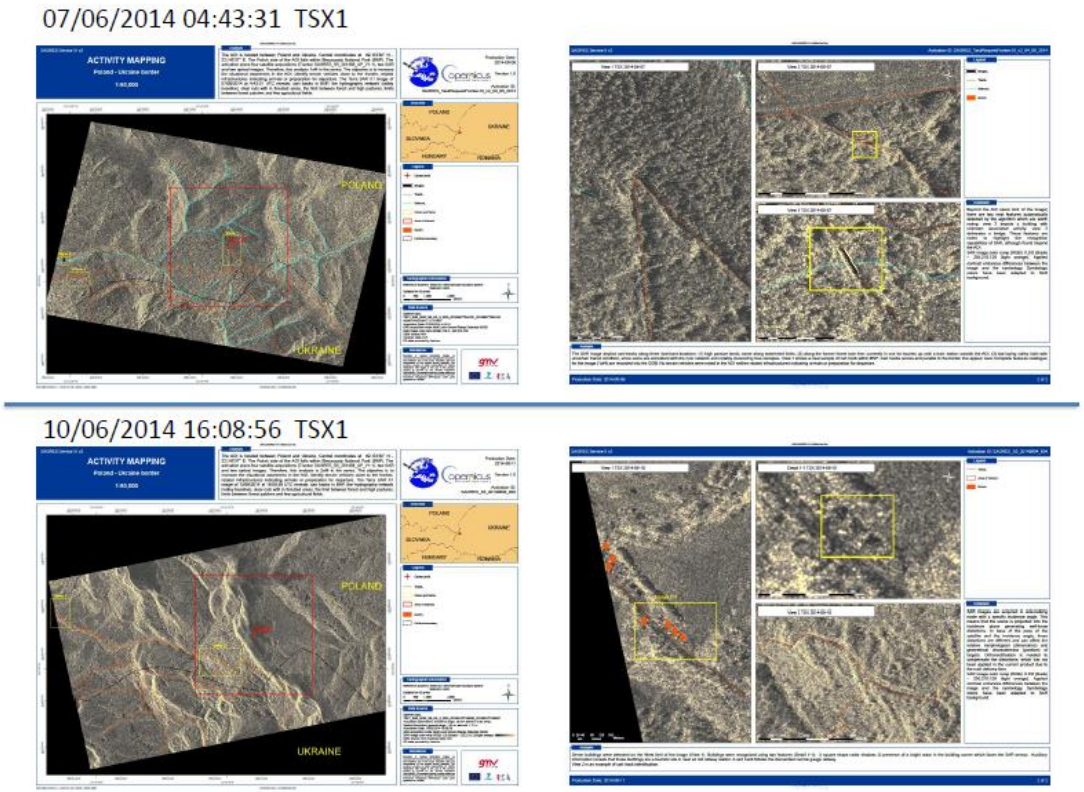

*(from image availability)

Thank you

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INNOVATING SOLUTIONS