



Project Information

MARitime Integrated Surveillance Awareness (MARISA)

Coordinator: Leonardo



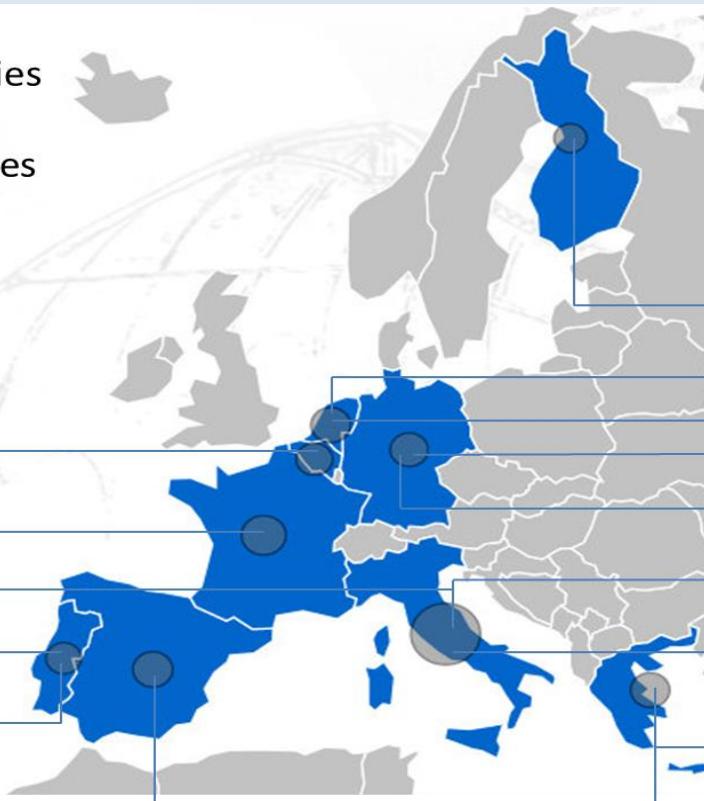
Project Costs: € 9.765.658,75

EU Contribution: € 7.997.492,50

Start: 1st May 2017

End: 31st October 2019

- ✓ 22 Partners from 9 Countries
- ✓ 6 Large Enterprises,
- ✓ 4 Small/Medium Enterprises
- ✓ 6 Academia,
- ✓ 1 Non Profit Org
- ✓ 5 End Users ★



MARISA Consortium

Industry

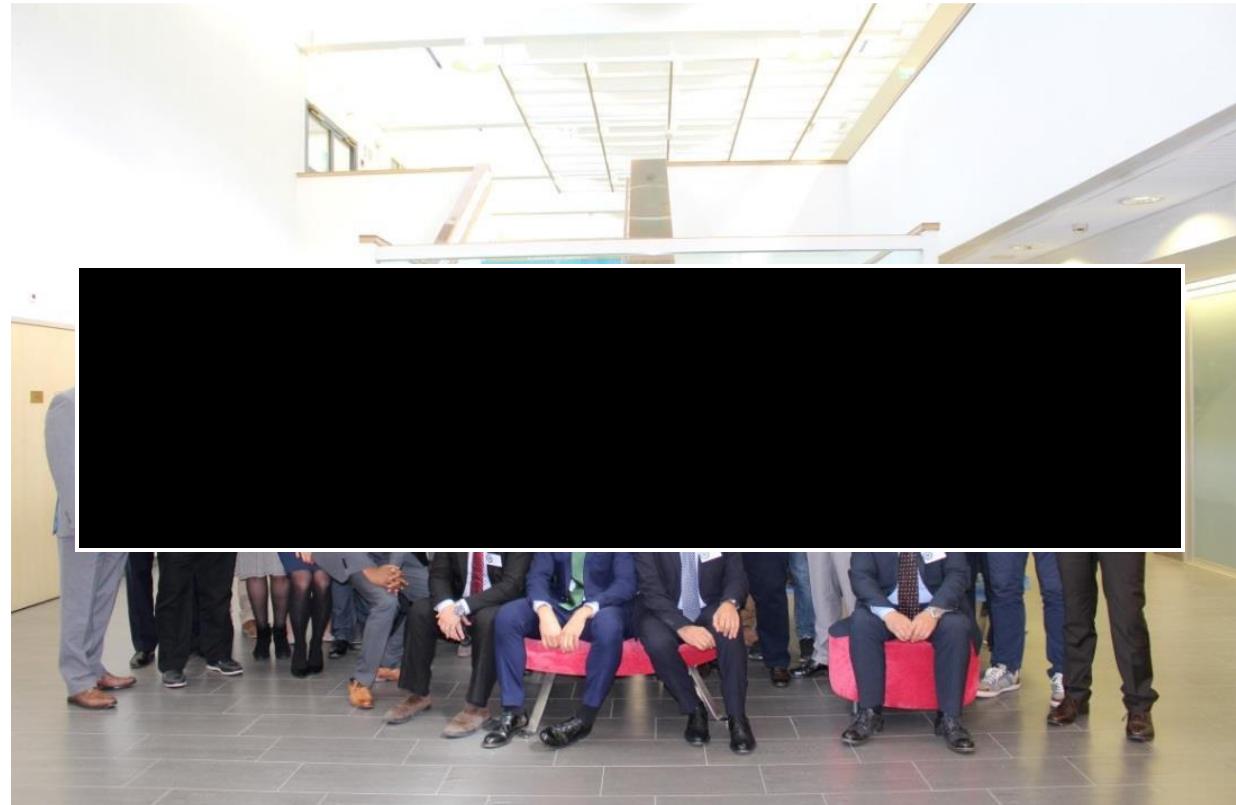
- Leonardo (IT)
- Engineering (IT)
- Airbus (FR)
- GMV (ES)
- e-GEOS (IT)
- SATWAYS (GR)
- PLATH (DE)
- Aster (IT)
- Inovaworks (PT)
- Luciad (BE)
- Polémer Mediterannée (FR)

Research

- TNO (NL)
- University of Bologna (IT)
- Laurea University (FIN)
- Fraunhofer IOSB (DE)
- INOV (PT)
- NATO CMRE (BE)

End-Users

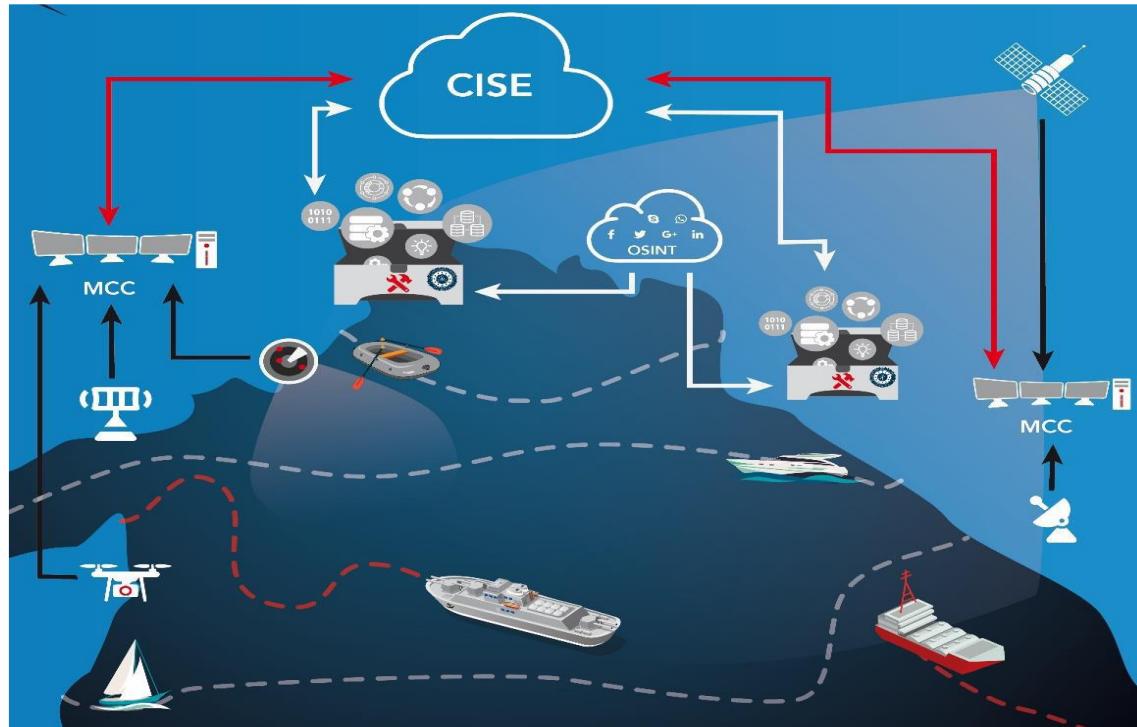
- Hellenic MoD
- Netherlands Coastguard
- Guardia Civil
- Italian Navy
- Portuguese Navy



MARISA...

...delivers a **toolkit providing a suite of services**:

- ✓ to correlate and fuse heterogeneous and homogeneous data from different sources
- ✓ to improve information exchange, situational awareness, decision-making and reaction capabilities

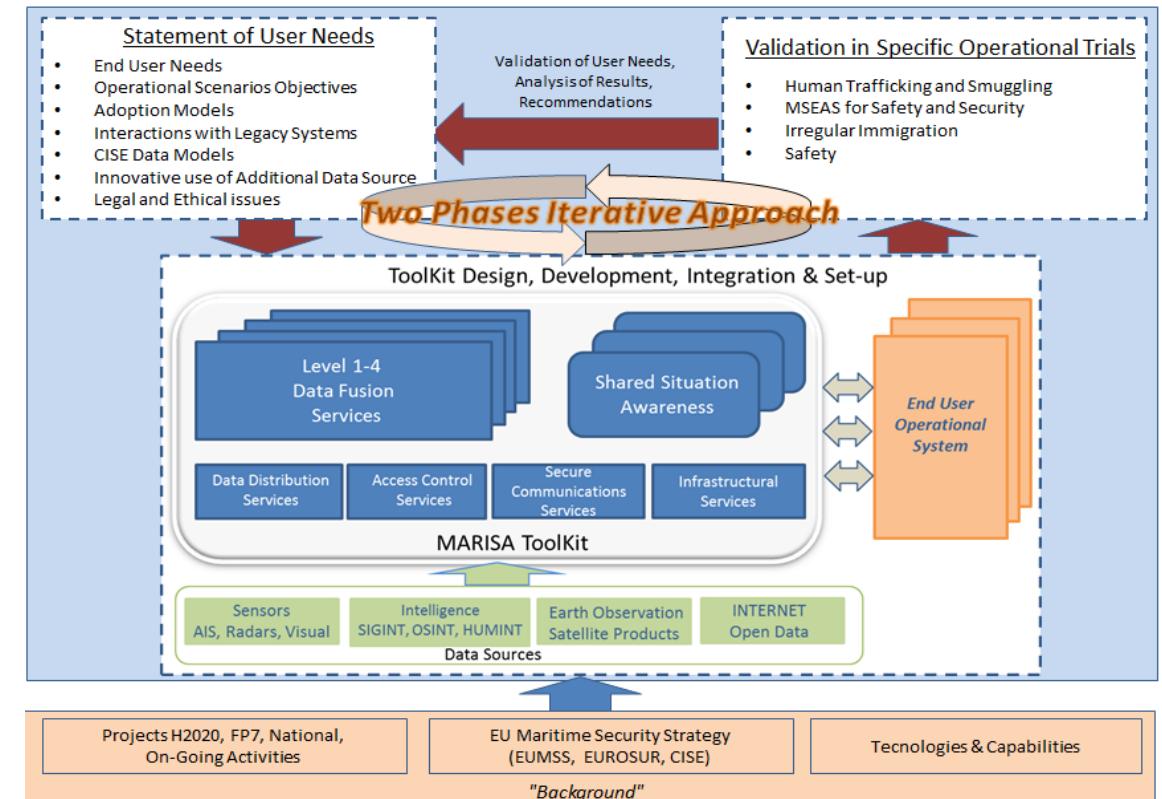


...supports the **cooperation among different Member States and User communities**:

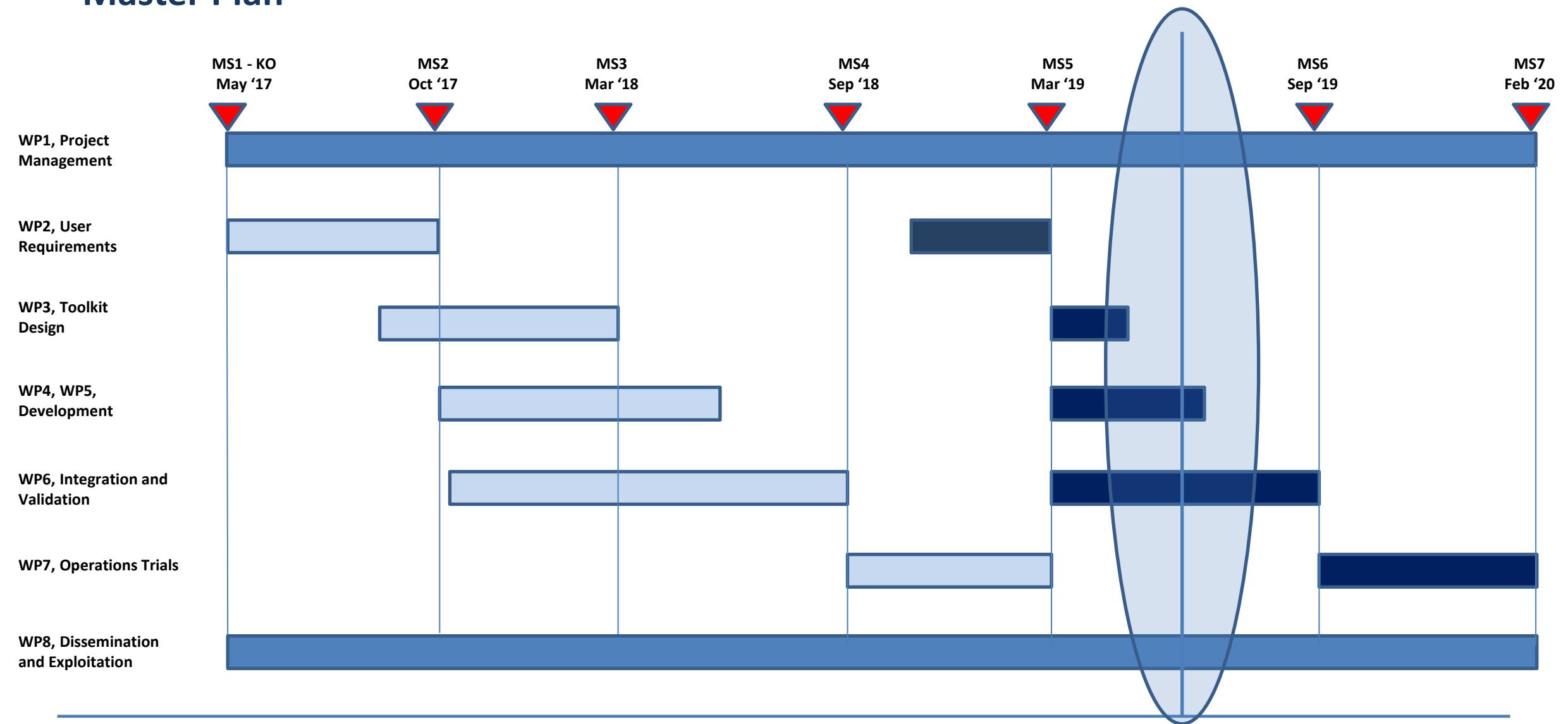
- ✓ providing networking and infrastructural services
- ✓ adopting the CISE data model as the basis for the definition of the MARISA data model

Approach and methodology

- Strong Involvement of the User Community
- Compliance with European Maritime Security Strategy and CISE Data Model
- Attention to reuse capabilities and results coming from other European programs
- Protection of Data Fusion Products based on the “need-to-share” approach
- Validation of MARISA in specific operational trials
- Two Phase Approach

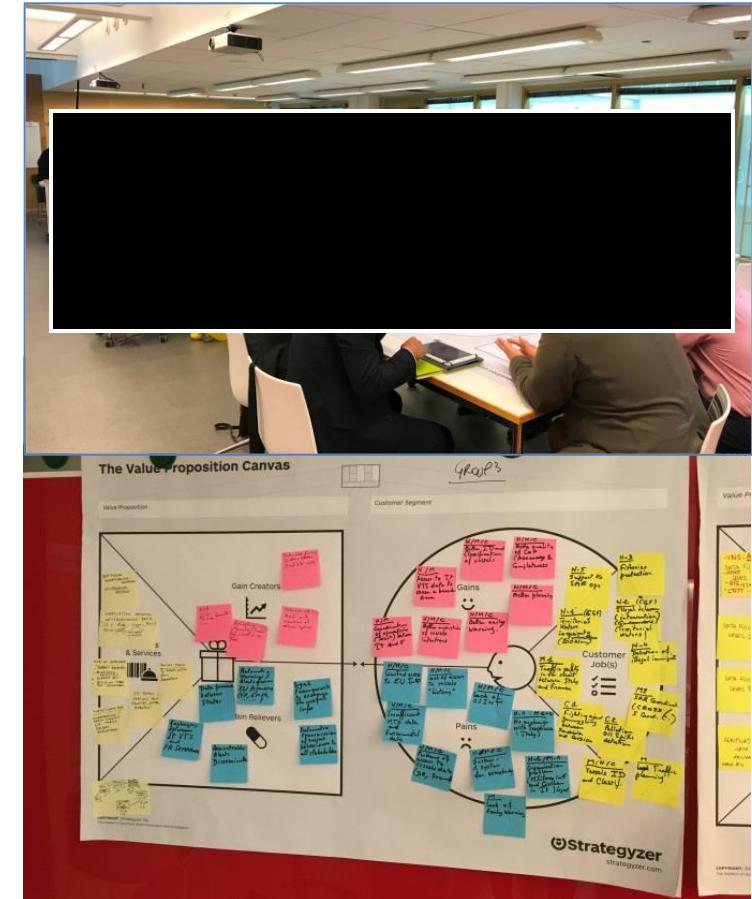


Master Plan



User Community

- **UC1 at LAUREA premises**, Helsinki, on 27th and 28th June 2017
 - Value Proposition Canvas with Customer Jobs, Pains, Gains
 - Products and services, Pain relievers, Gain creators
- **UC2 at GMV premises**, Madrid, on 16th and 17th January 2018
 - MARISA Services definition
 - MARISA Trials definition & exercises during these trials
- **UC3 at PN premises**, Lisbon, on 17th and 18th December 2018
 - Review of the First Phase Operation Trials results
 - Gather additional feedbacks from the end-users in order to prepare the Phase 2



Brainstorming workshop based on User-centered design methodology

User Community Meeting – Helsinki – June 2017

User Requirements Definition



Helped in brainstorming
User Requirements

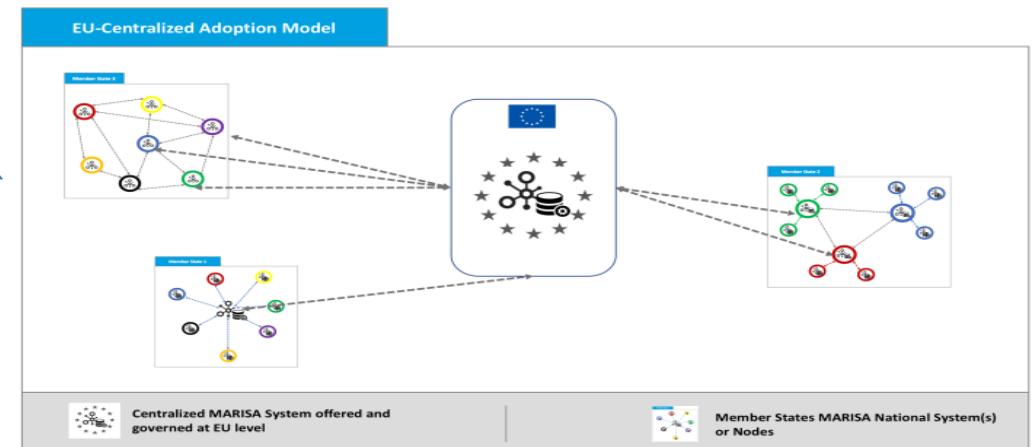


Contributed to MARISA
Adoption Models

Brainstorming workshop based on User-centered design
methodology

User Community Meeting – Helsinki – June 2017

	T1 NCG	T2 GUCI	T3 PTN	T4 FRN	T5 MMI	HMOD	HMOD
Level 3 Data Fusion Services	yes	yes	yes	yes	yes	yes	yes
MARISA_UR_DF3_300							
MARISA Toolkit shall allow the assessment (e.g. seriousness and possible impacts, underlying problem that stimulated the threatening) of detected threats in the area of interest.	yes	yes	yes	yes	yes	yes	yes
MARISA_UR_DF3_305							
MARISA Toolkit shall allow the prediction in the area of interest of the evolution of vessel tracks of non-cooperating targets (e.g. vessels with no AIS on-board or turned off).	yes	yes	yes	yes	yes	yes	yes
MARISA_UR_DF3_310							
MARISA toolkit shall allow the prediction of potential threats and its evolution over a potential area of interest .	yes	yes	yes	yes	yes	yes	yes
MARISA_UR_DF3_315							
MARISA toolkit shall allow the prediction of the evolution of the observed abnormal behaviour .	yes	yes	yes		yes	yes	yes
MARISA_UR_DF3_320							
MARISA Toolkit shall allow the planning of SAR operation planning considering METOC and drift information, available assets and search plans	yes		yes				
MARISA_UR_DF3_325							
MARISA toolkit shall allow the automatic optimal vessel route planning over the area of interest considering extreme sea conditions forecasted threats (e.g. significant wave height, wave direction, current direction, wind extremes, marine fog).	yes		yes				
MARISA_UR_DF3_330							
MARISA toolkit shall allow the automatic optimal deployment of air and naval assets for Search and Rescue operations over the area of interest considering extreme sea conditions forecasts (e.g. significant wave height, wave direction, current direction, wind extremes, marine fog).	yes		yes	yes	yes	yes	yes
MARISA_UR_DF3_335							



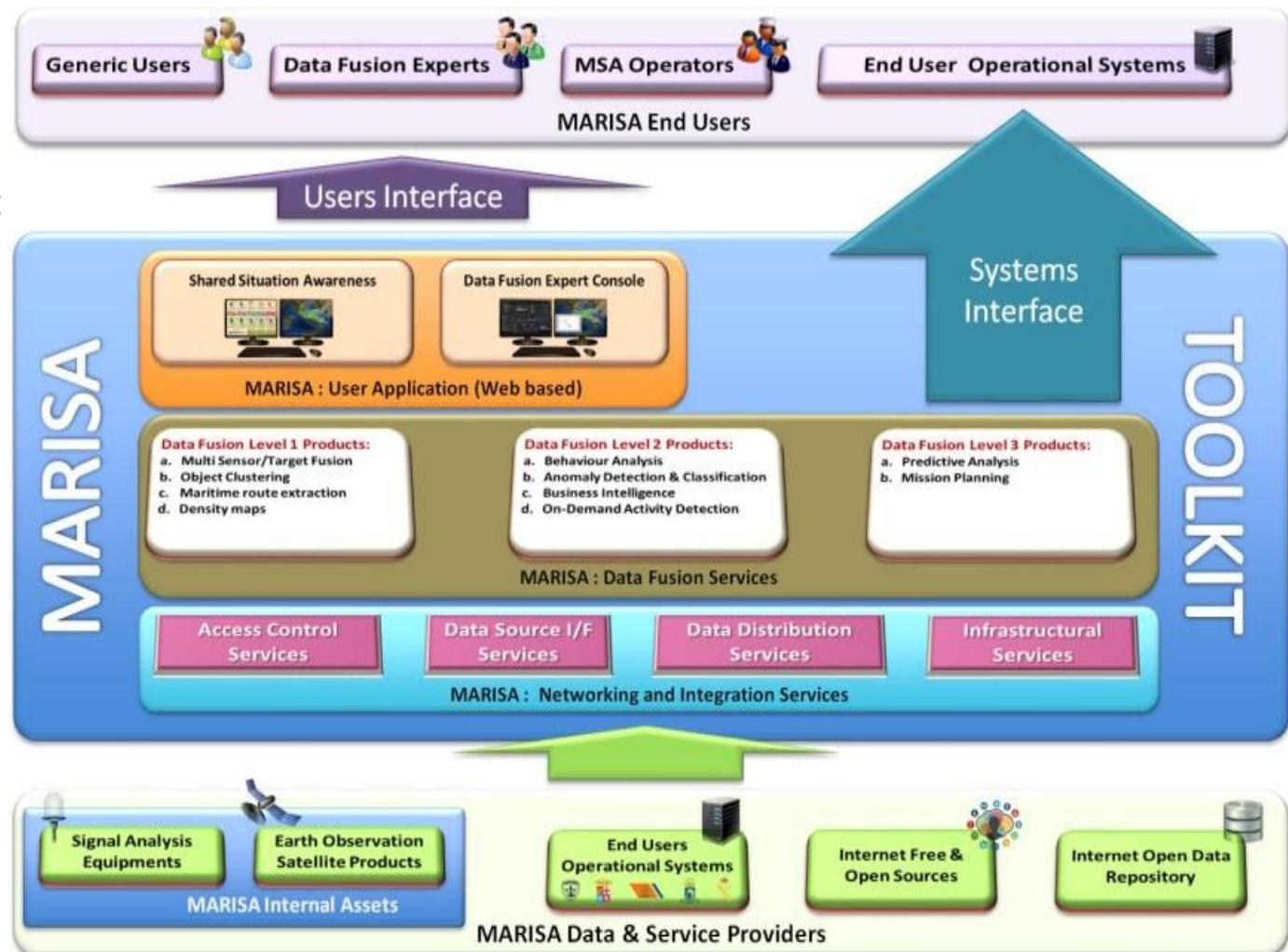
MARISA Conceptual View

Data Fusion Services

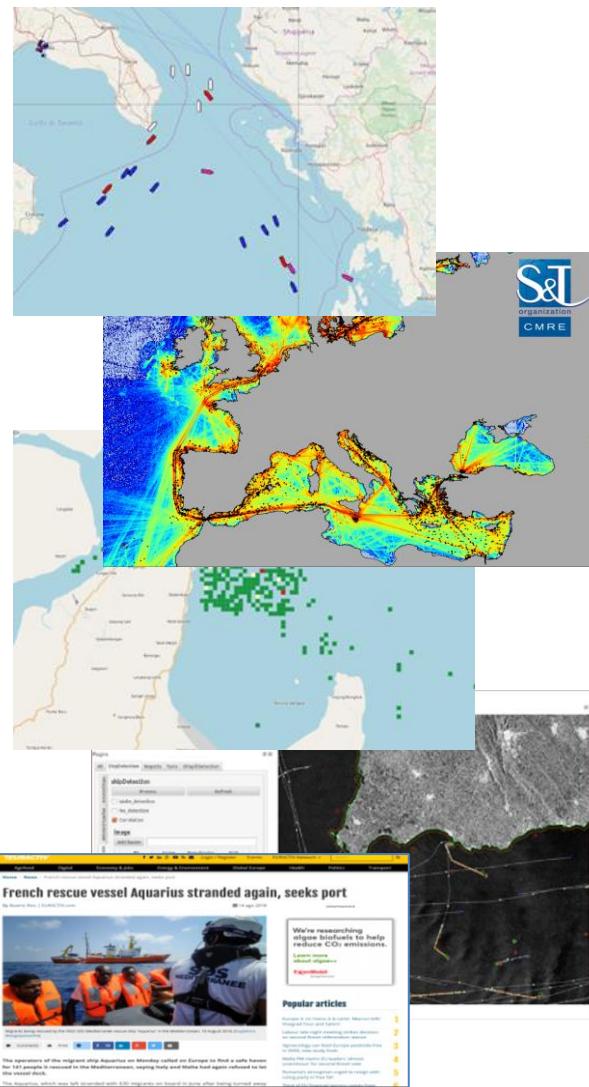
- Level 1 - Observation of elements in the environment
- Level 2 - Comprehension of the current situation
- Level 3 – Projection of Future States

Common Services

- Infrastructure Services
- Human Computer Interface
- Data Distribution Services
- Access Control Services

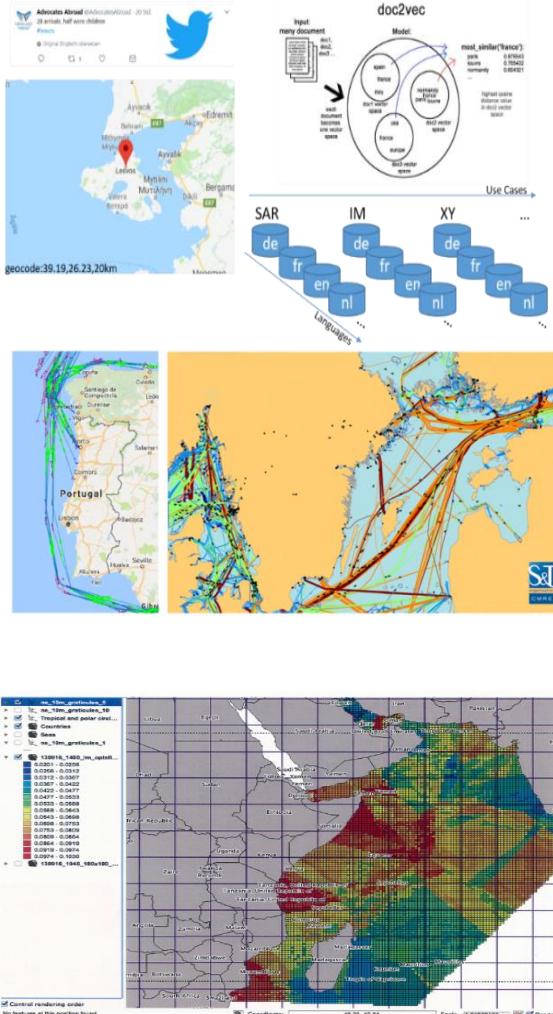


Overview of Level 1 Services: “Observation of elements in the environment”



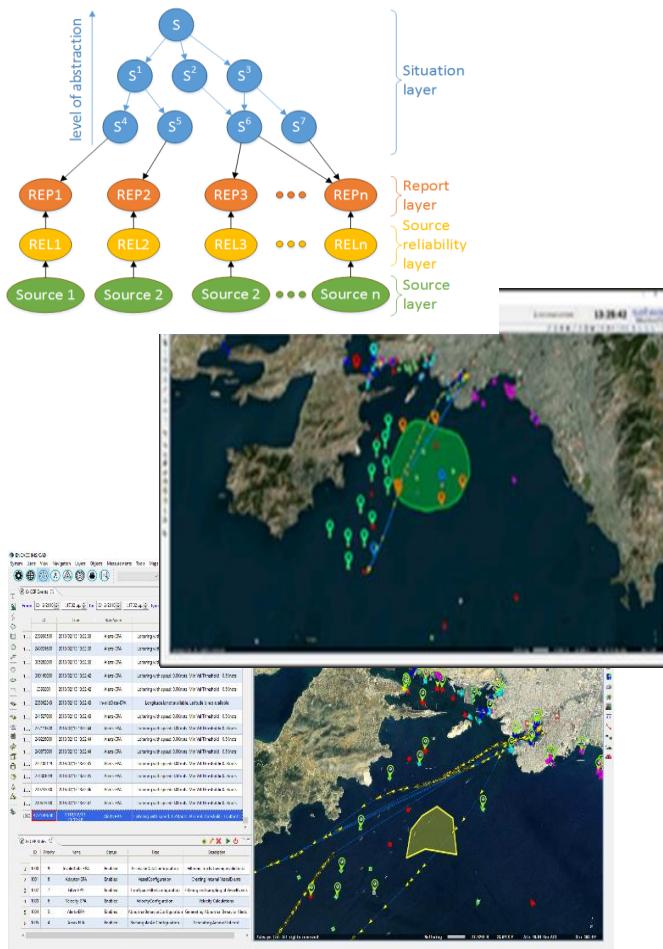
- **Multi Sensor Track Fusion (GMV):** Fusion of track data coming from a variety of sensors (AIS Receivers and Radars) and Legacy Systems
- **AIS Verification (Plath):** Verification of the AIS reported positions against measurements provided by a radio locating system
- **Satellite Vessel Detection (e-GEOS):** Target detection by processing SAR and VHR optical imagery and ship parameters estimation
- **Density Maps (CMRE):** Density of vessel traffic in a given geographical area extracted from AIS historic data
- **Heat Maps (e-GEOS):** Heat Maps showing traffic patterns extracted from satellite VHR and SAR images
- **OSINT Integration (e-GEOS):** Extraction and integration of maritime security and safety events from open sources platform (Global Database of Events - GDELT)
- **COP Fusion (AST):** Fusion of surveillance pictures produced in different operational environment to generate a common operational picture without redundant objects/tracks

Overview of Level 1 Services “Observation of elements in the environment” (Cont'd)



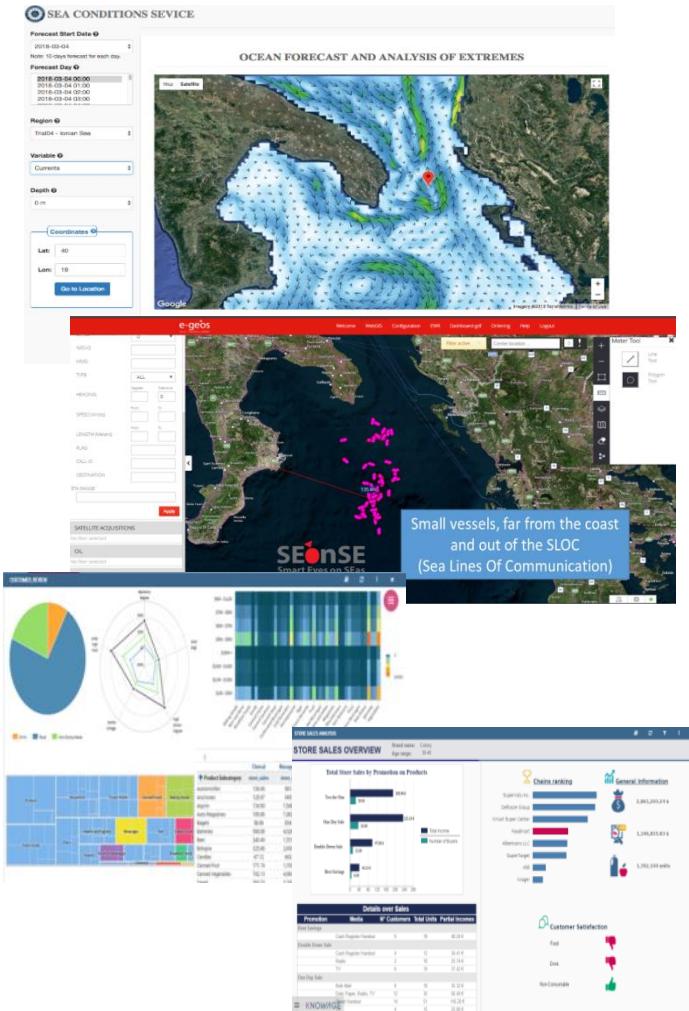
- **Twitter Services (IOSB):** Analysis of tweets for language and classification algorithms to assess the risk and relevance of the tweet in the intended context domain.
- **Ship Routes (CMRE):** Traffic patterns that are automatically learned from AIS data and suitably synthesized in a compact representation (routes, waypoint areas, navigational legs, stationary areas, ports, ...etc.)
- **Risk Maps (NLCG):** Production of risk maps for collisions, penetration in dangerous/forbidden areas analyzing historical incident, weather and sea data by using different machine learning techniques and support to SaR operations
- **Object Data Correlation (ENG):** Analysis and correlation of all information relevant to the observed object such as track data, anomalies, incidents, risks, ...etc.

Overview of Level 2 Services: "Analysis and comprehension of the current situation"



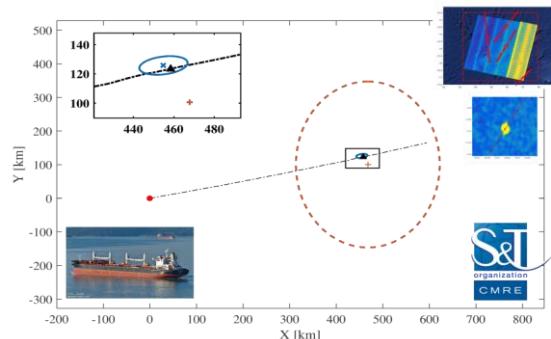
- **Behaviour Analysis and Anomaly Detection:** A set of services to detect anomalies and abnormal behaviour. Different technical approaches are used:
 - ✓ **Rule based:** built on end user's field experience
 - ✓ **Dynamic Bayesian Networks (IOSB/CMRE):** use of probabilistic models of the vessel traffic parameters and their situational dependencies for vessel behaviours analysis and ship-to-ship interactions
 - ✓ **Geospatial Complex Event Processing (STW):** Combines geospatial data analysis to infer events or patterns, to identify and analyze motion patterns of vessels that indicate an ongoing situation that needs attention
 - ✓ **AI & Machine Learning (INOV):** use of AI techniques and Data Mining to better detect patterns and "weak signals" patterns for analysis and prediction of abnormal tracks, movements or collective vessel behaviors.

Overview of Level 2 Services "Analysis and comprehension of the current situation" (Cont'd)



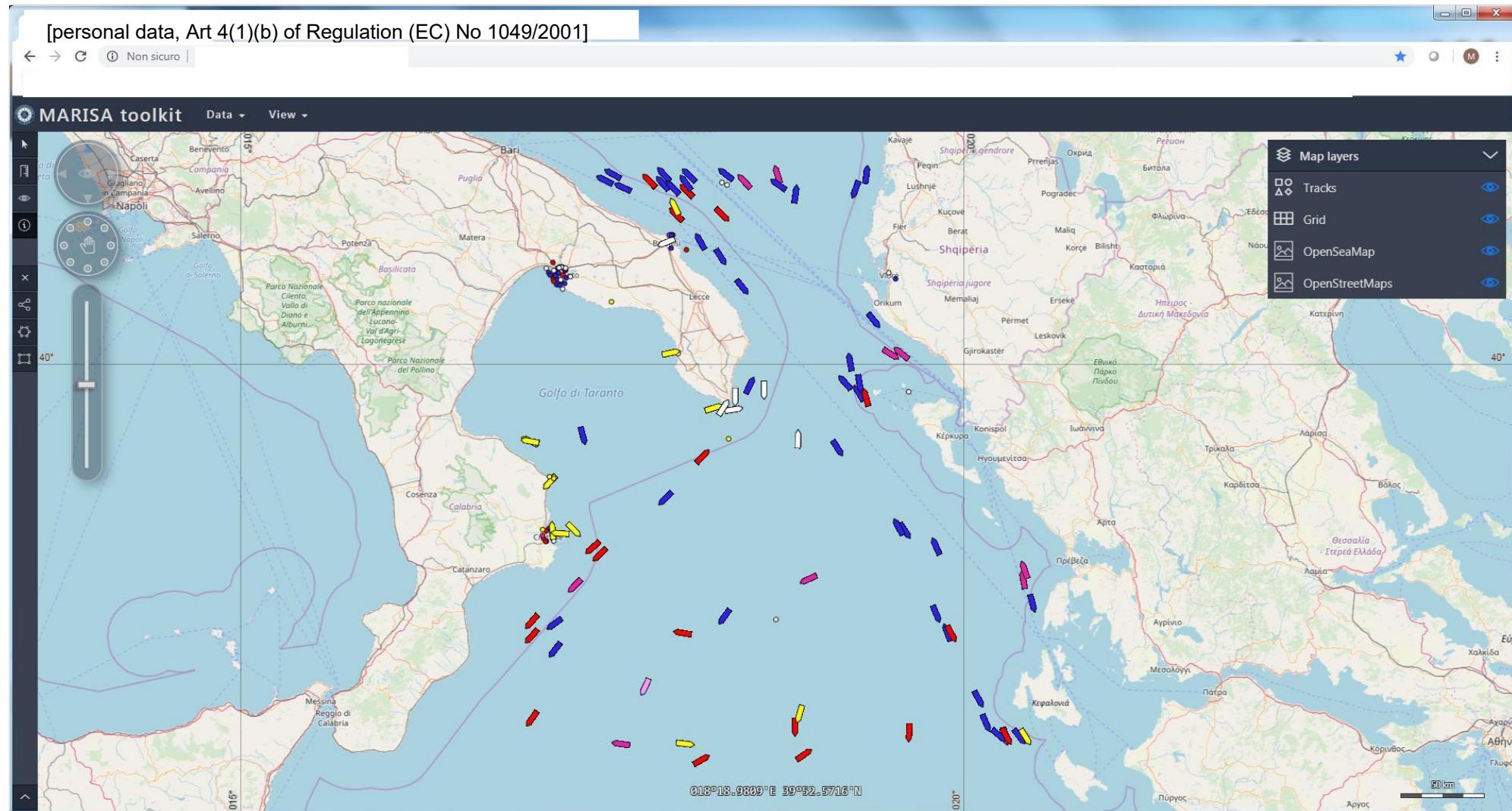
- **Sea Environment Awareness (UniBO):** production of detailed daily/hourly forecasts on surface currents, sea temperature, significant wave height and direction. Forecasts of field extreme conditions for users in selected areas of interest
- **Satellite Behaviour Analysis (e-GEOS):** vessel anomalies detected by processing and analyzing satellite VHR and SAR images
- **Business Intelligence Reports (ENG):** A set of analysis and reports based on managed data in support to operational assessment and decision making
- **Vessel Route Extraction (IW):** regular route extraction from AIS tracks and other spatiotemporal observations, allowing operators to identify recurrent behavior in vessels and the extent to which maritime traffic belongs to a given route.

Overview of Level 3 Services "Impact assessment and Prediction of future states"

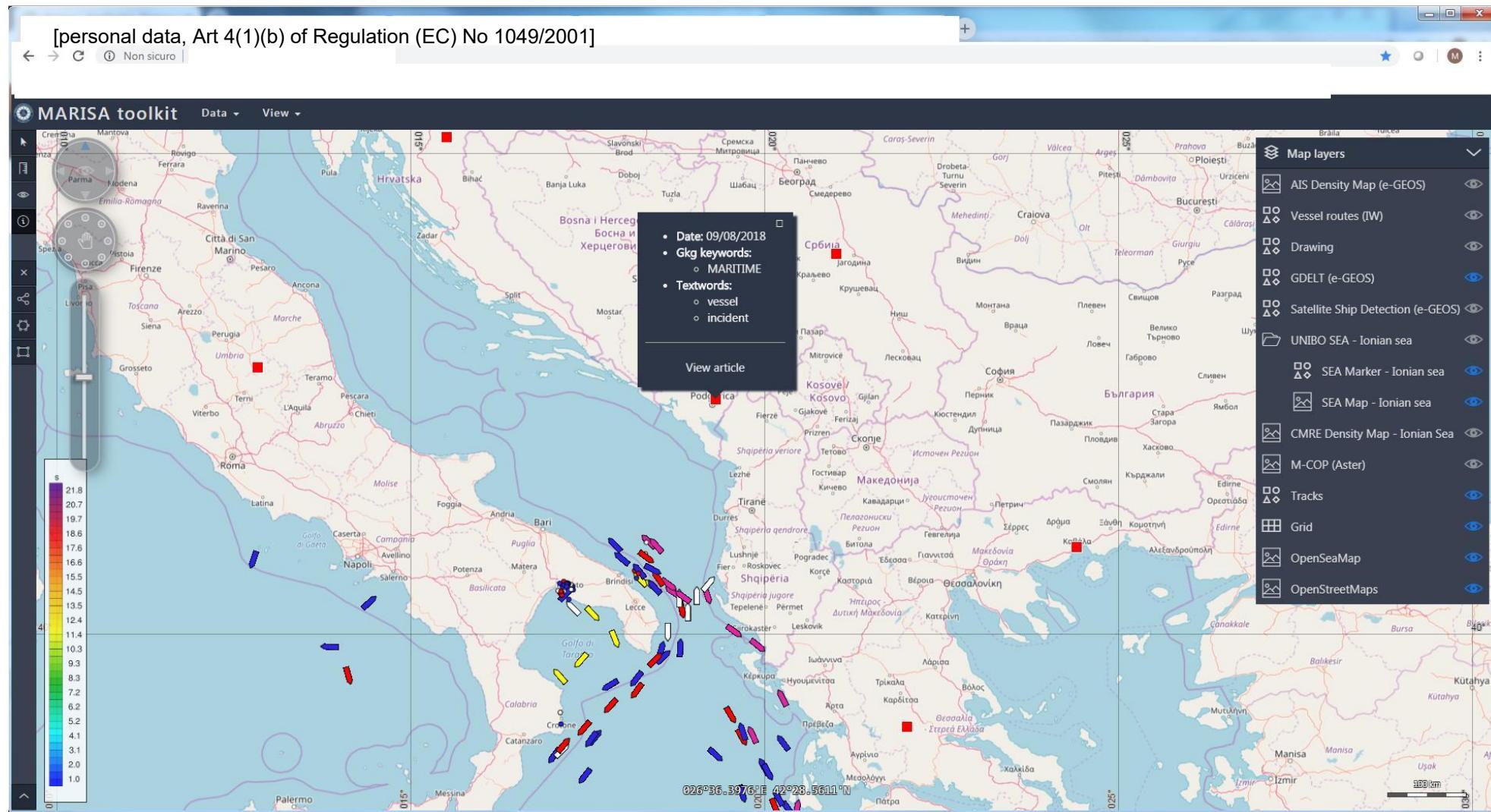


- **Vessel Route Analysis (IW):** To fit, match and extrapolate whether a vessel route is being travelled according to nominal historic patterns, or is being abnormally deviated, in which case it will try to predict the future evolution.
- **Ship prediction (CMRE):** Accurate long term prediction in open seas and across sensor coverage gaps of future positions of a vessel on the basis of its AIS track.
- **IVEF Threat Analysis (TNO):** Analysis and assessment of an anomalous behaving object including the prediction of the object's future state such as its next position or anticipated behaviour
- **Complex Threat Assessment (ADS):** Detection and assessment of potential threats from the combination of automated analysis capabilities using AIS, tracks from VTS/CSS systems and OSINT information, and providing rapid alerts to the user
- **Mission Planning (ENG):** Support in the optimal deployment of assets and graphical evaluation of an automatic optimal route vessel planning

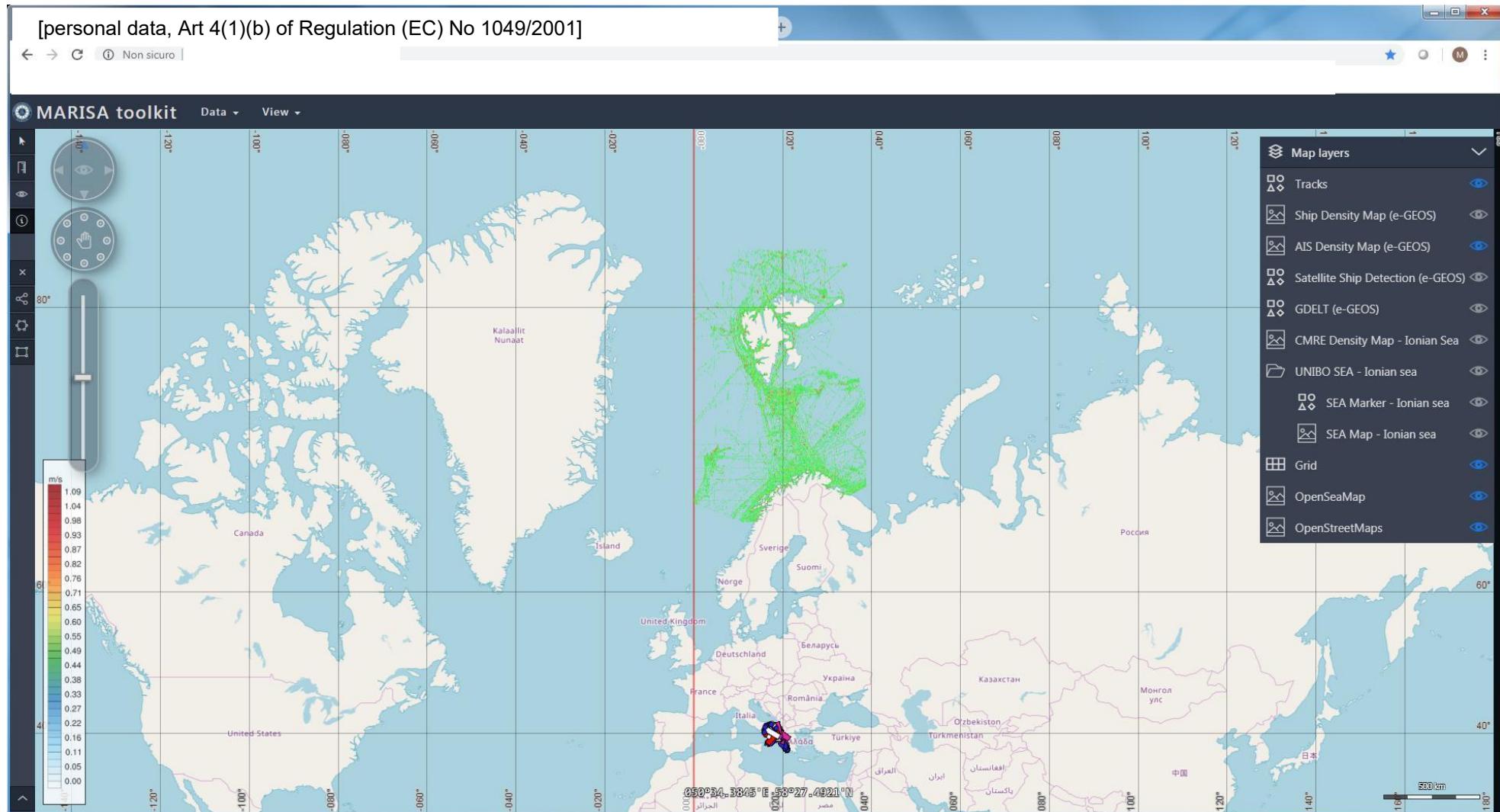
Real-time tracks



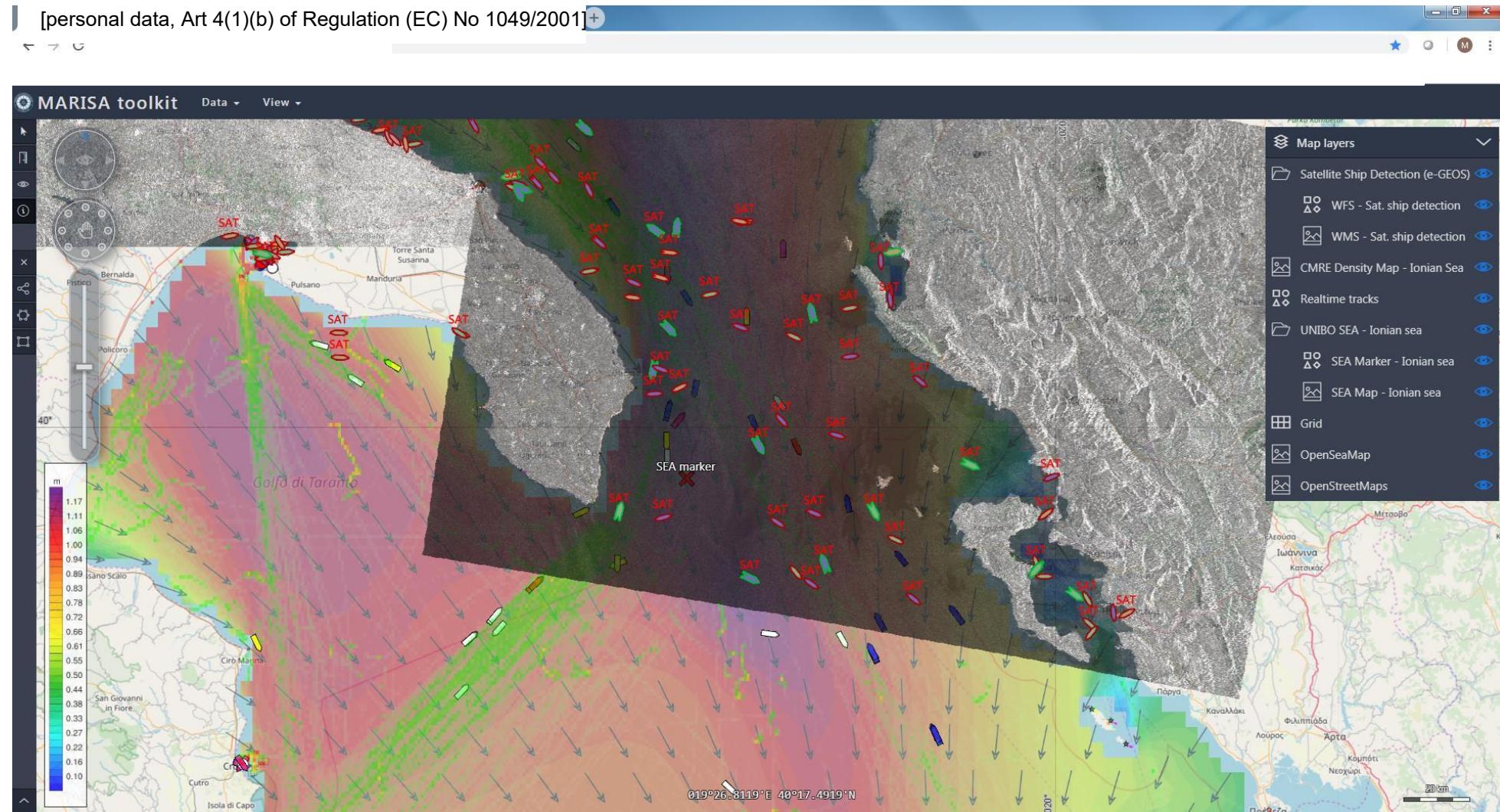
Real-time tracks



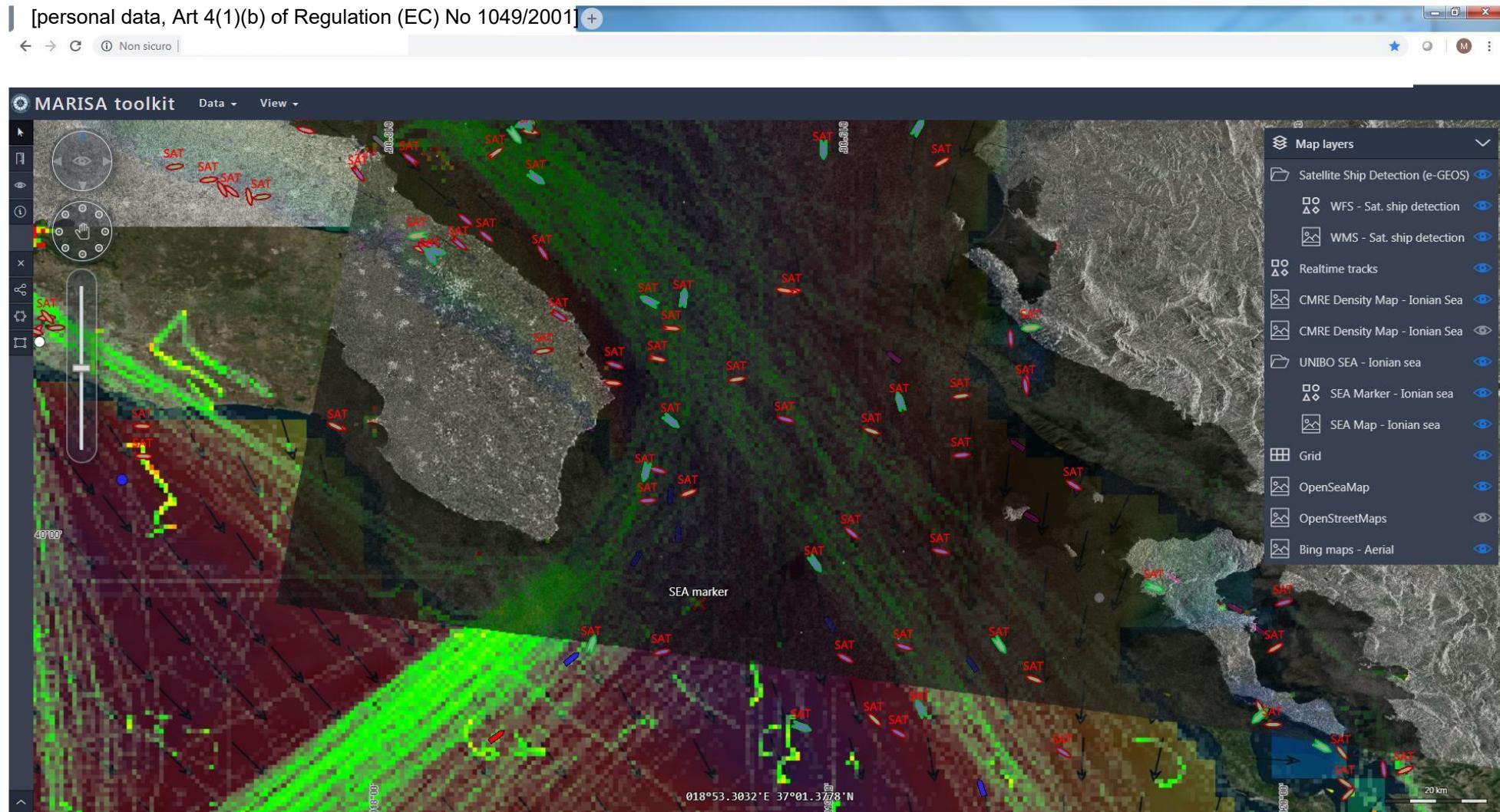
AIS Density Map



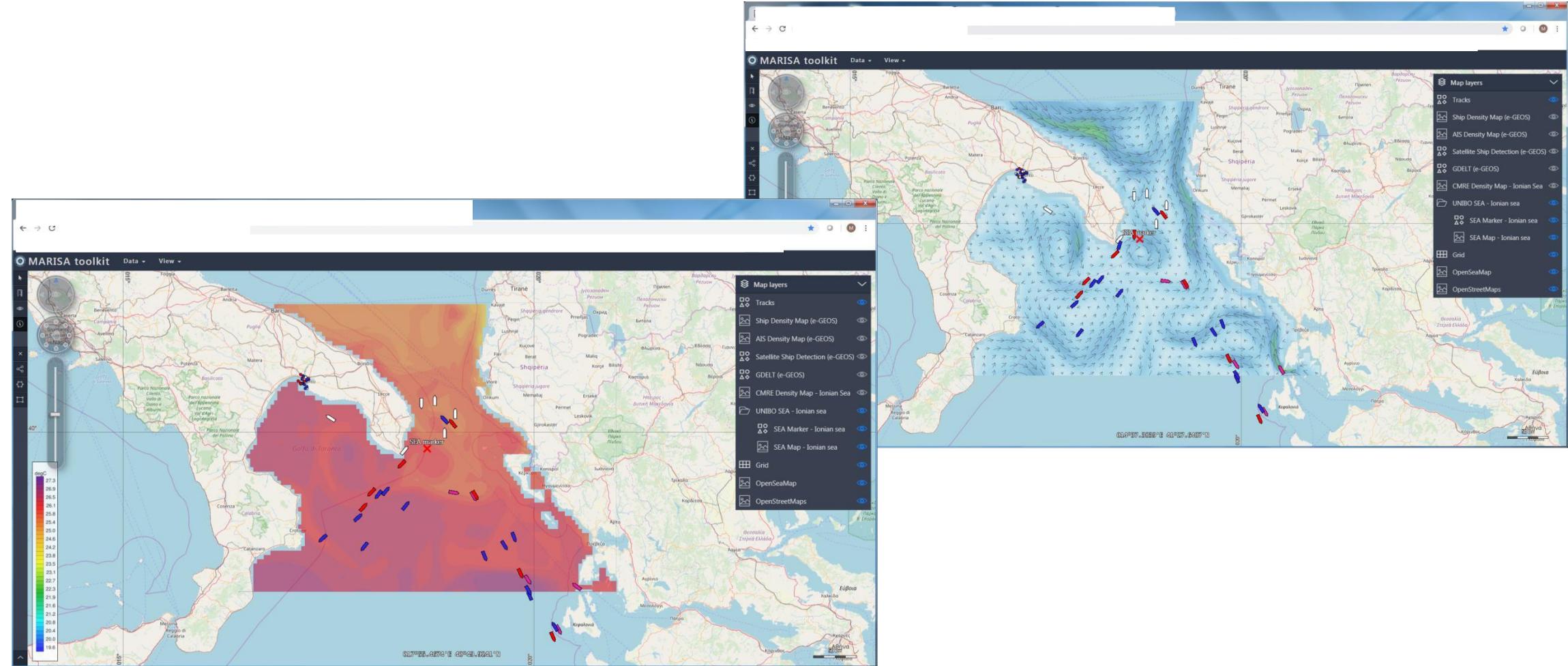
MARISA HCI Multi Layers View



MARISA HCI Multi Layers View

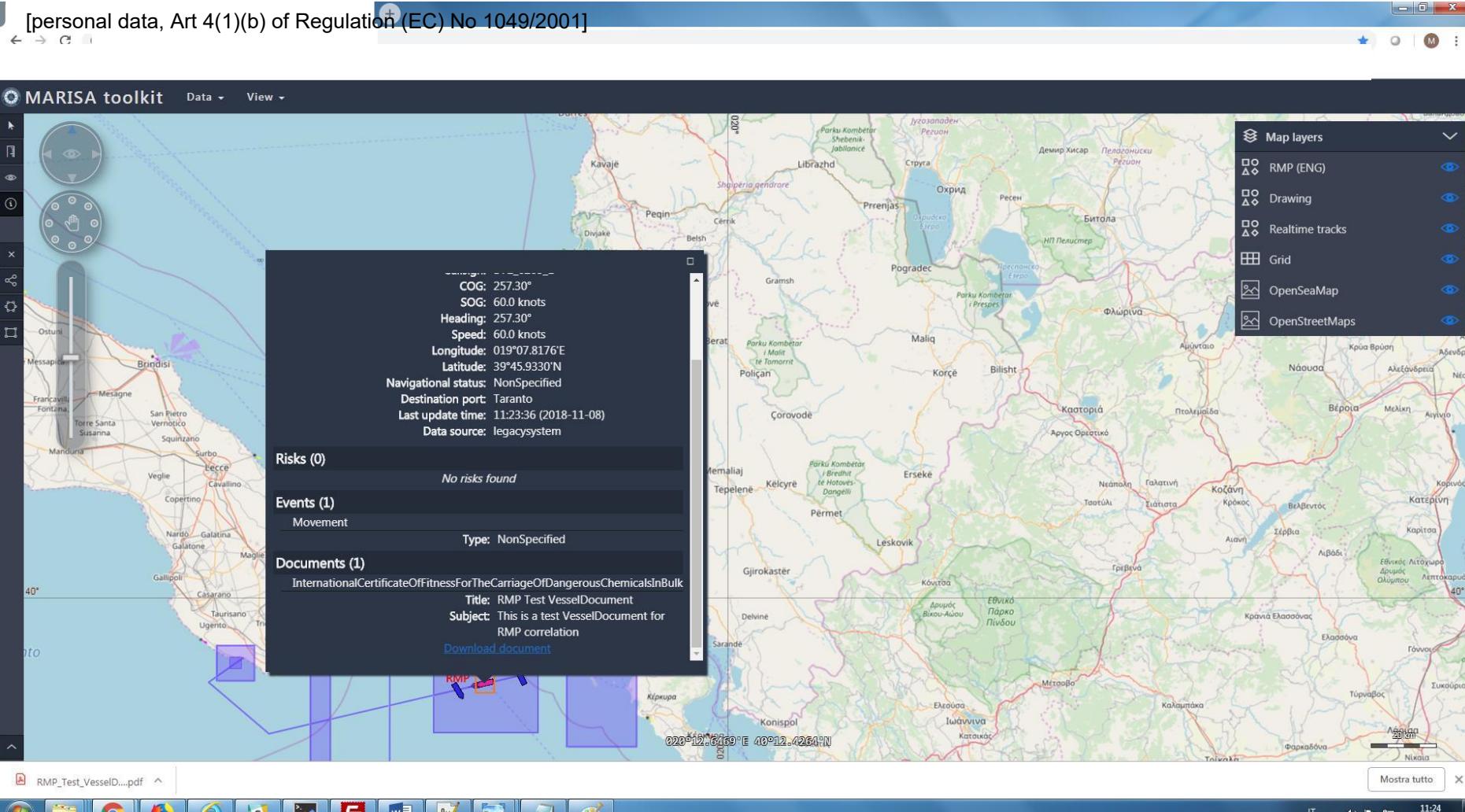


Sea Conditions – Currents and Temperatures



Vessel data correlation

[personal data, Art 4(1)(b) of Regulation (EC) No 1049/2001]



The screenshot displays the MARISA toolkit interface. On the left, a sidebar contains navigation controls and a central panel showing vessel data. The main area is a map of the Mediterranean Sea and surrounding landmasses, including Italy, Sicily, Greece, and parts of the Balkans and Turkey. A vessel's track is plotted on the map, showing a path from the west towards the east. A callout box provides detailed vessel information:

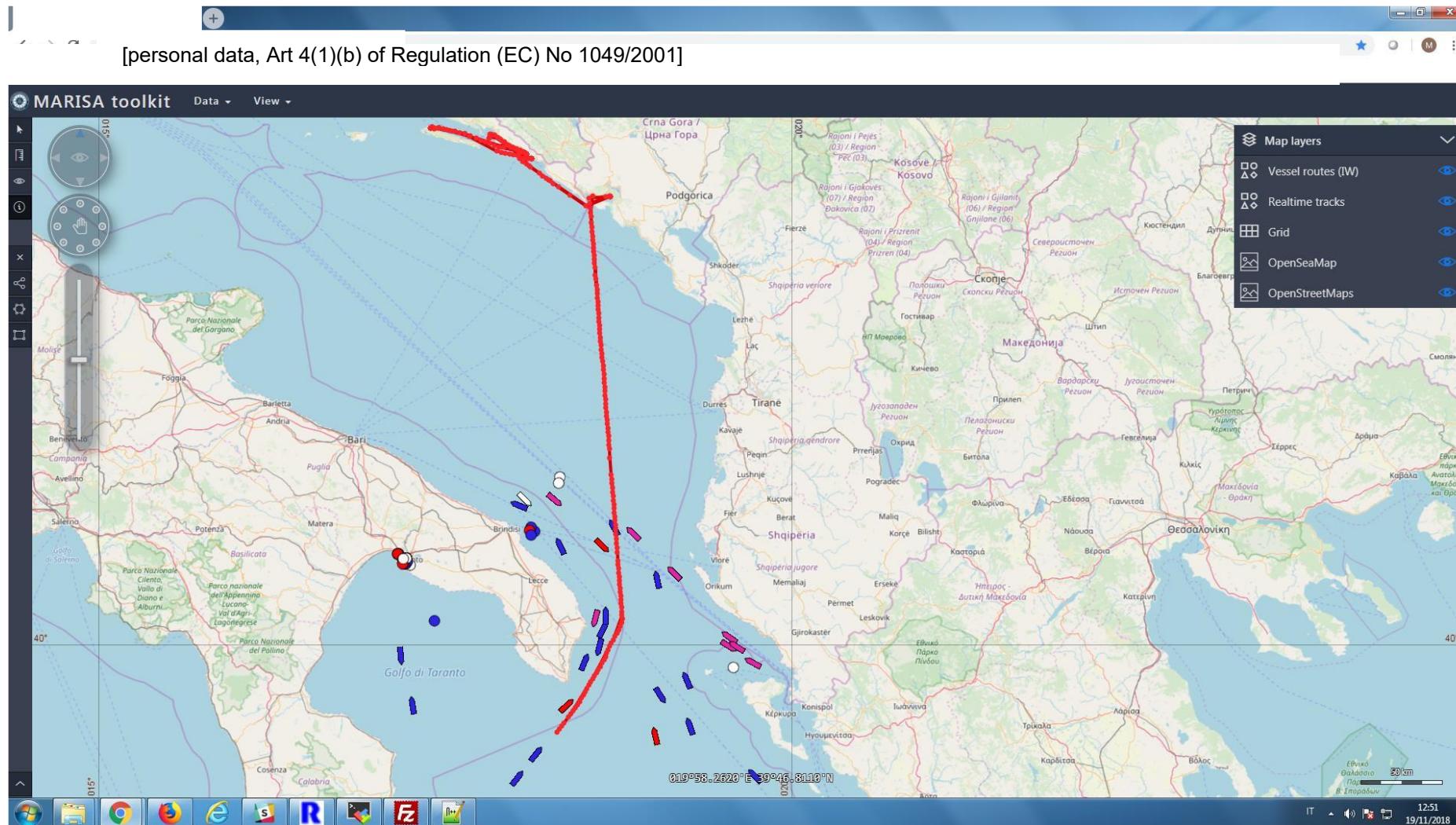
- COG:** 257.30°
- SOG:** 60.0 knots
- Heading:** 257.30°
- Speed:** 60.0 knots
- Longitude:** 019°07.817' E
- Latitude:** 39°45.9330' N
- Navigational status:** NonSpecified
- Destination port:** Taranto
- Last update time:** 11:23:36 (2018-11-08)
- Data source:** legacyystem

The sidebar also lists other data categories:

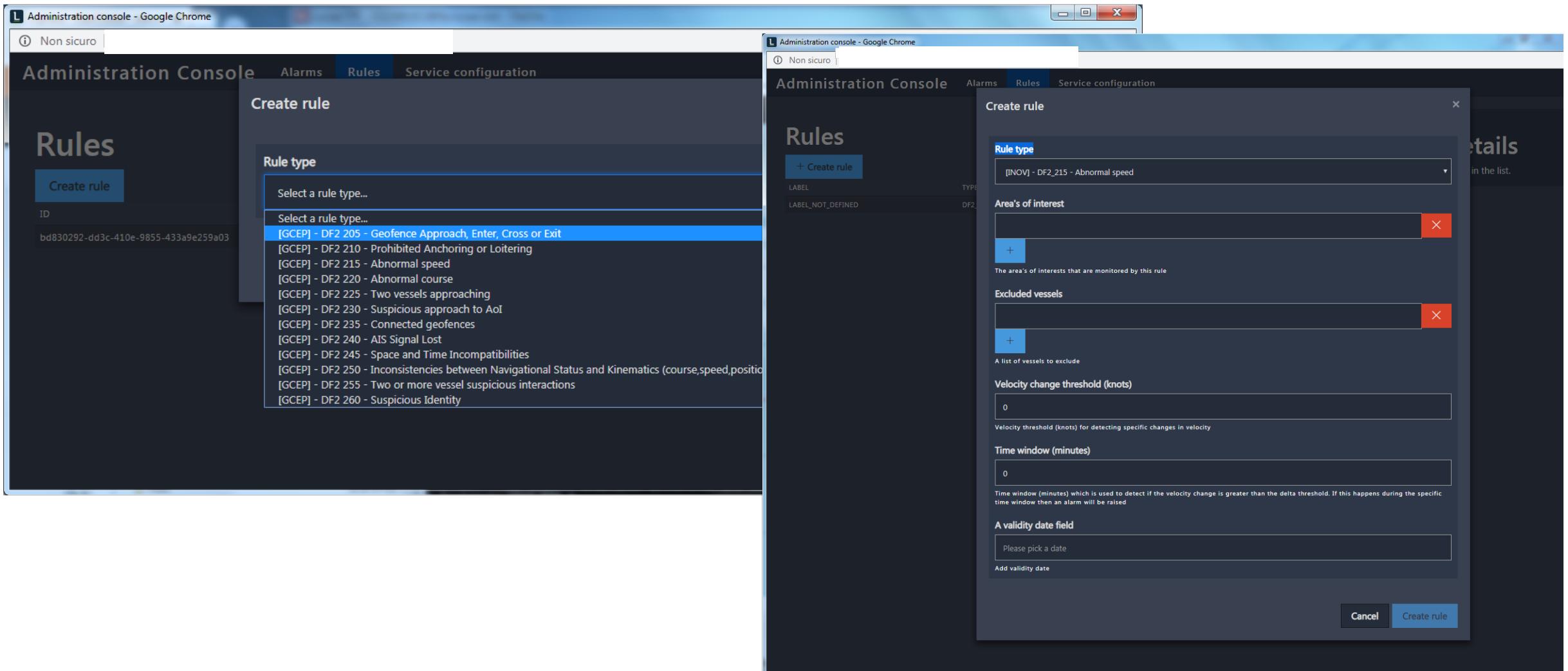
- Risks (0)**: No risks found.
- Events (1)**: Movement, Type: NonSpecified.
- Documents (1)**: International Certificate of Fitness for the Carriage of Dangerous Chemicals in Bulk, Title: RMP Test Vessel Document, Subject: This is a test Vessel Document for RMP correlation, Download document.

On the right side of the map, a legend titled "Map layers" lists several options: RMP (ENG), Drawing, Realtime tracks, Grid, OpenSeaMap, and OpenStreetMaps. The bottom of the screen shows the Windows taskbar with various icons and the system tray indicating the date and time (11:24, 08/11/2018).

Vessel routes extraction



Rules Configuration



The image displays two side-by-side screenshots of the MARISA Administration Console's Rules configuration interface, showing the process of creating a new rule.

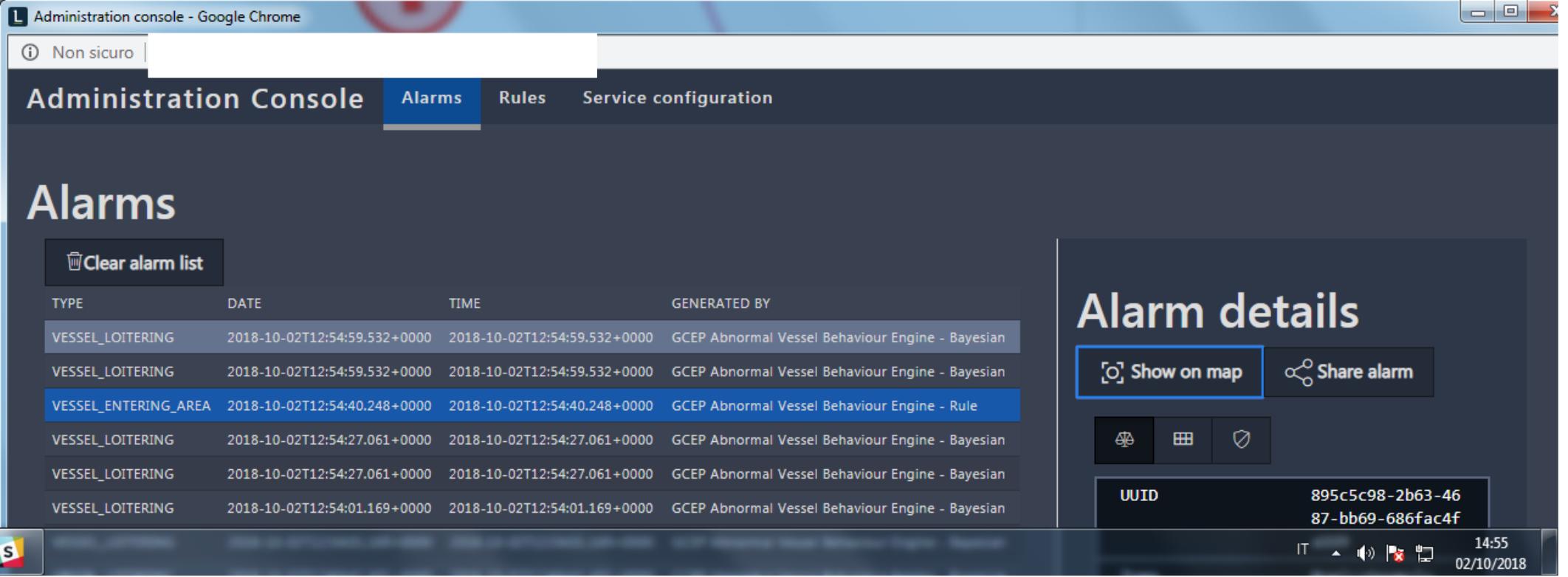
Left Screenshot (Create rule dialog):

- Header:** Administration console - Google Chrome, Non sicuro
- Navigation:** Administration Console, Alarms, Rules (selected), Service configuration
- Section:** Rules
- Sub-section:** Create rule
- Form Fields:**
 - Rule type:** Select a rule type... (dropdown menu)
 - [GCEP] - DF2 205 - Geofence Approach, Enter, Cross or Exit (highlighted)
 - [GCEP] - DF2 210 - Prohibited Anchoring or Loitering
 - [GCEP] - DF2 215 - Abnormal speed
 - [GCEP] - DF2 220 - Abnormal course
 - [GCEP] - DF2 225 - Two vessels approaching
 - [GCEP] - DF2 230 - Suspicious approach to AoI
 - [GCEP] - DF2 235 - Connected geofences
 - [GCEP] - DF2 240 - AIS Signal Lost
 - [GCEP] - DF2 245 - Space and Time Incompatibilities
 - [GCEP] - DF2 250 - Inconsistencies between Navigational Status and Kinematics (course,speed,position)
 - [GCEP] - DF2 255 - Two or more vessel suspicious interactions
 - [GCEP] - DF2 260 - Suspicious Identity

Right Screenshot (Create rule dialog):

- Header:** Administration console - Google Chrome, Non sicuro
- Navigation:** Administration Console, Alarms, Rules (selected), Service configuration
- Section:** Rules
- Sub-section:** Create rule
- Form Fields:**
 - Rule type:** [INOV] - DF2_215 - Abnormal speed
 - Area's of interest:** LABEL_NOT_DEFINED
 - DF2...:** TYPE
 - Excluded vessels:** (empty)
 - Velocity change threshold (knots):** 0
 - Time window (minutes):** 0
 - A validity date field:** Please pick a date

Auxiliary and Alarm Details



The screenshot shows the MARISA Administration Console interface. The top navigation bar includes tabs for "Administration Console", "Alarms" (which is selected), "Rules", and "Service configuration".

The main left panel is titled "Alarms" and contains a "Clear alarm list" button. Below it is a table listing six alarms:

TYPE	DATE	TIME	GENERATED BY
VESSEL_LOITERING	2018-10-02T12:54:59.532+0000	2018-10-02T12:54:59.532+0000	GCEP Abnormal Vessel Behaviour Engine - Bayesian
VESSEL_LOITERING	2018-10-02T12:54:59.532+0000	2018-10-02T12:54:59.532+0000	GCEP Abnormal Vessel Behaviour Engine - Bayesian
VESSEL_ENTERING_AREA	2018-10-02T12:54:40.248+0000	2018-10-02T12:54:40.248+0000	GCEP Abnormal Vessel Behaviour Engine - Rule
VESSEL_LOITERING	2018-10-02T12:54:27.061+0000	2018-10-02T12:54:27.061+0000	GCEP Abnormal Vessel Behaviour Engine - Bayesian
VESSEL_LOITERING	2018-10-02T12:54:27.061+0000	2018-10-02T12:54:27.061+0000	GCEP Abnormal Vessel Behaviour Engine - Bayesian
VESSEL_LOITERING	2018-10-02T12:54:01.169+0000	2018-10-02T12:54:01.169+0000	GCEP Abnormal Vessel Behaviour Engine - Bayesian

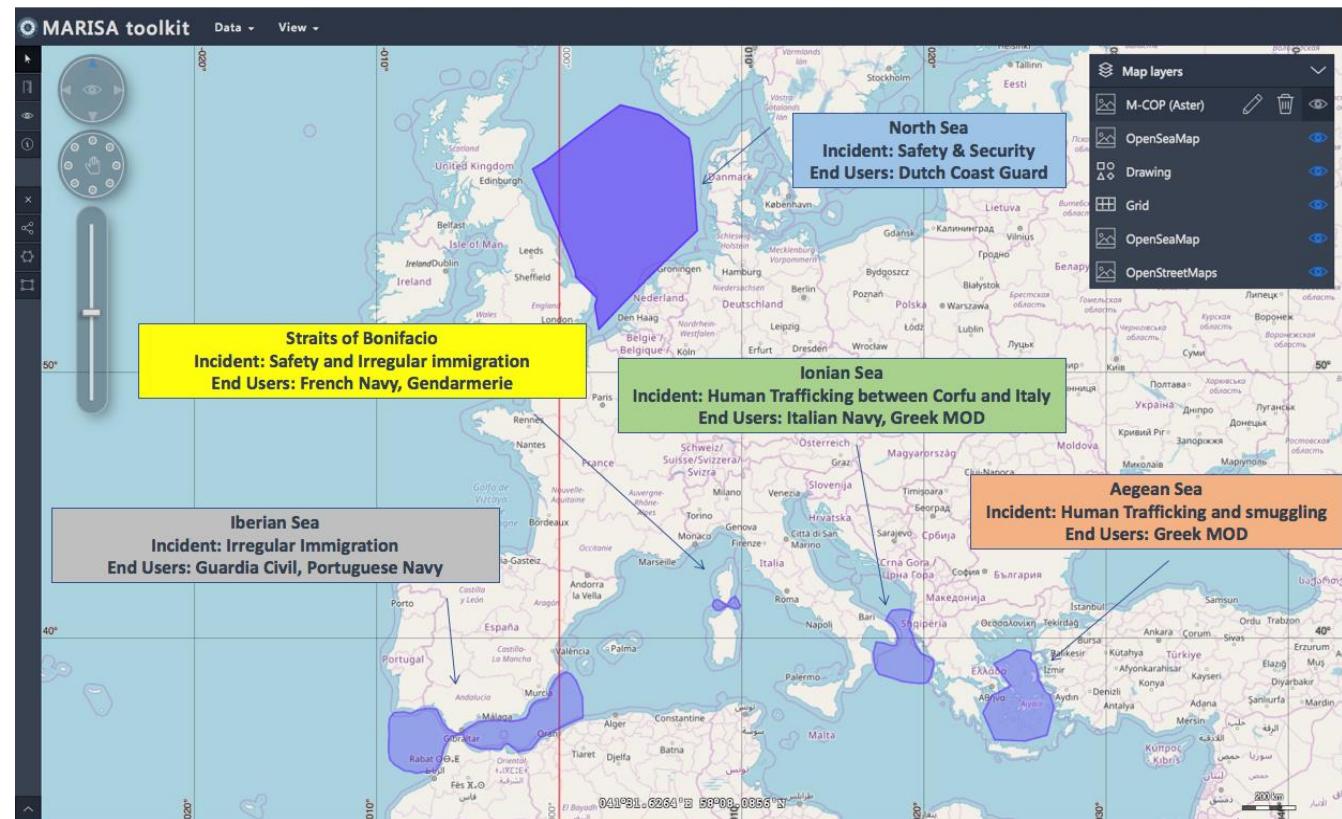
The right panel is titled "Alarm details" and displays the following information:

- "Show on map" button (highlighted with a blue border)
- "Share alarm" button
- Three small icons: a magnifying glass, a grid, and a shield.
- UUID: 895c5c98-2b63-4687-bb69-686fac4f
- System status icons: IT, sound, battery, signal, and a red error icon.
- Date and time: 02/10/2018, 14:55

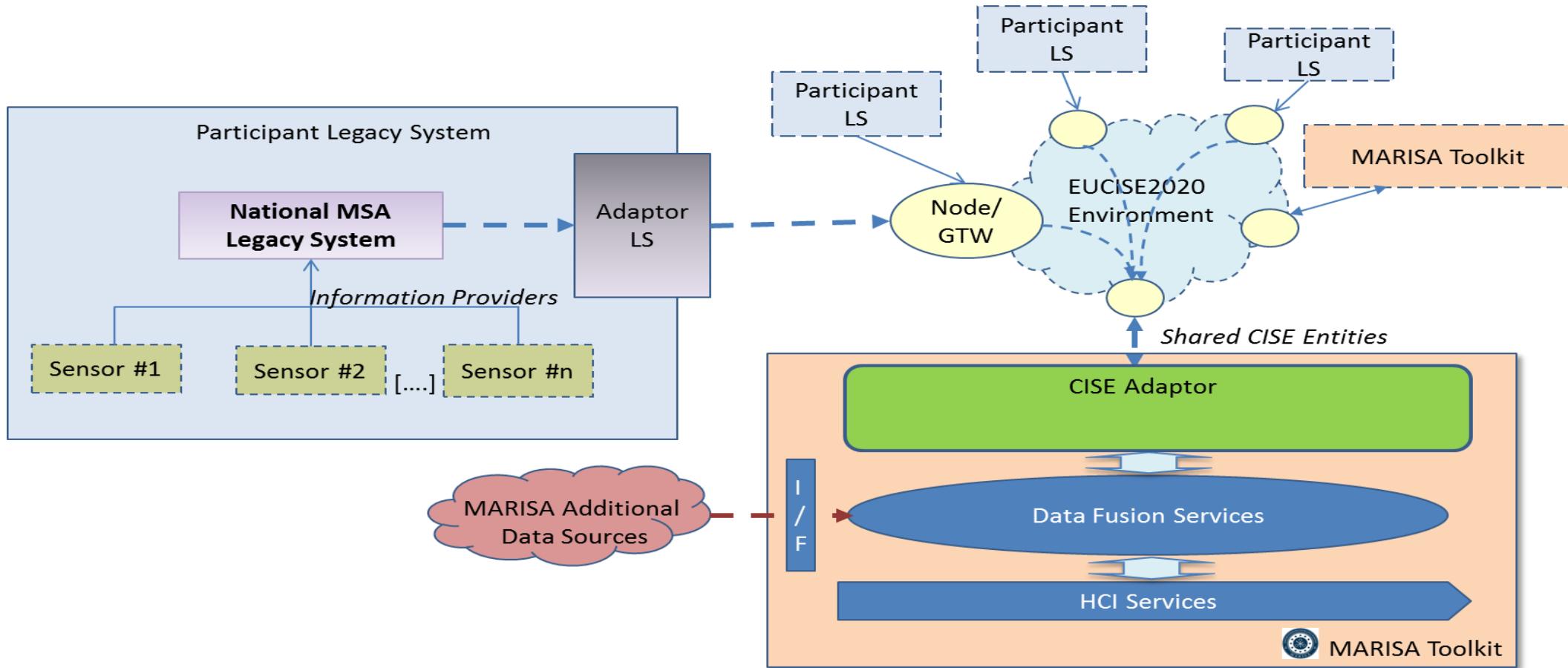
MARISA Operational Trials

Name	Output
Trial 1 – North Sea	Suspicious behaviour detection products, alerts from OSINT, risks and threat assessment, decision support products
Trial 2 – Iberian Sea	Shared situation awareness pictures, selected events, business intelligence products
Trial 3 – Strait of Bonifacio	Predicted behaviour products, possible threats and plans to coordinate the response
Trial 4 – Ionian Sea	Suspicious behaviour detection, threat assessment, predictive analysis products for suspicious vessels route, decision support and mission planning products
Trial 5 – Aegean Sea	Suspicious small and fast vessels detection, enhanced operational picture

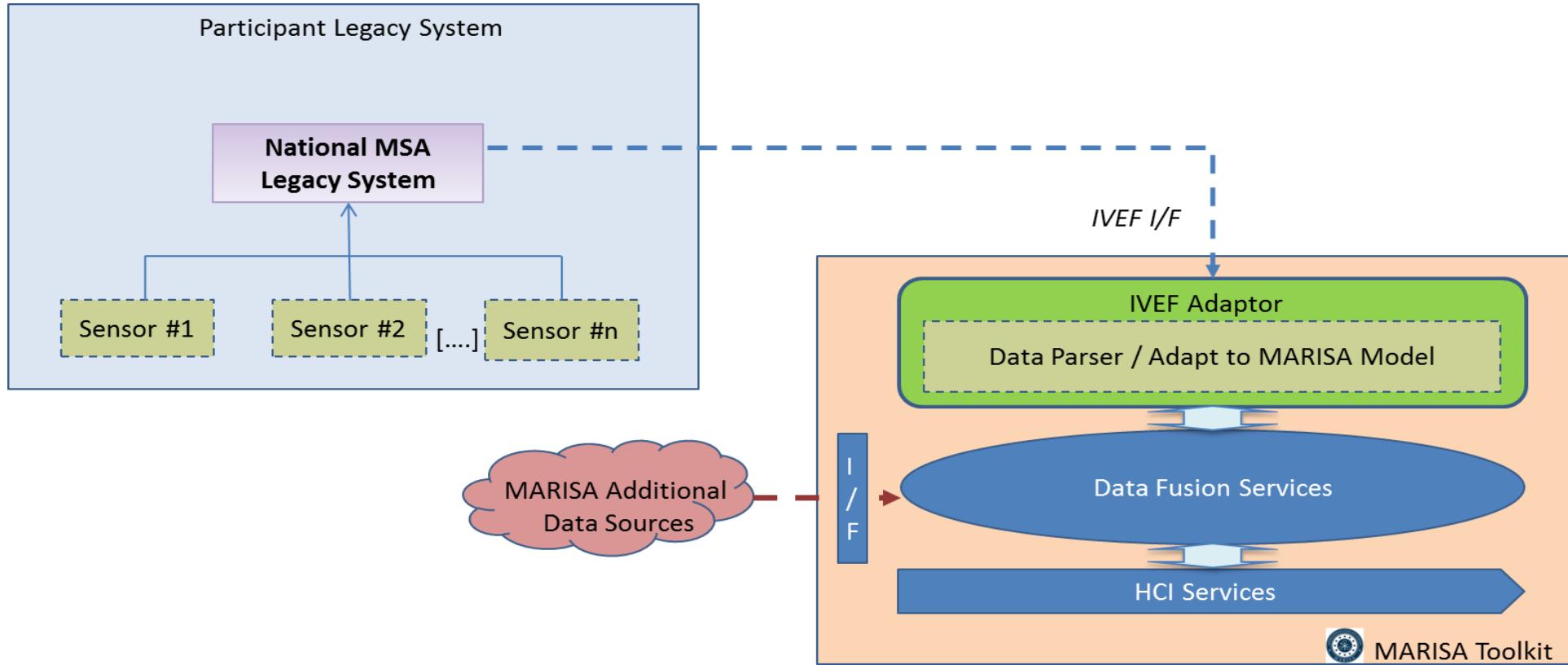
The **MARISA services** are validated through the **Operational Trials**



MARISA Interacts with Legacy Systems through EUCISE 2020



MARISA Interaction with Legacy Systems – IVEF I/F



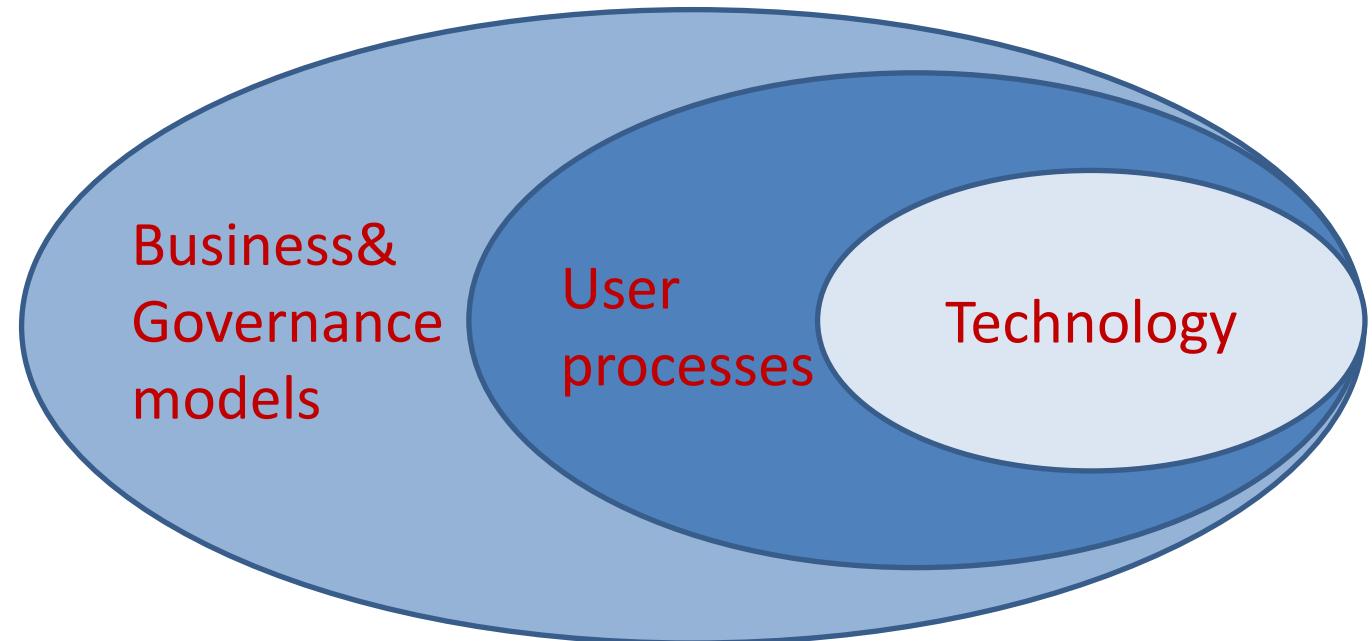
Ethical Dimensions of the MARISA Project

Ethical requirements for the MARISA solution

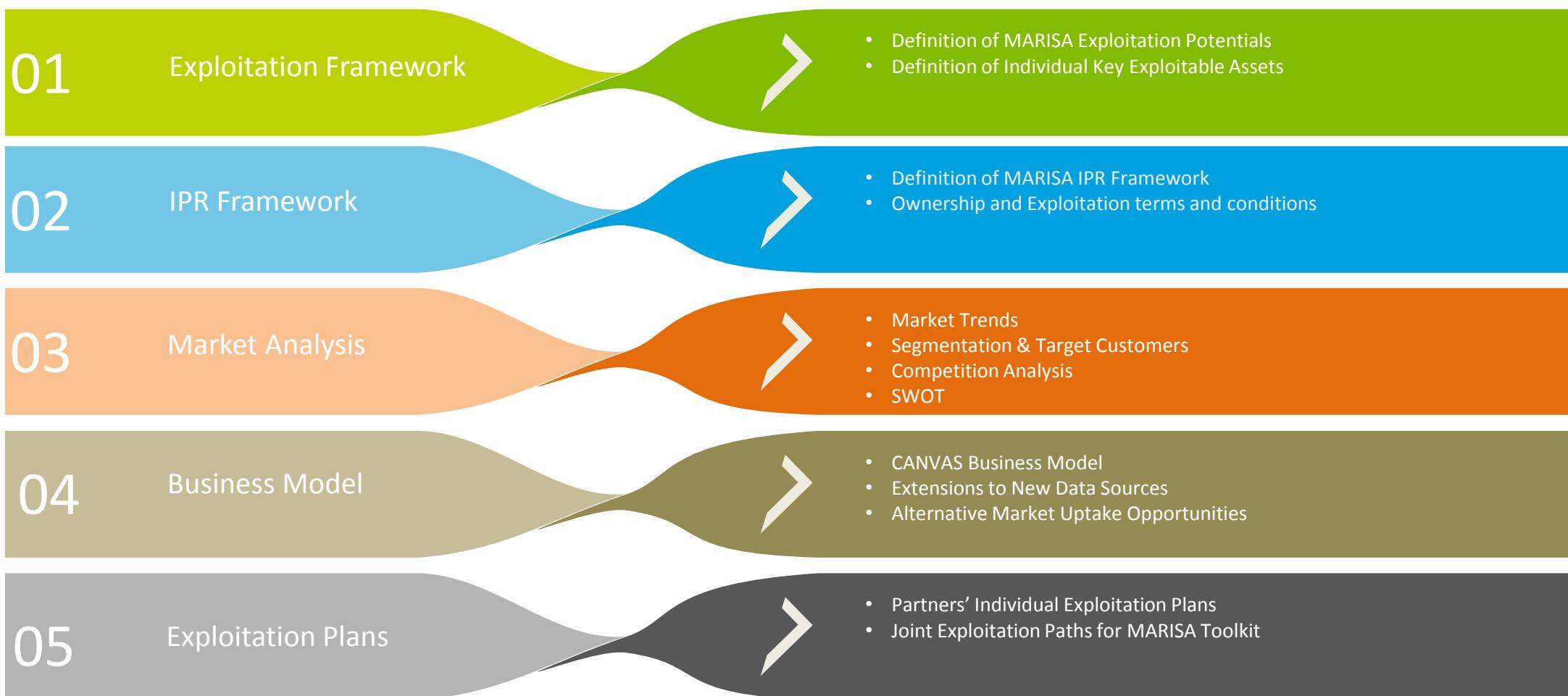
- technology and software
- user processes & training
- governance & business models

Ethics Compliance Check Template
for MARISA deliverables

Trial Information Sheet and Consent Form
for each Operational Trial



Exploitation Plan





THANK YOU FOR YOUR ATTENTION

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