



SARA

Warsaw, Frontex premises, June 27th 2019



European
Global Navigation
Satellite Systems
Agency

HORIZON 2020





Outline

- ✓ SARA consortium
- ✓ Abstract
- ✓ Needs
- ✓ SARA solution and ConOps
- ✓ Addressed Market domains
- ✓ Tethered cable added value
- ✓ EGNSS and EO as key-enabling technologies
- ✓ Preliminary tests in Szczecin





SARA Consortium



SMRE Group



Maritime University
of Szczecin



UNIVERSITÀ
DEGLI STUDI
FIRENZE



SCHOOL OF BUSINESS AND SOCIAL SCIENCES
AARHUS UNIVERSITY

endurance - night - data transmission



EURO^{DEV}



Search And Rescue Aid and
Surveillance using High EGNSS
Accuracy

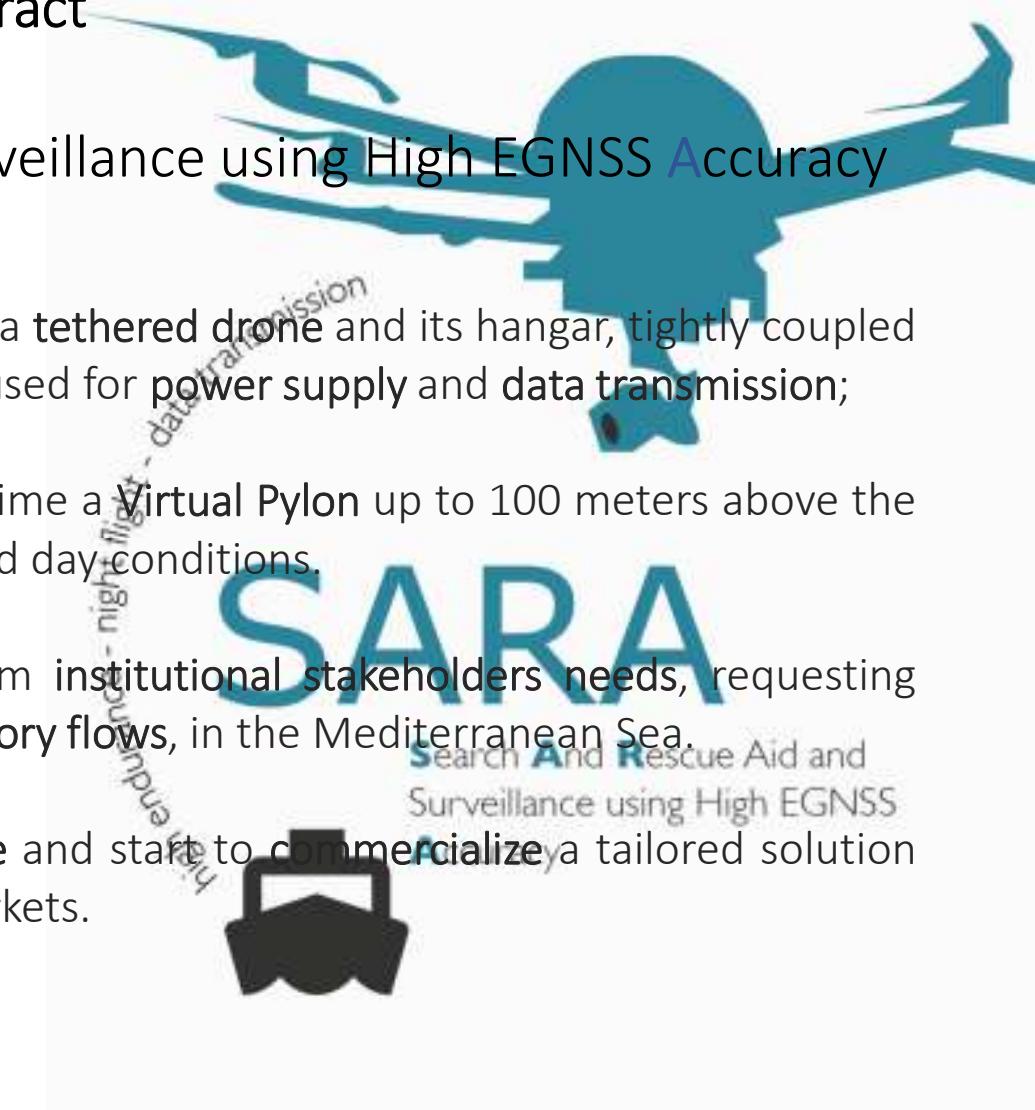
This project has received funding from the European GNSS Agency (GSA) grant agreement No 776099, under the European Union's Horizon 2020 research and innovation programme GALILEO-3-2017.



Abstract

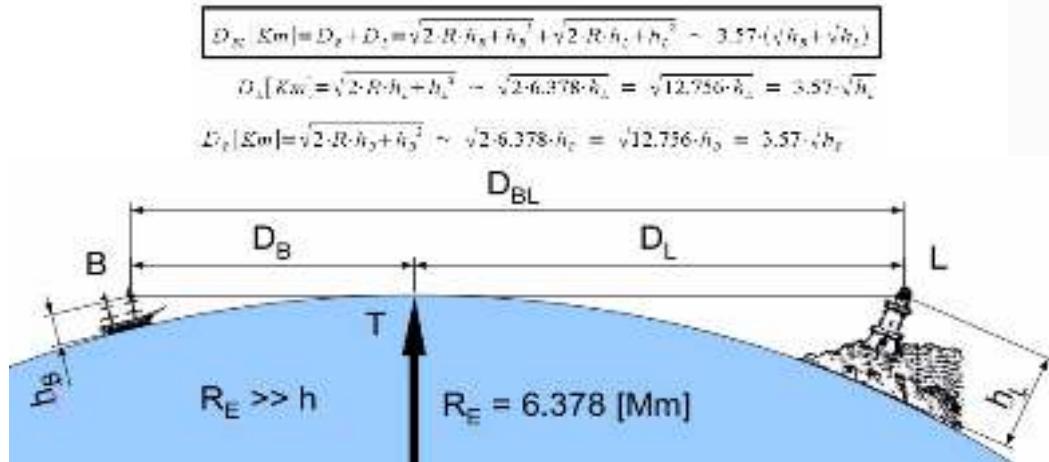
SARA: Search And Rescue Aid and Surveillance using High EGNSS Accuracy

- ✓ SARA is a semi-automated system composed by a tethered drone and its hangar, tightly coupled onboard a vessel through a strong kevlar cable used for power supply and data transmission;
- ✓ Its main advantage is to deploy in a very short time a Virtual Pylon up to 100 meters above the vessel for persistent flight operations in night and day conditions.
- ✓ SARA solution is a clear response coming from institutional stakeholders needs, requesting a technological support to the increasing migratory flows, in the Mediterranean Sea.
- ✓ Purpose of SARA project is to design, prototype and start to commercialize a tailored solution for niche S.A.R. market and in other parallel markets.





- ✓ Extended surveillance area;
- ✓ Cost-effective solution compared to Helicopter operations;
- ✓ Identification and geo tagging of floating objects or hot spots;
- ✓ Shorter surveillance time;
- ✓ More reliable surveillance and fast deployment solution
- ✓ Continuity of Service during S.A.R. operations;
- ✓ Easier Take-off/Landing procedures;



Need

SARA
Search **A**nd **R**escue Aid and
Surveillance using High EGNSS
Accuracy

night flight - data transmission



1st campaign for Proof of Concept validation

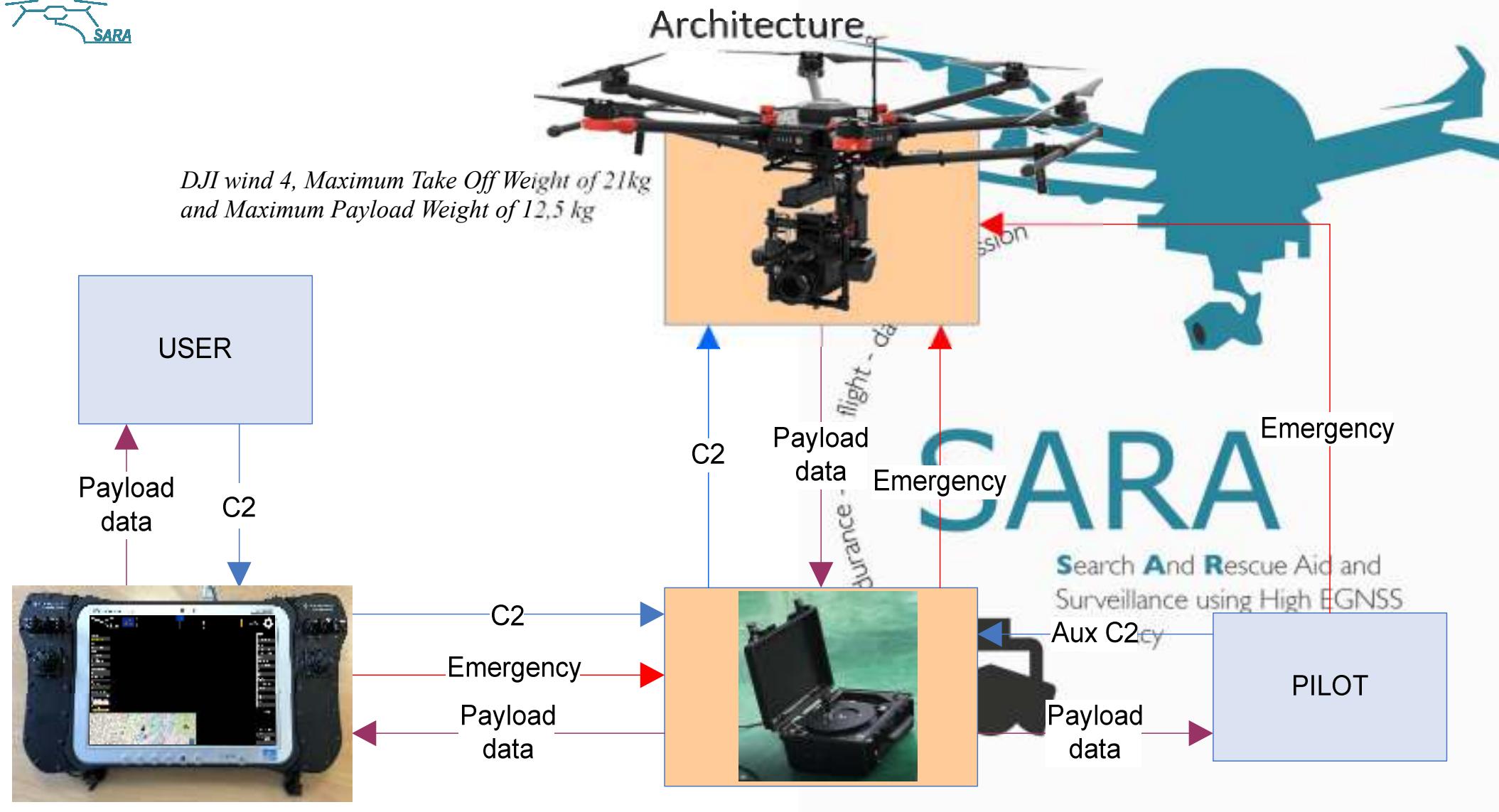
Test activities with Italian Coast Guard (Guardia Costiera di Napoli)

- ✓ A preliminary proof-of-concept of SARA, for detection of survivors in the sea was implemented in July 2015 and tested on board a class 200 vessel of Italian Coast Guard
- ✓ Tests were performed with a small drone for CONOPS verification;
- ✓ A low resolution **thermic sensor** (FLIR Lepton, 80x60 pixels) was used to validate the mathematical algorithm (Mixed Pixel model) in an environment with a low thermic gradient;
- ✓ Onboard the vessel thermal / optical video stream was available in real time to terminal with software elaboration.



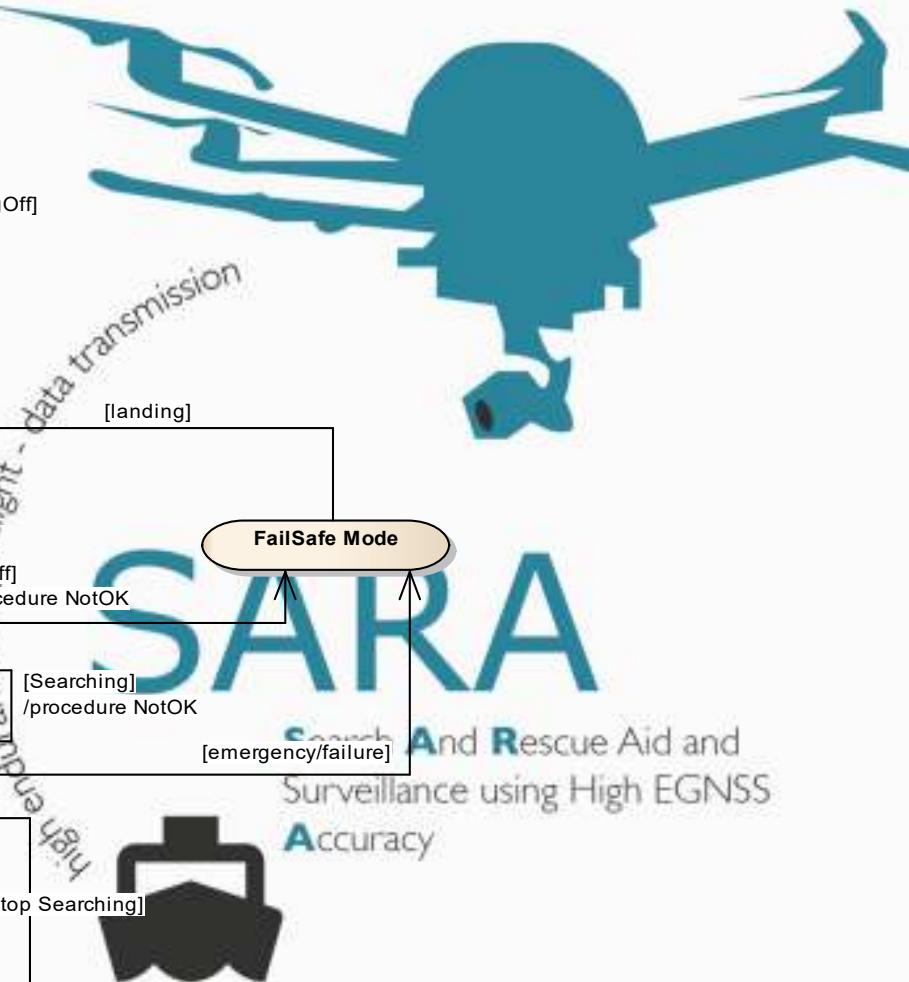
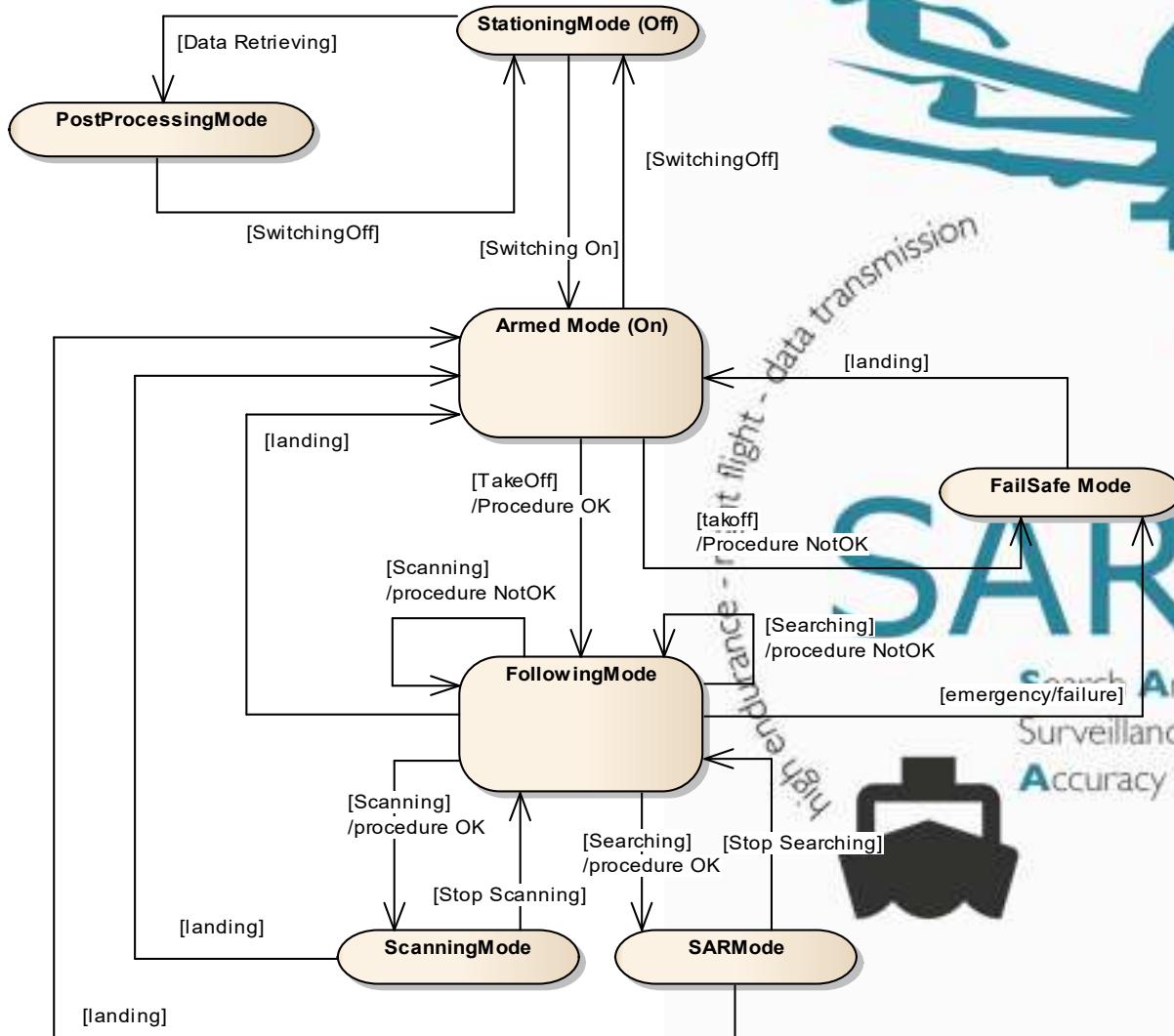


DJI wind 4, Maximum Take Off Weight of 21kg and Maximum Payload Weight of 12.5 kg





ConOps





User Experience

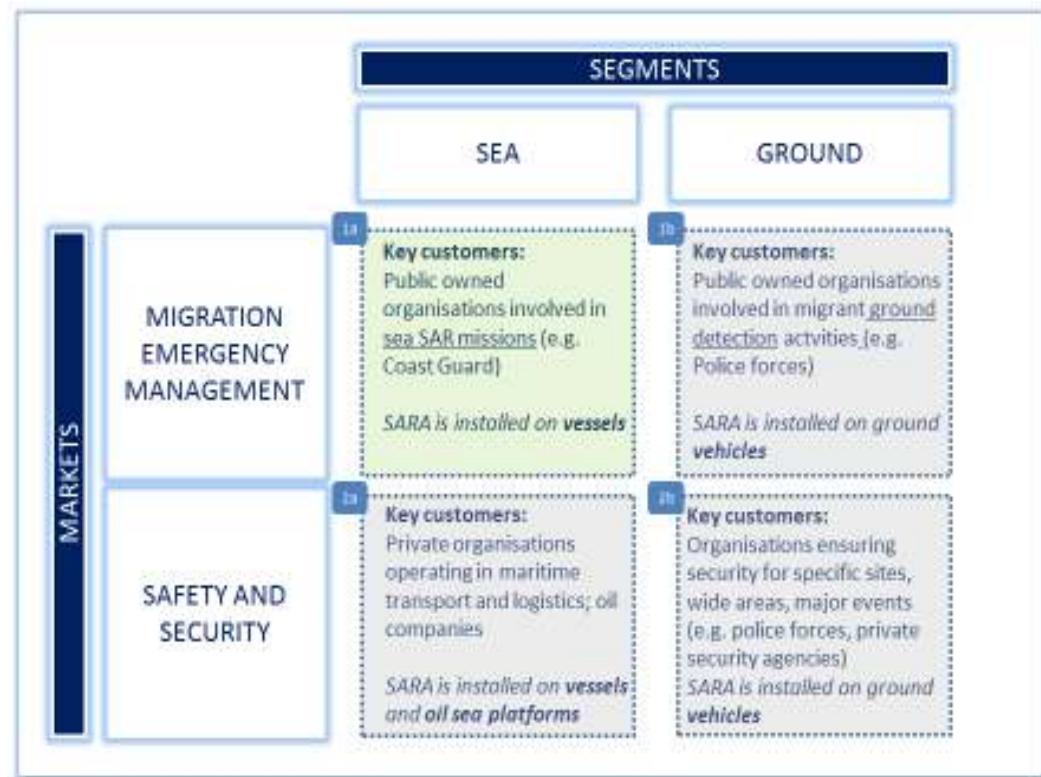
The screenshot shows a user interface for a UAV system. At the top, there are four red-outlined boxes labeled 1, 2, 3, and 4. Box 1 contains the SARA logo. Box 2 contains the GSA logo and the EU flag. Box 3 contains a battery icon. Box 4 contains a gear icon. Below these are several other UI elements: a status bar with 'Status: Disarmed', coordinates 'Lat: 53.430049' and 'Lon: 14.568831', height 'Height (m): 0', baseline 'Baseline (m): 0', cable length 'Cable (m): 0', torque 'Torque: 5', unrolling percentage 'Unrolling (%): 0%', baseline/cable ratio 'Baseline/Cable: 0%', and battery level 'Battery:'. To the right is a large video feed showing a city skyline with a ship in the water. In the bottom left corner is a map view with a red box labeled 7. In the bottom right corner is a camera status box labeled 6, which includes 'Last Shoot:' and a thumbnail image. A red box labeled 8 is positioned over the video feed.

Search And Rescue Aid and Surveillance using High EGNSS

1. Logos
 2. Galileo satellite meter. It identifies Galileo satellites used in the PVT solution.
 3. Notification area → (Green circle: OK | Yellow circle (appearing after sending a command): operation not allowed (e.g. switch off video during registration) | Red circle: error, Not OK)
 4. Setup/ config /control. It includes → Aeronav battery status | setup | post processing
 5. Real time payload. It includes → Position and bearing of observed point | Status of data stream | Mode (photo or video) | Camera commands (pan, tilt)
 6. Last Acquired payload. It includes quick view of acquired picture/ video and its relevant position.
 7. Map area
 8. Real time stream area
 9. SAR system telemetry. It includes → Drone position | Drone battery status | Hangar cable torque | % of cable unrolling | Baseline/ cable length ratio



Market domains



LAW ENFORCEMENT
Crowd Control
Traffic Monitoring
Event Control



PUBLIC SAFETY
Firefighting
Situational Awareness
Search and Rescue



HOMELAND SECURITY
Border Control
Critical Infrastructures
Port Security



MILITARY
Force Protection
Communications Extensions
ISR



PRIVATE SECURITY
Industrial Crisis Monitoring
Assets Protection
Event Management

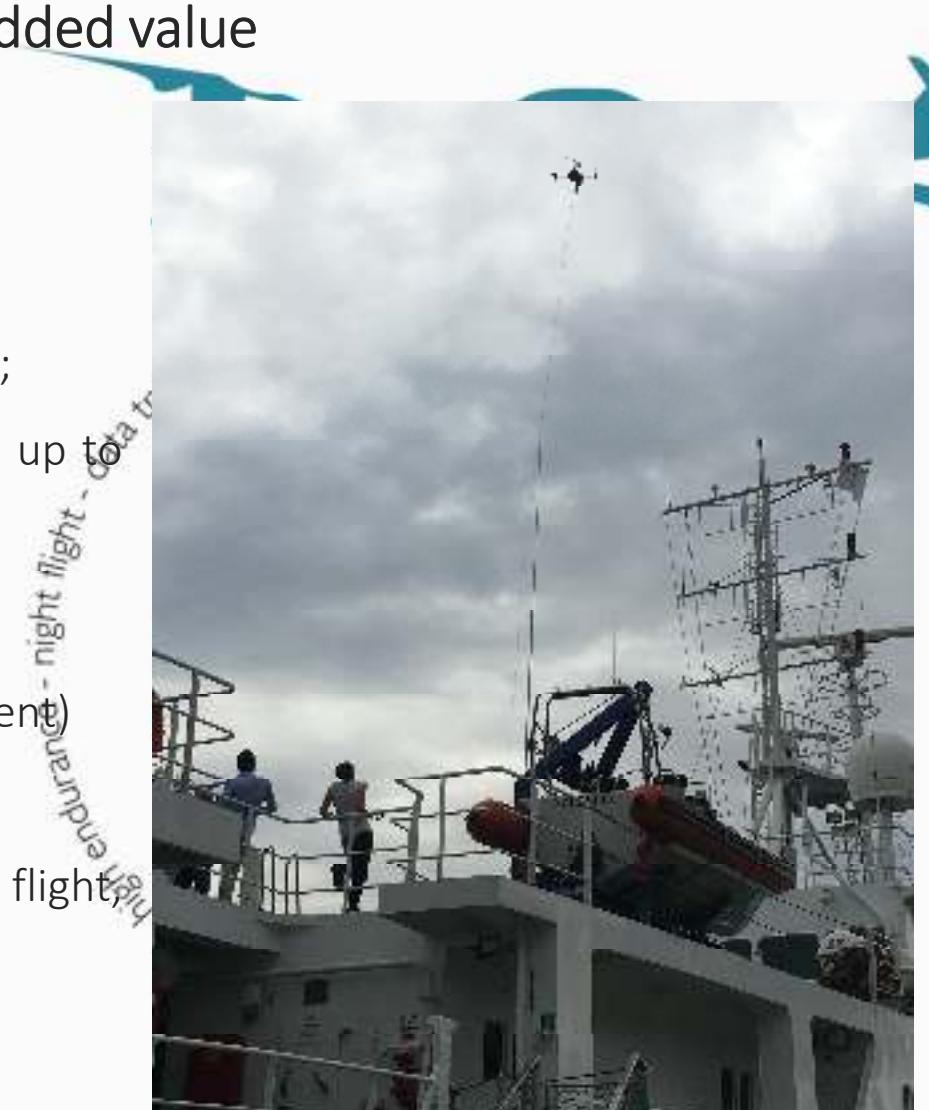


DISASTER RECOVERY
Emergency First Responders
Popup Telecommunications
Relief Efforts



Tethered cable added value

- ✓ Continuity of service during S.A.R. operations;
- ✓ Persistent Surveillance during navigation;
- ✓ Power over cable for extended flight time operations;
- ✓ Secure data download from payload through cable up to 200 Mbps;
- ✓ C2 link data security & integrity through cable
 - (X/S/C Band Vessel's Radar, VHF distress equipment)
 - Spoofing rejection
- ✓ Physical constraint to limit the RPAS envelope of flight, easing authorization requests;
- ✓ Mechanical aid for landing





EGNSS as key-enabling technology

1. ...Ship following
2. ...baseline measurement
3. ...GNSS Integrity information

... emergency landing procedure

Dynamic
baseline

Tethered cable

winch
mechanism
(cable integrity)

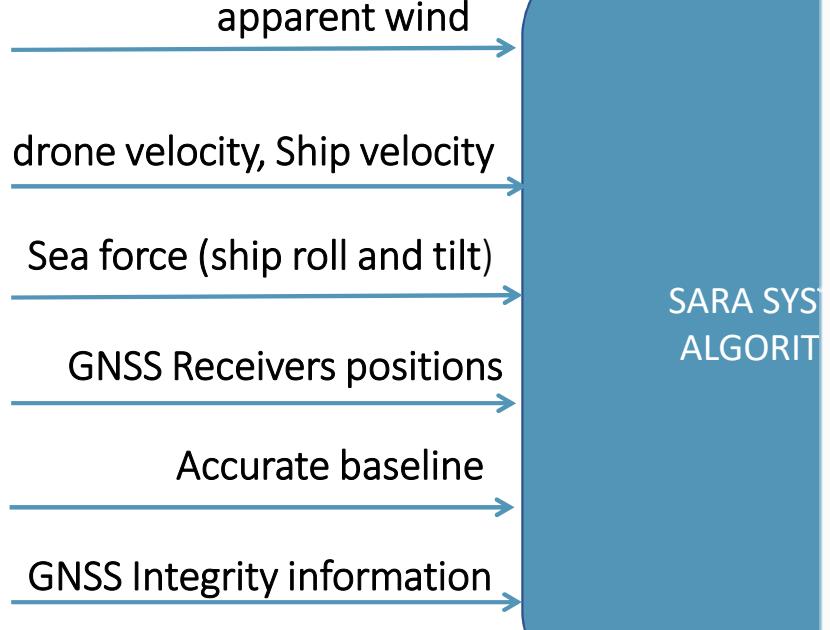
I and
EGNSS

- ✓ GNC for SARA drone;
- ✓ SARA hangar as **reference station** for SARA drone;
- ✓ **Ship following** functionality (only GNSS based, no computer vision);
- ✓ **Baseline accurate measuring** for idle torque settings (winch mechanism);
- ✓ GNSS Integrity information, triggering drone emergency procedures



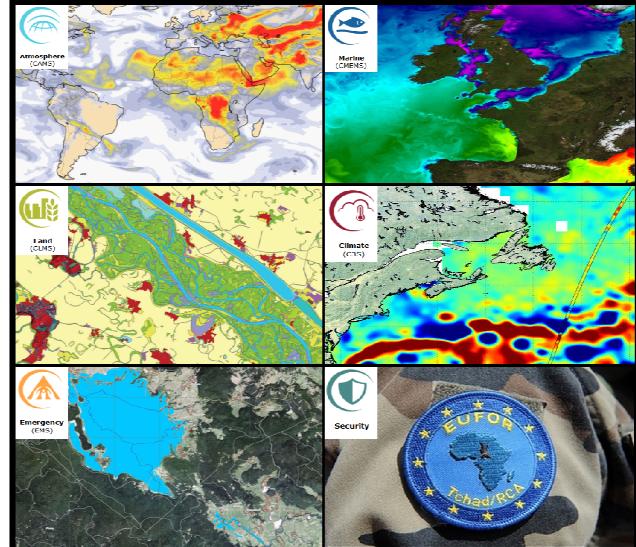
EGNSS as key-enab

INPUT
→



Cable is used to also to share GNSS recei

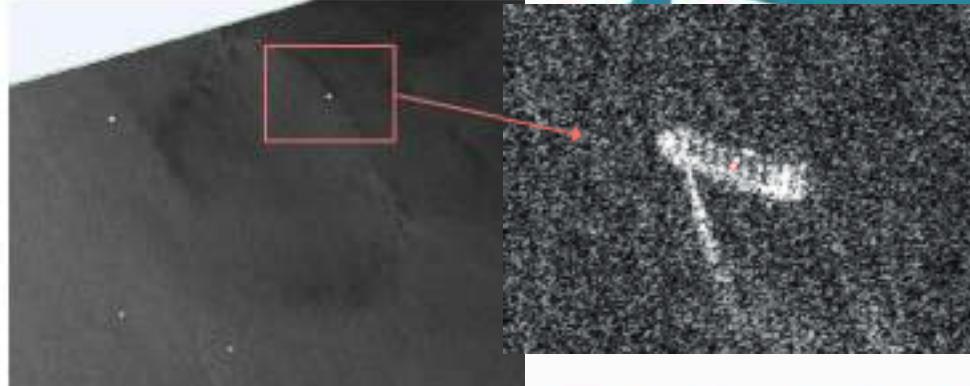




Data	Image code	Processing Level	Orbit
2018 January 07	5AFF	SLC (14x5 m of pixel resolution)	Descending
2018 January 07	851B	SLC (14x5 m of pixel resolution)	Descending
2018 April 25	BDC3	SLC (14x5 m of pixel resolution)	Descending
2018 April 25	CABD	SLC (14x5 m of pixel resolution)	Descending
2018 July 18	9CF7	SLC (14x5 m of pixel resolution)	Descending
2018 July 18	5239	SLC (14x5 m of pixel resolution)	Descending
2018 August 23	6057	SLC (14x5 m of pixel resolution)	Descending
2018 August 23	0C4F	SLC (14x5 m of pixel resolution)	Descending
2018 October 10	A0C9	SLC (14x5 m of pixel resolution)	Descending
2018 October 10	D3AB	SLC (14x5 m of pixel resolution)	Descending
2019 March 03	84C3	SLC (14x5 m of pixel resolution)	Descending
2019 March 03	05DE	SLC (14x5 m of pixel resolution)	Descending

EO as key-enabling technology

EMSA entrusted with the operation of the maritime surveillance component of the Copernicus Security Service

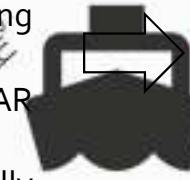


The EMSA product catalogue: on demand ship detection. Example on a C-band RADARSAT-2 image.

Sentinel-1 is a game changer in Earth Observation applications:

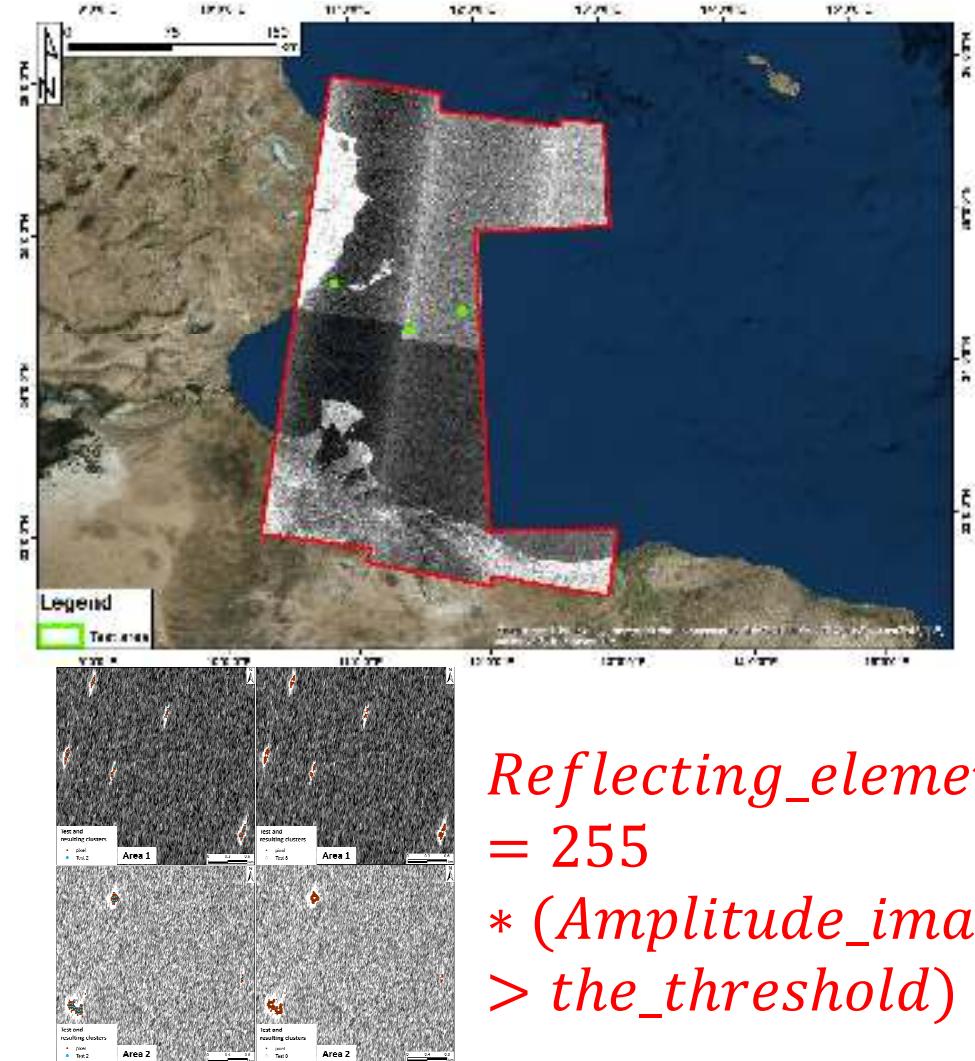
- regional-scale mapping capability,
- systematic and regular SAR observations;
- rapid product delivery (typically in less than few hours from data acquisition).

Search And Rescue Aid and Surveillance using High GNSS Accuracy



Possibility to continuously (every 6 days) recognize, identify and extract the coordinates of vessels for the creation of density maps and for the tracking of most frequent routes.

Area of Interest for vessel detection in the SARA project

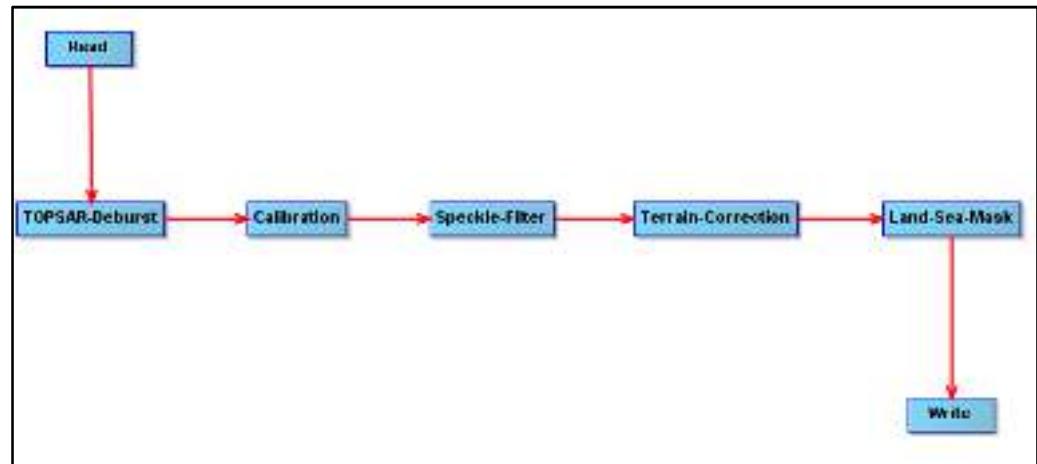


*Reflecting_element
= 255
* (Amplitude_image
> the_threshold)*

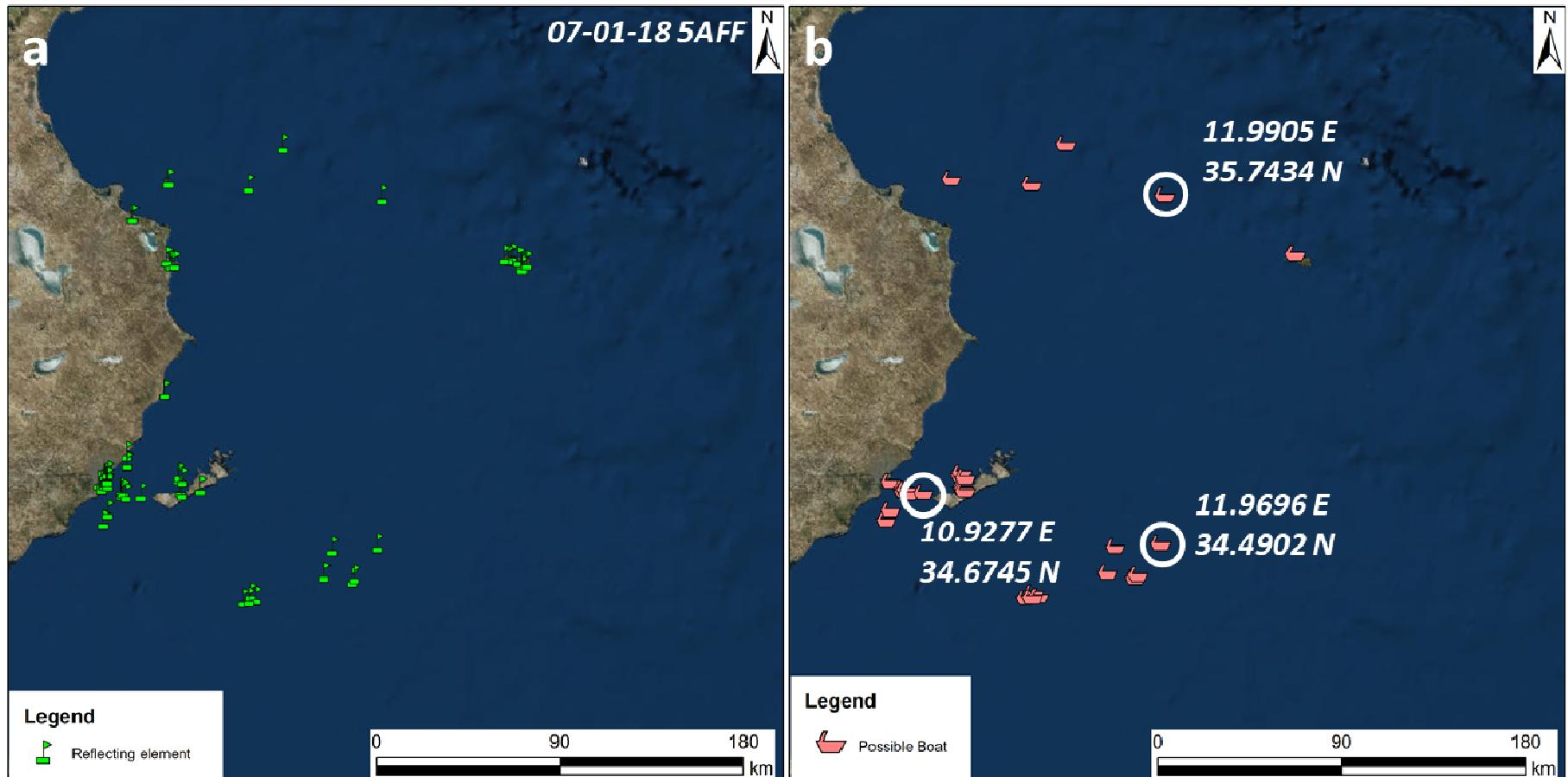


Image pre-processing on SNAP:

- Deburst, calibration and signal filtering;
- conversion from satellite coordinates (azimuth and range) to terrestrial coordinates (longitude and latitude);
- Land/sea mask.

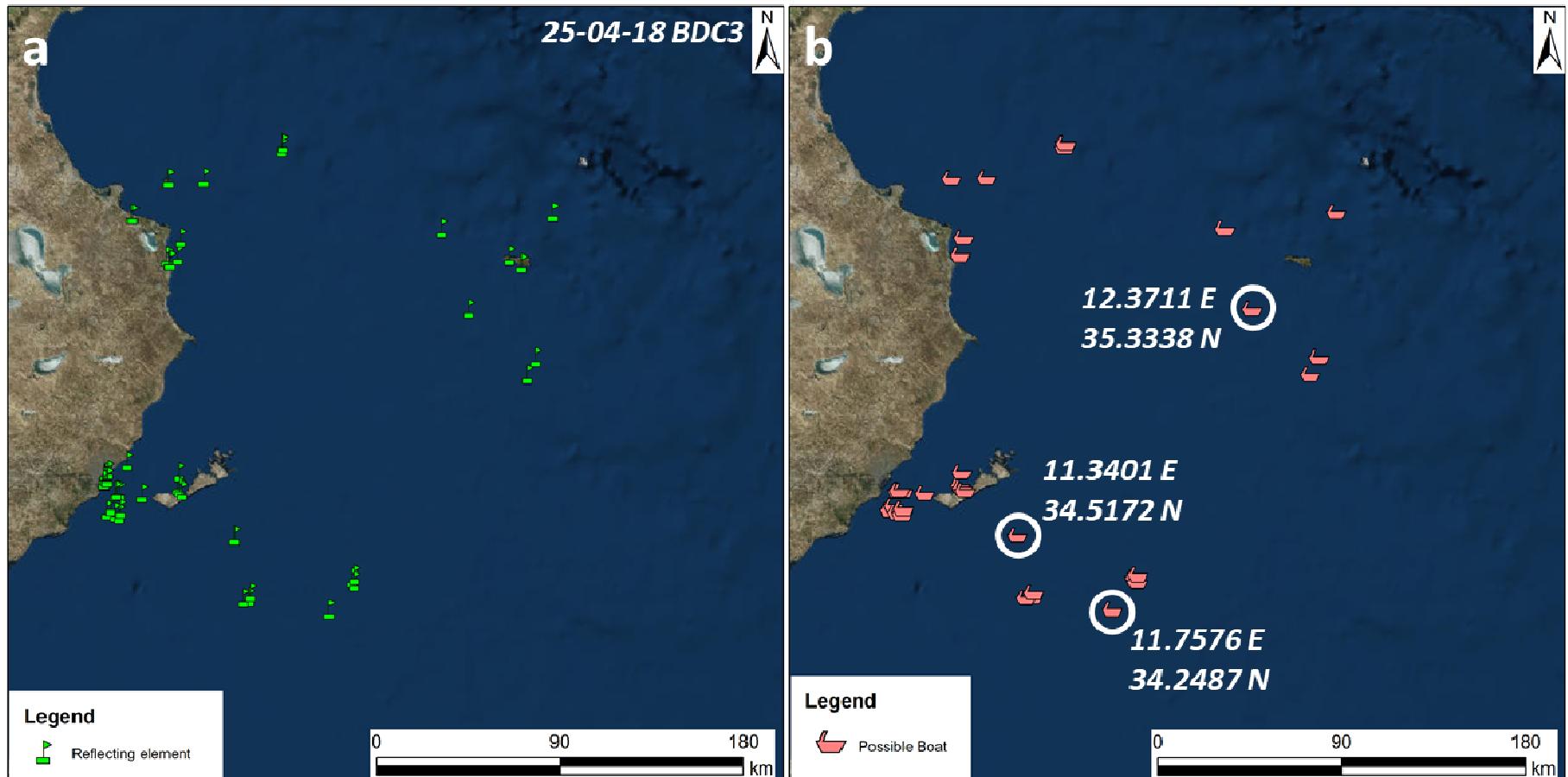


Results: cluster of reflecting points and possible boats



Sentinel-1A image 5AFF
7 January 2018

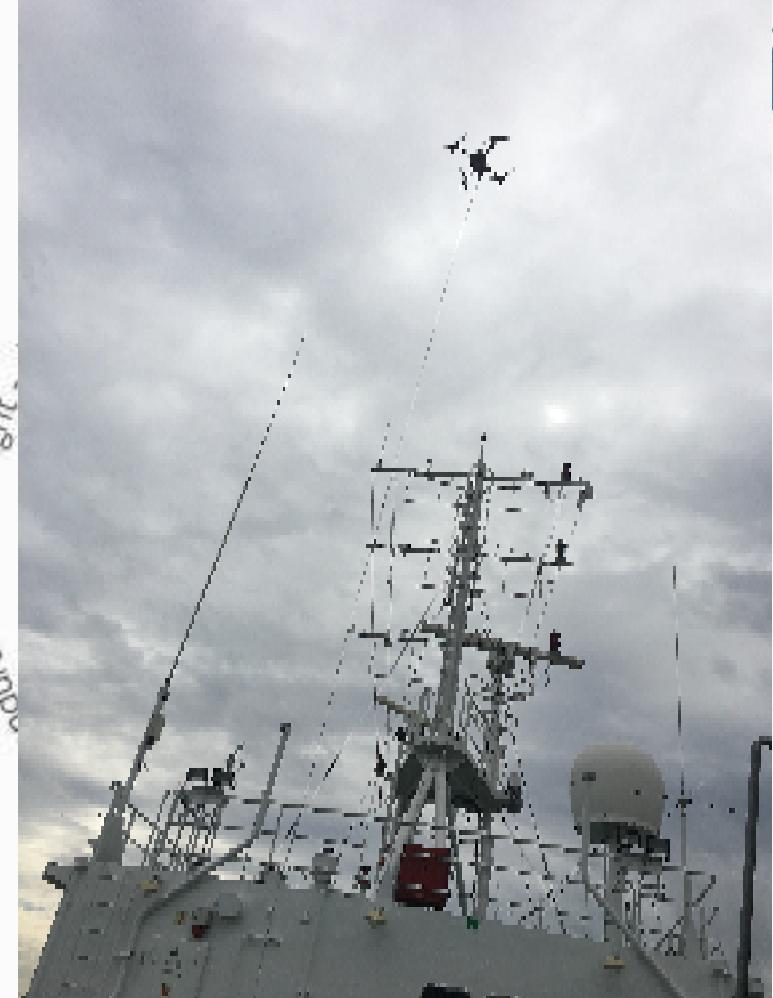
Results: cluster of reflecting points and possible boats



Sentinel-1A image BCD3
25 April 2018

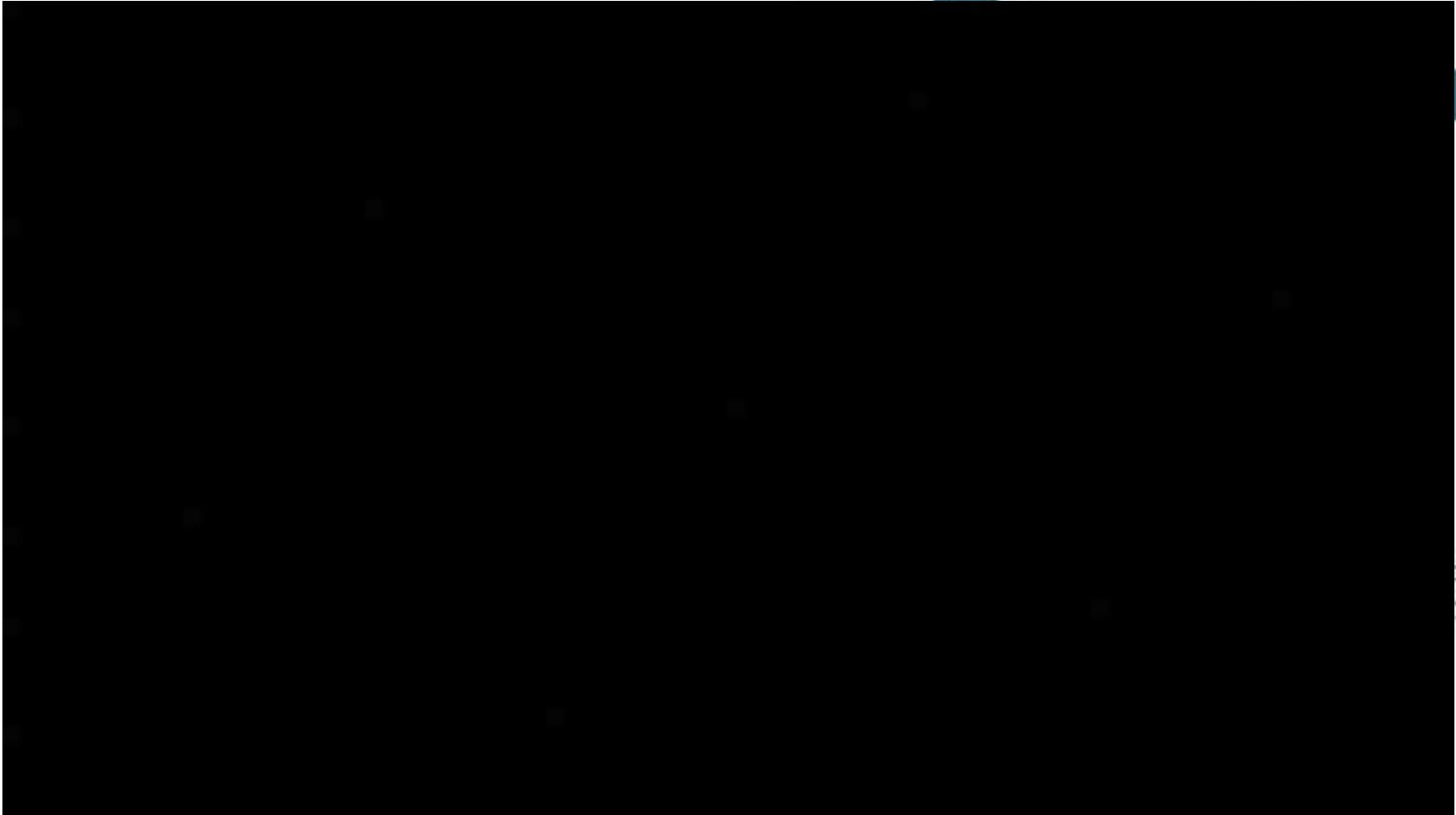


SARA preliminary tests onboard vessel Nawigator XXI





SARA preliminary tests onboard vessel Nawigator XXI

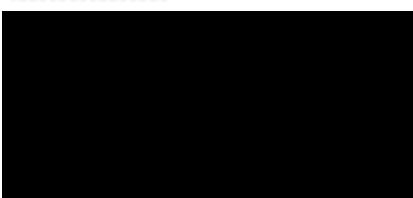


1
SS

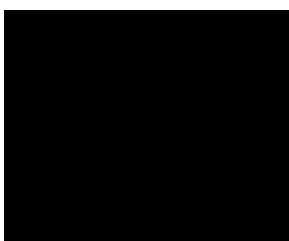


Headquarter

SISTEMATICA SPA



Sales & Marketing Department



Any questions



data transmission



SARA



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Maritime University
of Szczecin
using High GNSS



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