



**TAIEX-PI**  
**ASEAN Multi-Country Workshop**  
**on Space Applications**

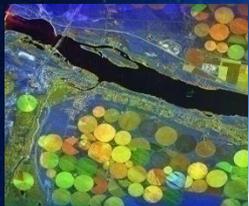
Bangkok, 18-19 September 2018

# Maritime Domain awareness

Patrizia Sacco  
Italian Space Agency



# The COSMO-SkyMed PROGRAMME



- ❑ The main Italian investment in Space System for Earth Observation

- ❑ A National Program conceived by Italian Space Agency (ASI) funded by It. Ministry of Research & It. Ministry of Defence

## DUAL USE SYSTEM

- ❑ Managed by ASI in cooperation with the It. MoD

- ❑ Developed by the Italian National Industry





8 JUN. - 2007  
COSMO-1



9 DEC. - 2007  
COSMO-2



25 OCT. - 2008  
COSMO-3



5 NOV. - 2010  
COSMO-4

**SINCE MAY 2011 THE ITALIAN COSMO SkyMed  
FOUR SAR SATELLITES CONSTELLATION IS  
FULLY OPERATIONAL**

400 MHz

619.6 Km

SSO

97.8°

~ 97 m

**NO OTHER 4 SAR SATELLITES  
CONSTELLATION TODAY ON THE EO  
OPERATIONAL SCENE**

# MULTI-MODE ACQUISITION CAPABILITY

## SPOTLIGHT

10 Km X 10 Km  
1 m Resol.

## 75 Narrow Field

### STRIPMAP - HIMAGE

40 Km X 40 Km  
3 m Resol.

## 375 Wide Field

Images per day  
per Satellite

### STRIPMAP - PING PONG

30 Km X 30 Km  
15 m Resol.

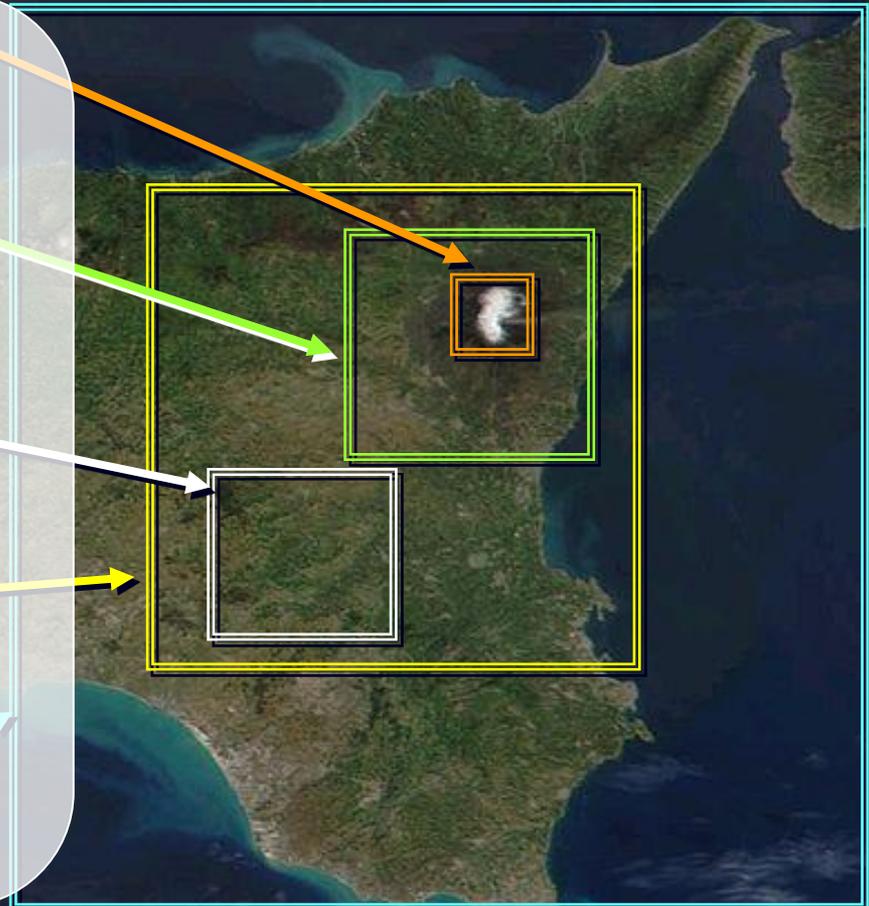
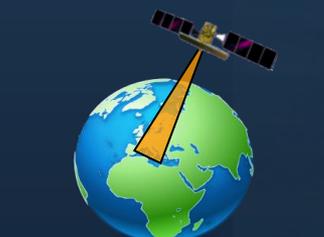
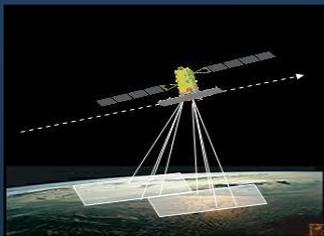
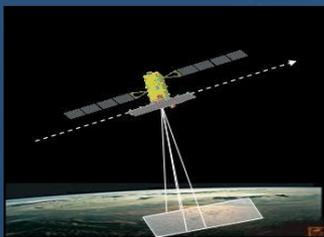
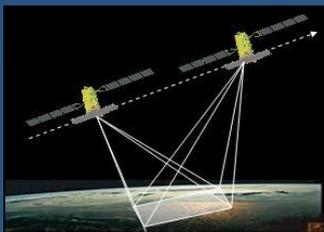
### SCANSAR WIDE

100 Km X 100 Km  
30 m Resol.

1800 images  
per day  
(Space Segment)

### SCANSAR WIDE

200 Km X 200 Km  
100 m Resol.



## WIDE FIELD

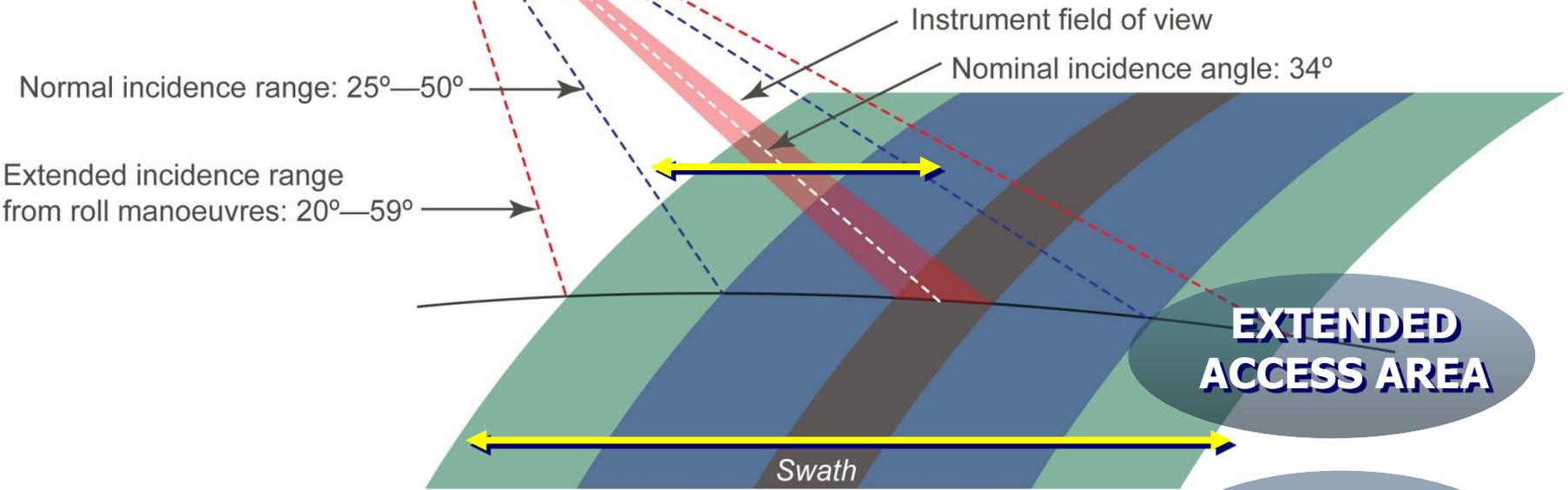
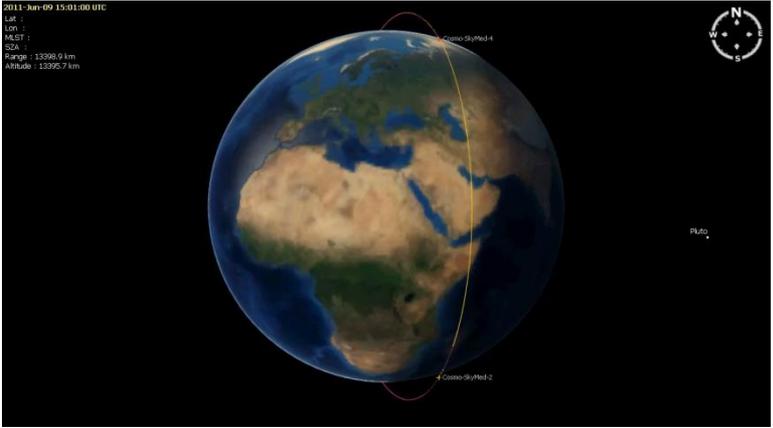
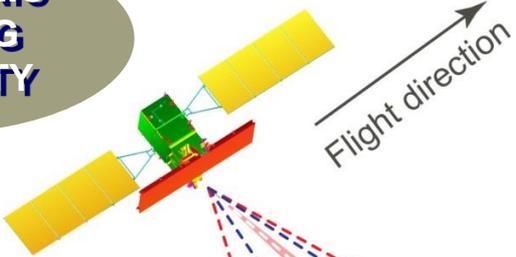


## NARROW FIELD



# WORLDWIDE GLOBAL COVERAGE

**ELECTRONIC STEERING CAPABILITY**



**EXTENDED ACCESS AREA**

**~ 1200 Km (RL / LL)**

Nominal Access Area

**~ 600 Km (one side)**

# Unmatched Revisit Time



At least 4 acquisitions / day (@ equator):

- 1 left looking and 1 right looking early morning (ASCENDING, approx. 6 AM local time)
- 1 left looking and 1 right looking late afternoon (DESCENDING, approx. 6 PM local time)

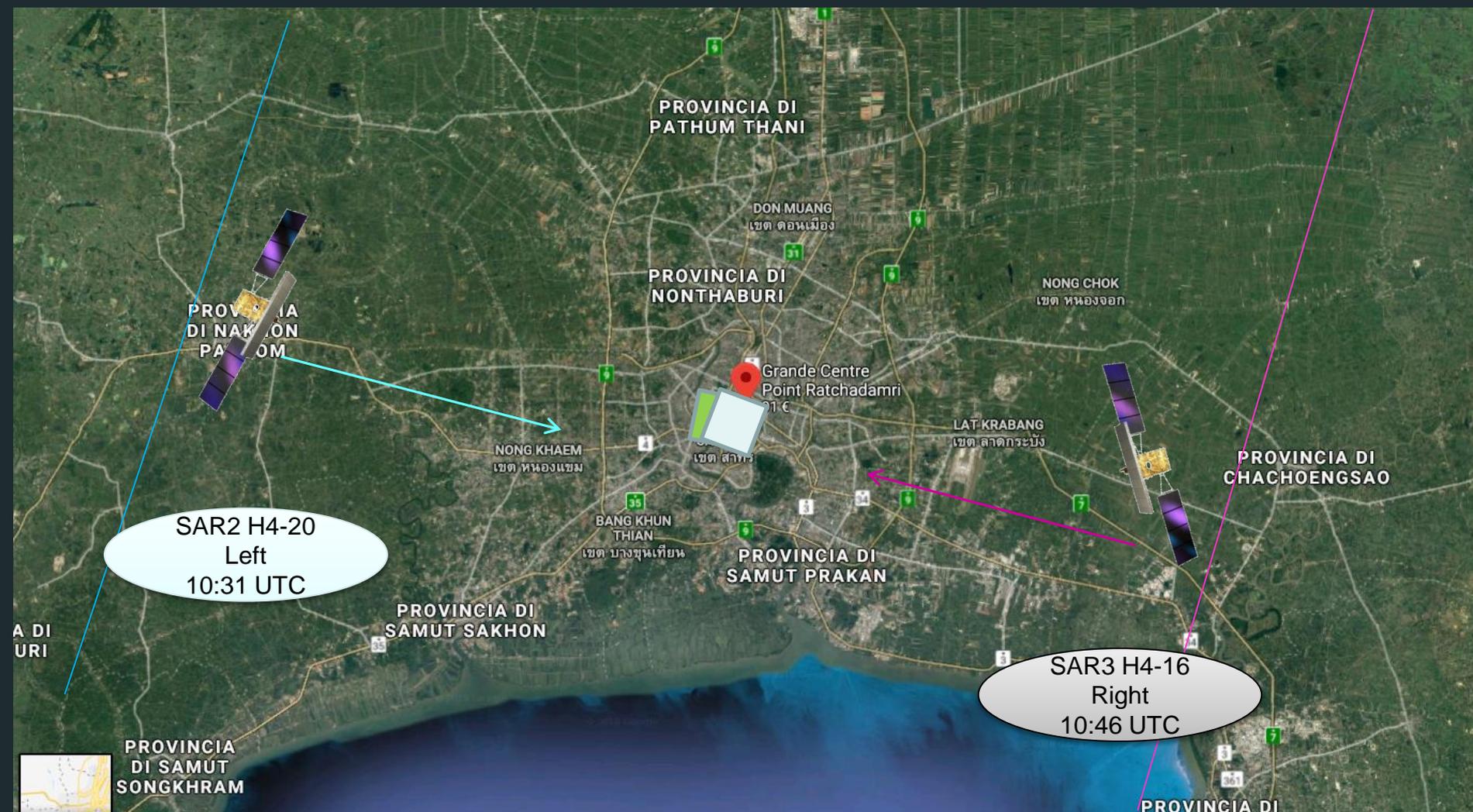
# BANGKOK



# BANGKOK, 18 September 2018 (evening - ASC)



# BANGKOK, 18 September 2018 (morning - DESC)





**RISK MONITORING AND  
MANAGEMENT OF  
EMERGENCIES**



**OCEAN AND ICE  
MONITORING**



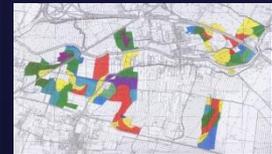
**MONITORING AND MANAGEMENT  
OF COASTAL LINES AND  
INLAND WATERS**



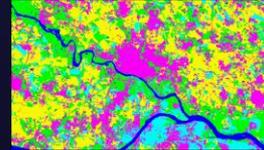
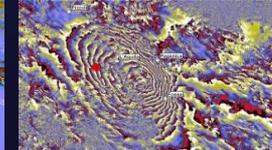
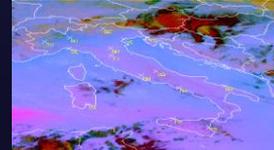
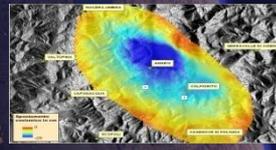
**MONITORING AND MANAGEMENT  
OF FORESTRY AND  
AGRICULTURAL RESOURCES**



**TECHNICAL CARTOGRAPHY  
- URBAN PLANNING**



**SCIENTIFIC  
APPLICATIONS**



**SECURITY APPLICATIONS**

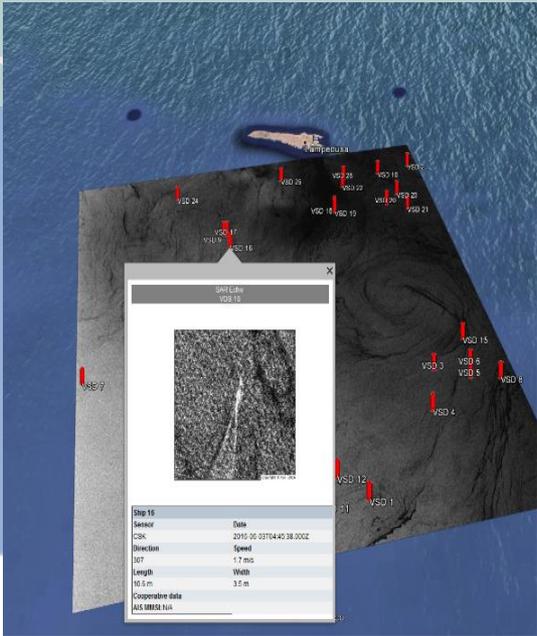


# The CLOSEYE project (2016)

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# Central Mediterranean experimental campaign



# COSMO-SkyMed contribution

**23/05/16 – 30/06/16**



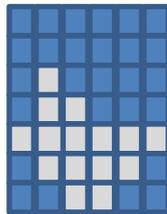
**Miles observed**  
**21600 nmi<sup>2</sup>**

RADAR images  
acquired  
**at least 3/day**



**87 CSK StripMap**  
**19 CSK Spotlight**

Spatial resolution  
**1m-3m**



Reports produced  
**104**

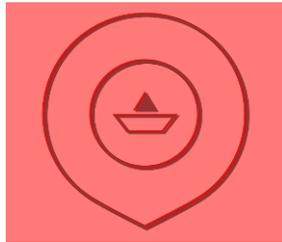
# Experimental campaign - Results

## Target detection



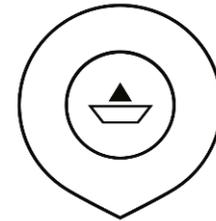
AIS vessels

**10**



Non AIS vessels

**1163**



Oil spill

**14**

## Vessel Classification



A (>100m)

**14%**



B (50m - 100m)

**17%**



C (20m - 50m)

**29%**



D (<20m)

**40%**

# Examples

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- Anomalous behavior
  - Big vessel close to small vessel
  - Not correlated vessel
- Small boat
- Correlated vessel
- Monitoring of port activity

# Big vessel close to small vessel

e-geos

Welcome WebGIS Logout Content Management

HLERS EARLY WARNINGS EDIT

DATE  
No filter selected

AREA OF INTEREST  
No filter selected

SHIPS  
No filter selected

SATELLITE ACQUISITIONS  
No filter selected

OIL  
No filter selected

OFFSHORE PLATFORM  
No filter selected

Erase filters

©ASI, Processed by e-GEOS

### SAT SHIP DETECTION

Copyright © ASI - 2016

AIS MMSI: N/A  
Date/time: 01/06/2016 04:51:15  
Sensor: CSK  
Heading: 19 / 199  
Velocity (kts): N/A  
Length: 27.9  
Width: 6.5  
Class: C

Route forecast

PRE-REGISTERED SHIP SHIPS DETECTION SATVMS OIL OFFSHORE PLATFORM SAT ACQUISITION SAT PLAN ALERTS SUMMARY ALERTS

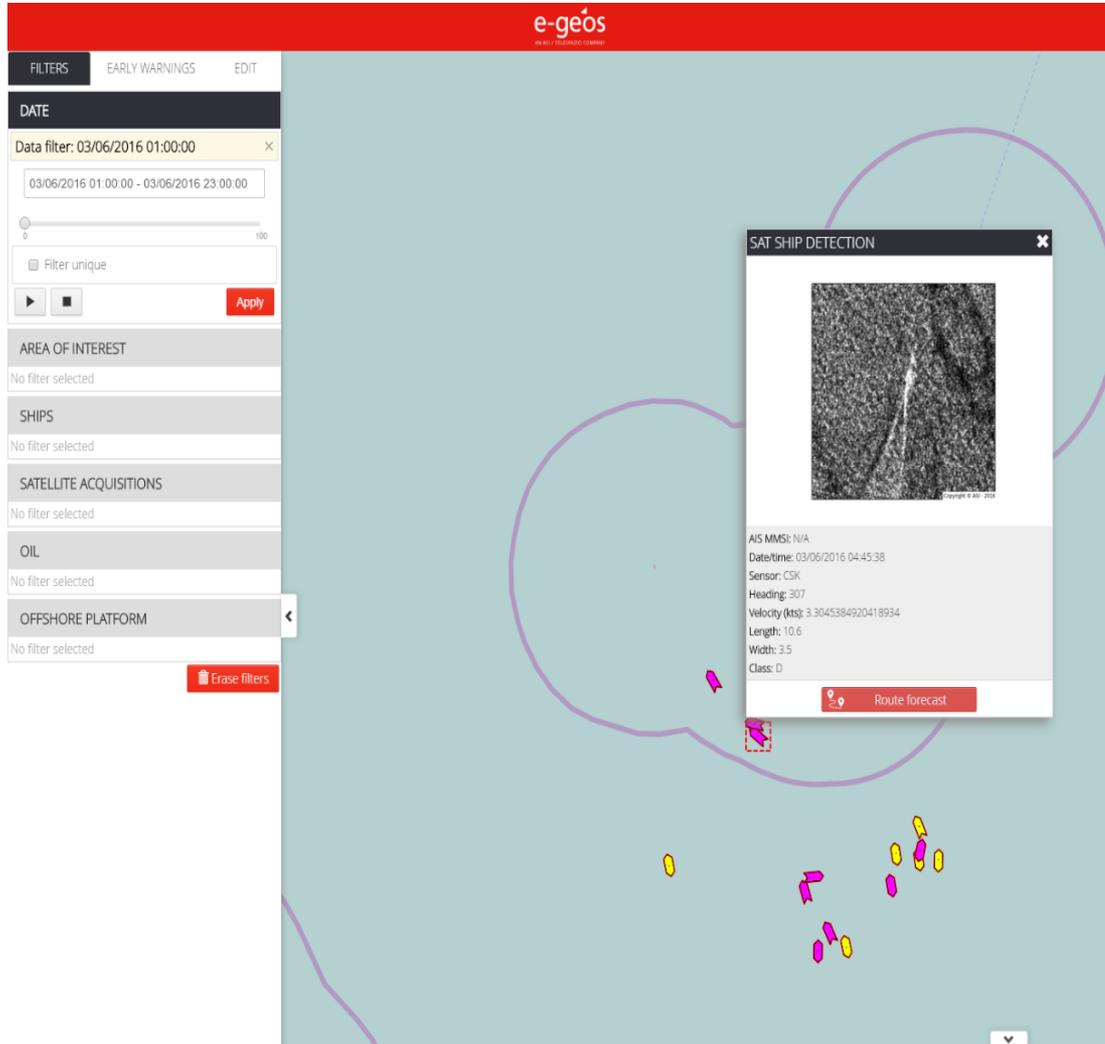
Search

View	Mmsi	Imo	Name	Type	Reporting organization	Last known transmission time
No data available in table						

Showing 0 to 0 of 0 entries

Previous Next

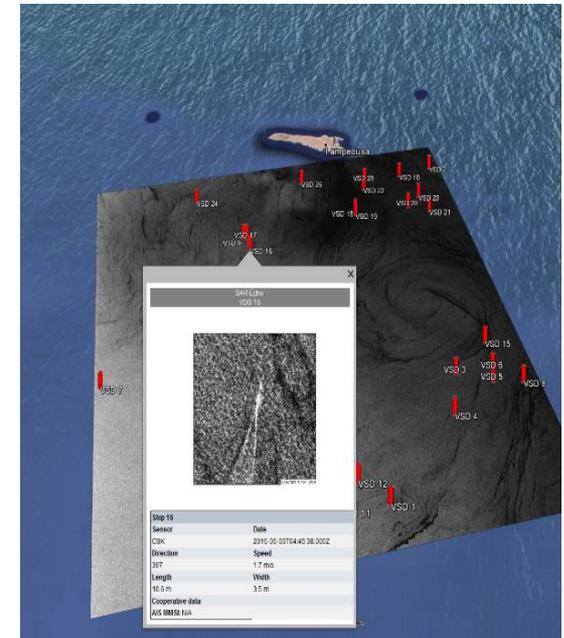
# Not AIS correlated - small vessels detection



The screenshot shows the e-geos web interface. On the left, there is a sidebar with various filter categories: FILTERS, EARLY WARNINGS, and EDIT. Under FILTERS, there are sections for DATE, AREA OF INTEREST, SHIPS, SATELLITE ACQUISITIONS, OIL, and OFFSHORE PLATFORM. The DATE filter is set to 03/06/2016 01:00:00. A 'SAT SHIP DETECTION' window is open, displaying a satellite image of a small vessel. Below the image, the following data is shown:

AIS MMSI: N/A  
Date/time: 03/06/2016 04:45:38  
Sensor: CSK  
Heading: 307  
Velocity (kts): 3.3045384920418934  
Length: 10.6  
Width: 3.5  
Class: D

At the bottom of the window, there is a 'Route forecast' button.



This screenshot shows a satellite map of a coastal area with several small vessels detected. The vessels are labeled with VSD numbers (e.g., VSD 1, VSD 2, VSD 3, VSD 4, VSD 5, VSD 6, VSD 7, VSD 8, VSD 9, VSD 10, VSD 11, VSD 12, VSD 13, VSD 14, VSD 15, VSD 16, VSD 17, VSD 18, VSD 19, VSD 20, VSD 21, VSD 22, VSD 23, VSD 24). A 'Satellite' window is open, showing a satellite image of a vessel and a table of data:

Ship ID	Date
Sensor	CSK
Date	2016-06-03T04:45:38.000Z
Direction	307
Speed	1.7 m/s
Length	10.6 m
Width	3.5 m
Cooperative data	AIS MMSI: N/A

# SAT AIS- Correlated vessel



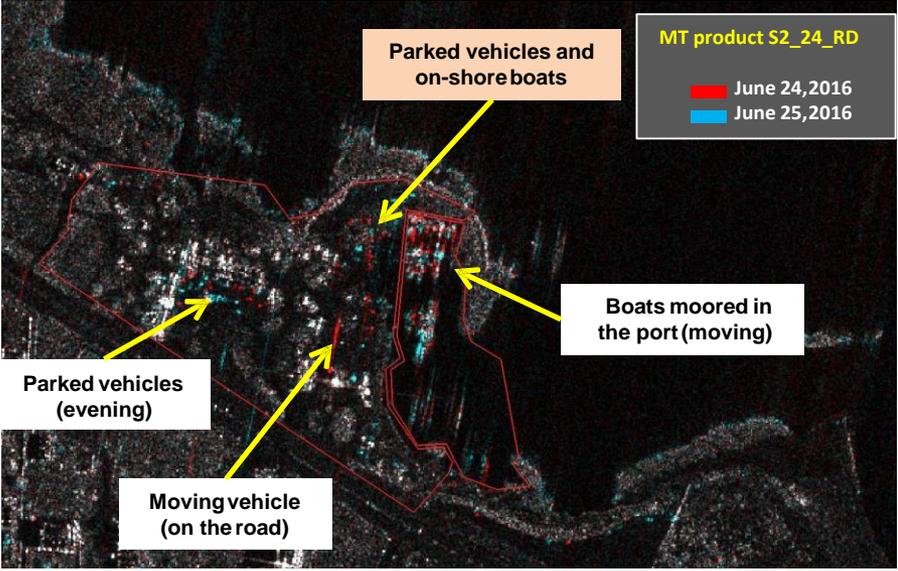
Example of vessel detected on COSMO- SkyMed image on 6<sup>th</sup> of June 2016 and correlated with Sat AIS

# Change detection

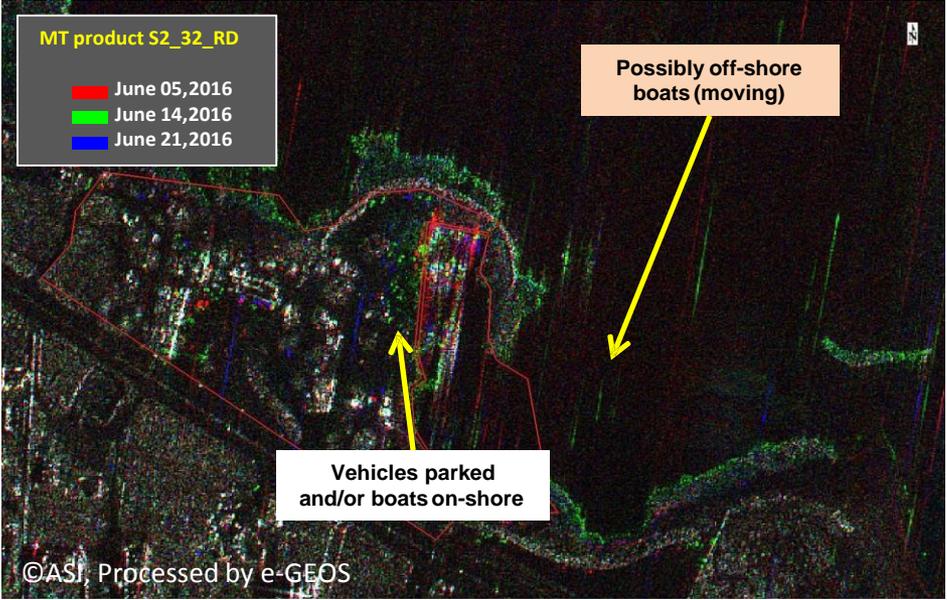
A small port for boats. The western shore is usually very busy with boats and vehicles, both in SAR (June 2016 and archive optical images)

Next to the shore there is a group of buildings with blue roof, very likely a commercial area. The large parking plaza is generally overcrowded with vehicles in DESC SAR acquisitions (around 6 pm local time). Some vehicles are present in optical images (around 11-12 am) while no vehicle is present in ASC SAR acquisitions (6 am)

It is not possible to distinguish between parked vehicles and boats on shore area. A detailed analysis of this area follows in the next page.

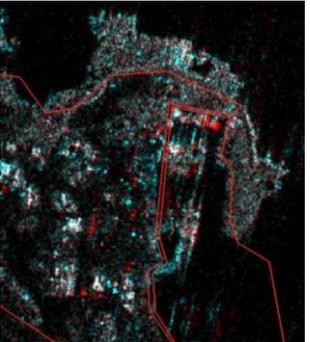


# Change detection



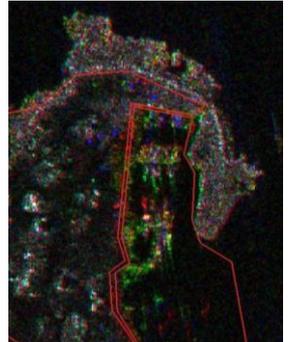
These snapshots illustrate the distribution of targets on-shore (either parked vehicles or boats), boats moored in the port.

On June 14, there is a number of moving targets on the sea nearby the port. They could be interpreted either as boats in motion or vehicles moving on the coastal road.



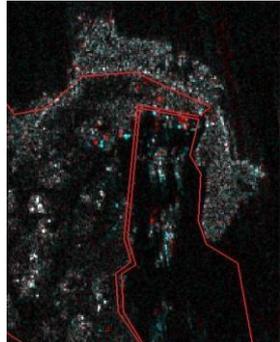
MT product S2\_08\_RD

- June 08, 2016
- June 14, 2016



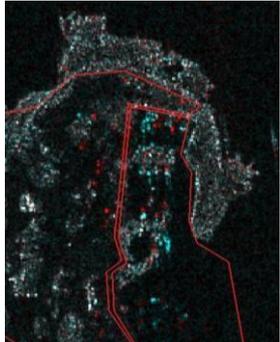
MT product S2\_13\_RA

- June 08, 2016
- June 16, 2016
- June 24, 2016



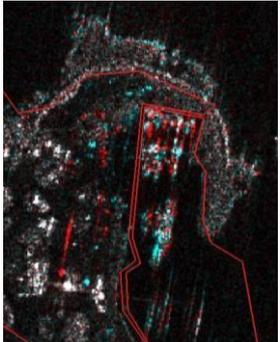
MT product S2\_13\_RA

- June 24, 2016
- June 25, 2016



MT product S2\_28\_RA

- June 14, 2016
- June 15, 2016

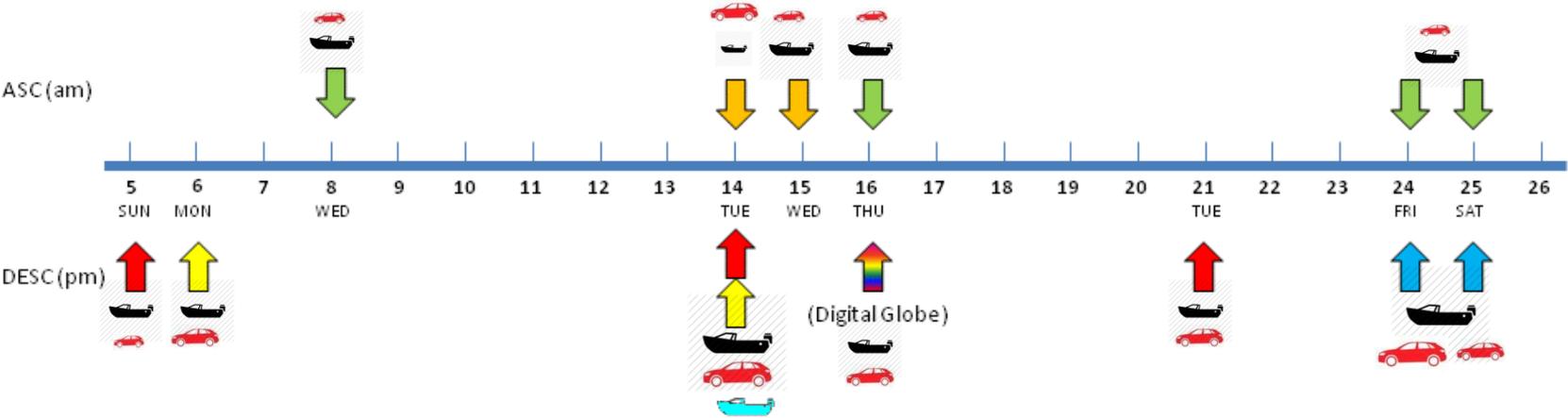


MT product S2\_24\_RD

- June 24, 2016
- June 25, 2016

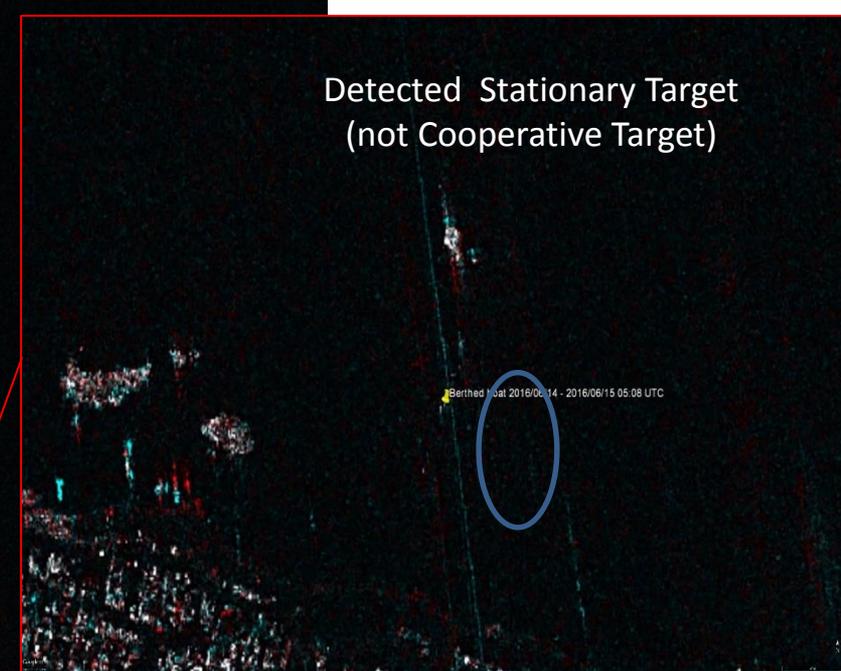
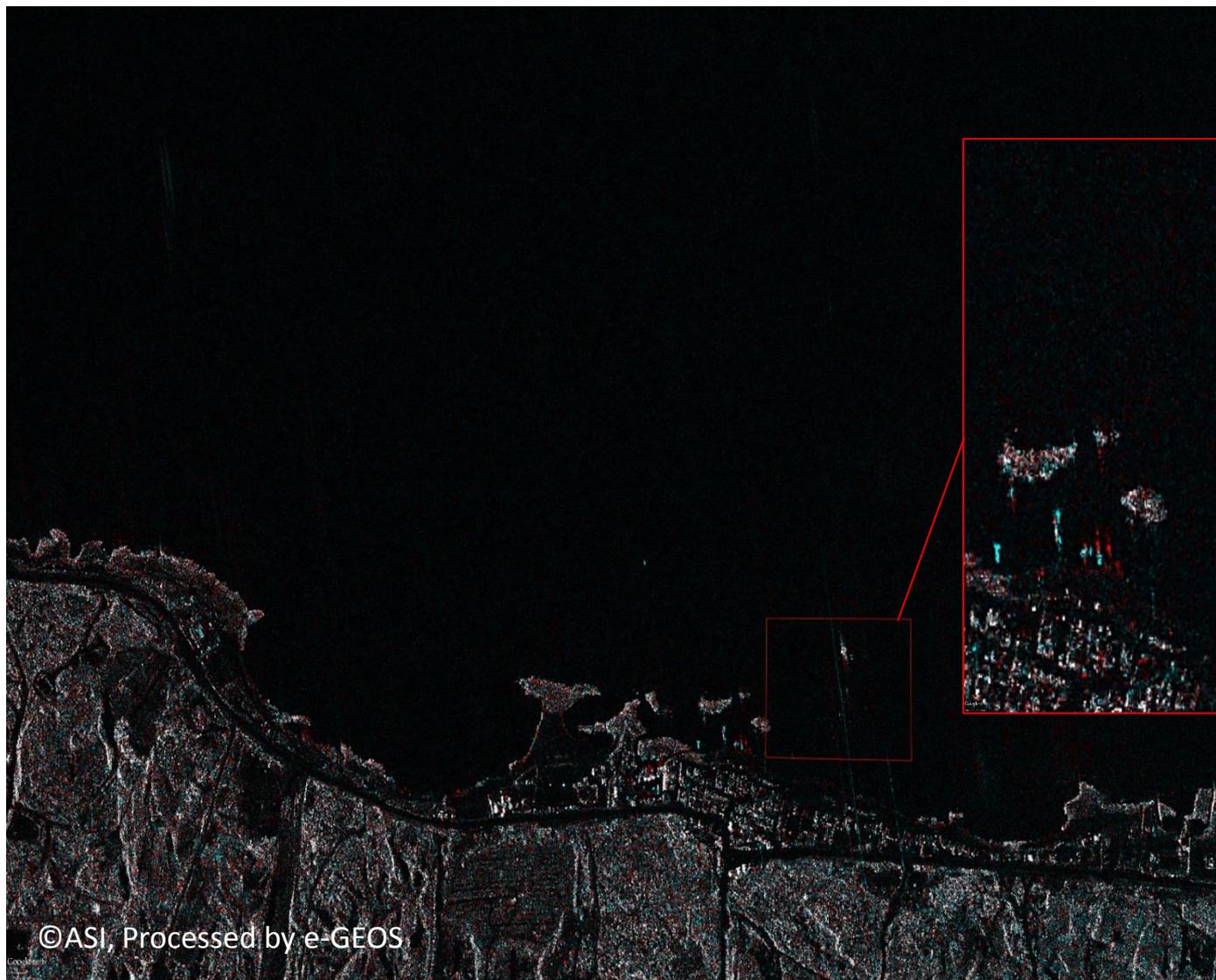
# Change detection

The following graph summarizes observations of boats and parked vehicles over the port area



- Boats moored in the port (Many. Some, Few)
- Cars parked and/or vehicles on shore (Many. Some, Few)
- Boats moving off-shore

# Stationary target





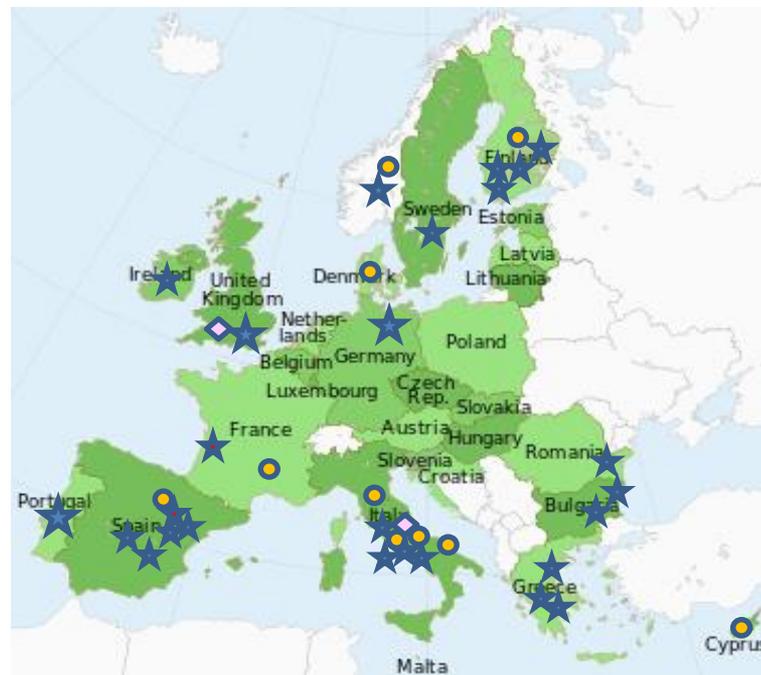
## CISE: Common Information Sharing Environment



EUCISE2020 received funding from the European Union's seventh framework programme under grant agreement no: 608385



- ASI: project coordinator
- 39 Partners
- 16 EU/EEA maritime Countries
- Open to new partners and to collaborations with EU Agencies



- ★ Maritime Authorities
- ◆ Experts
- Research Institutions

More than 40 maritime administrations

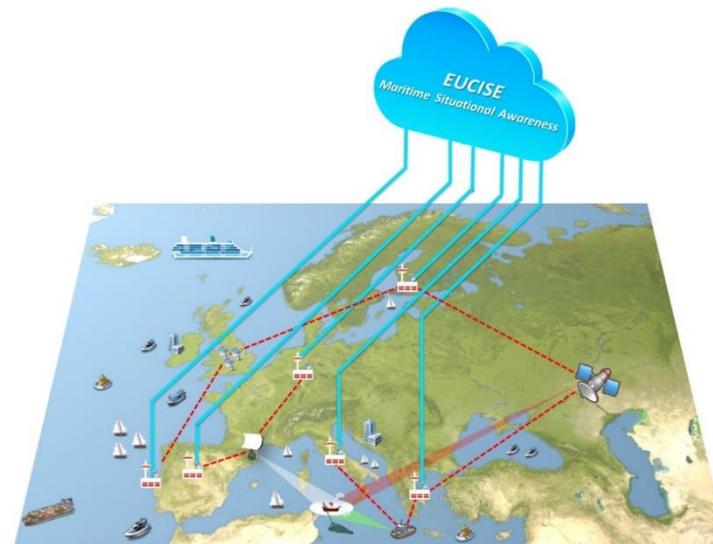


EUCISE2020 received funding from the European Union's seventh framework programme under grant agreement no: 608385

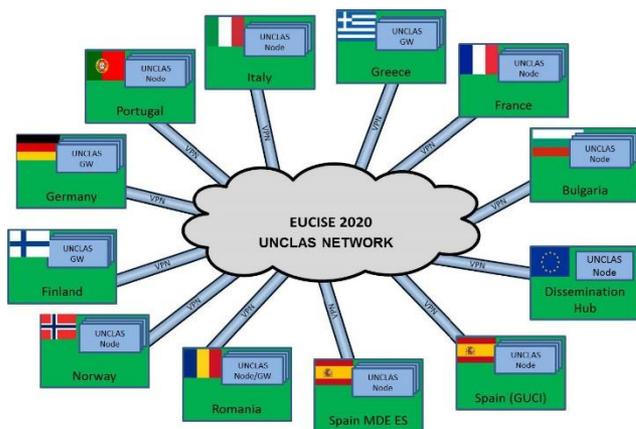




Primary mission of EUCISE2020 is to support the EU Maritime Situational Awareness capability by means of an **Information Sharing Environment** capable to implement adequate security measures and protocols ensuring the confidentiality, integrity and availability of the data required and transmitted in the CISE community.



**Blue lines depict flows of information within the CISE community**, while the red dashed lines depict flows of information within the legacy systems belonging to single Public Authorities.



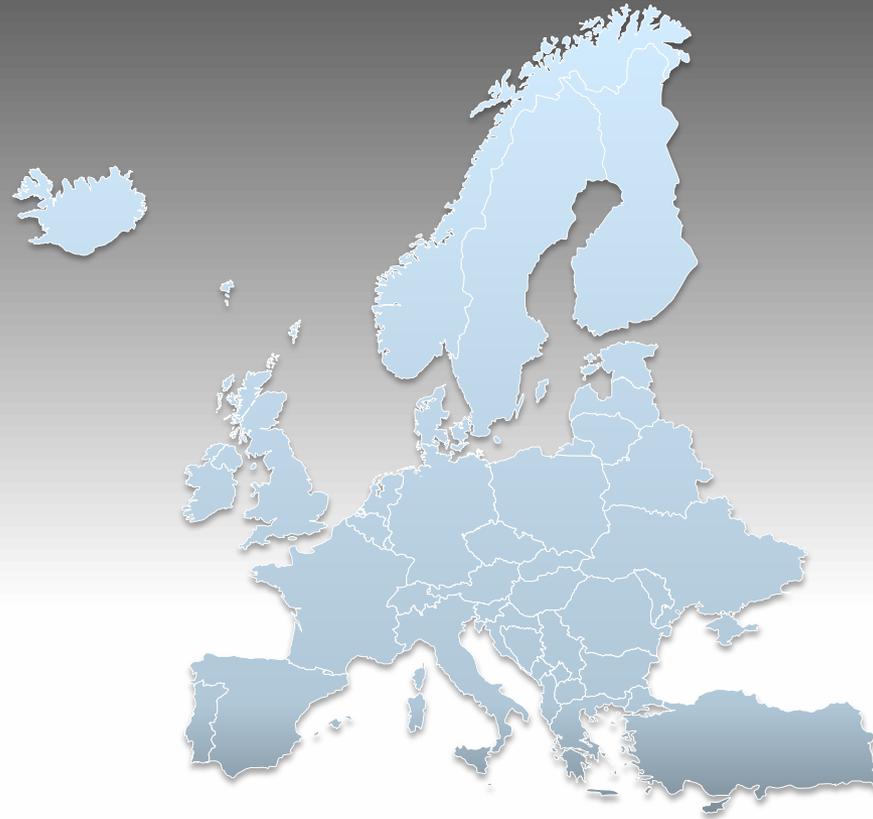
EUCISE2020 will not affect the functionalities of the operational information systems belonging to the participating Public Authorities or of the European existing sectorial information systems.





EUCISE 2020

Demonstration phase

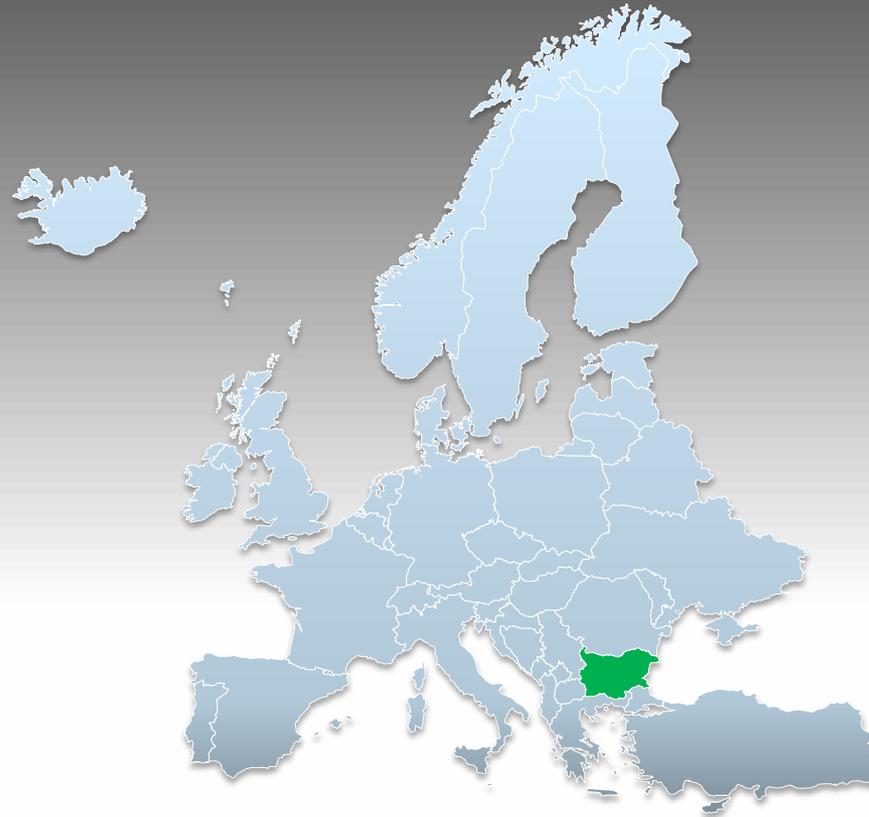


EUCISE2020 received funding from the European Union's seventh framework programme under grant agreement no: 608385





Bulgaria

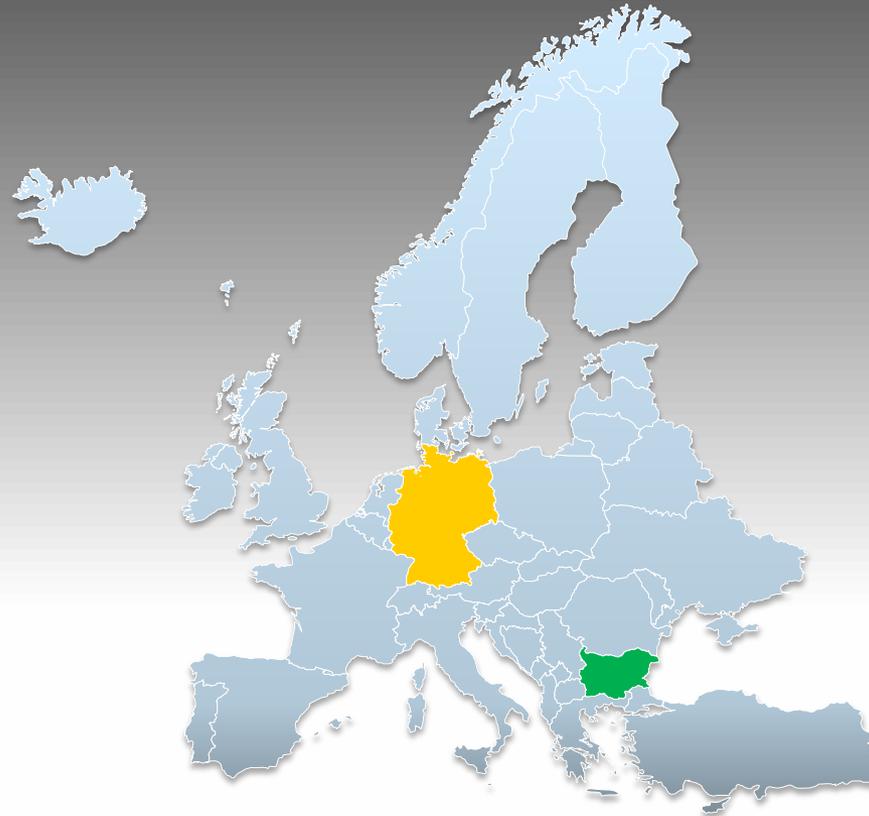


EUCISE2020 received funding from the European Union's seventh framework programme under grant agreement no: 608385





-  Bulgaria
-  Germany

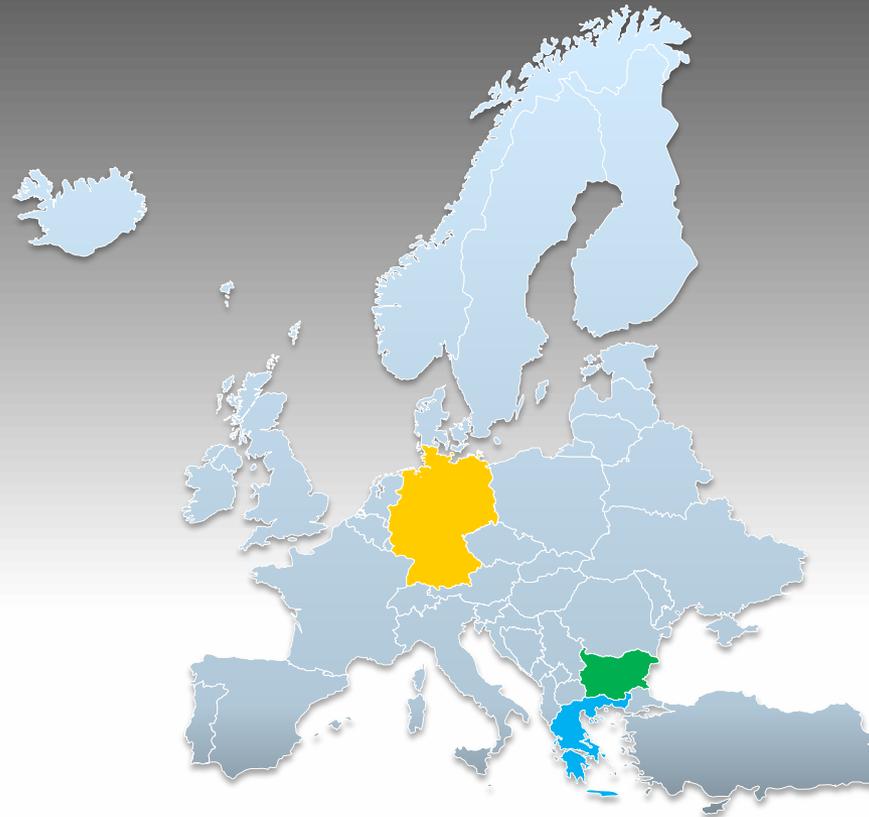


EUCISE2020 received funding from the European Union's seventh framework programme under grant agreement no: 608385





-  Bulgaria
-  Germany
-  Greece

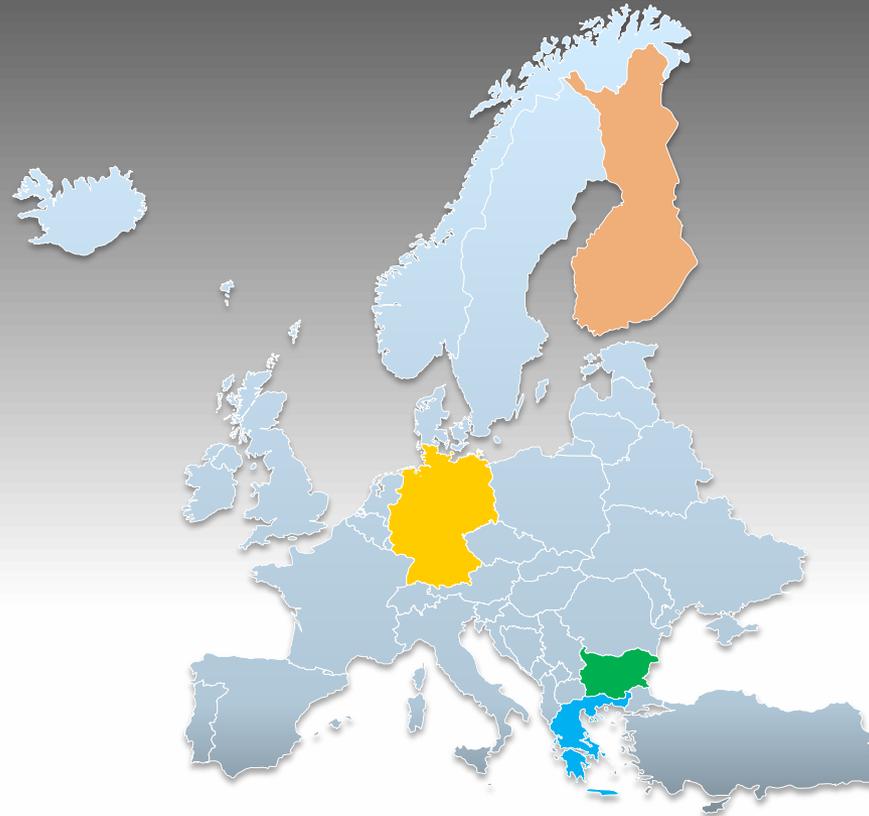


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-  Bulgaria
-  Germany
-  Greece
-  Finland

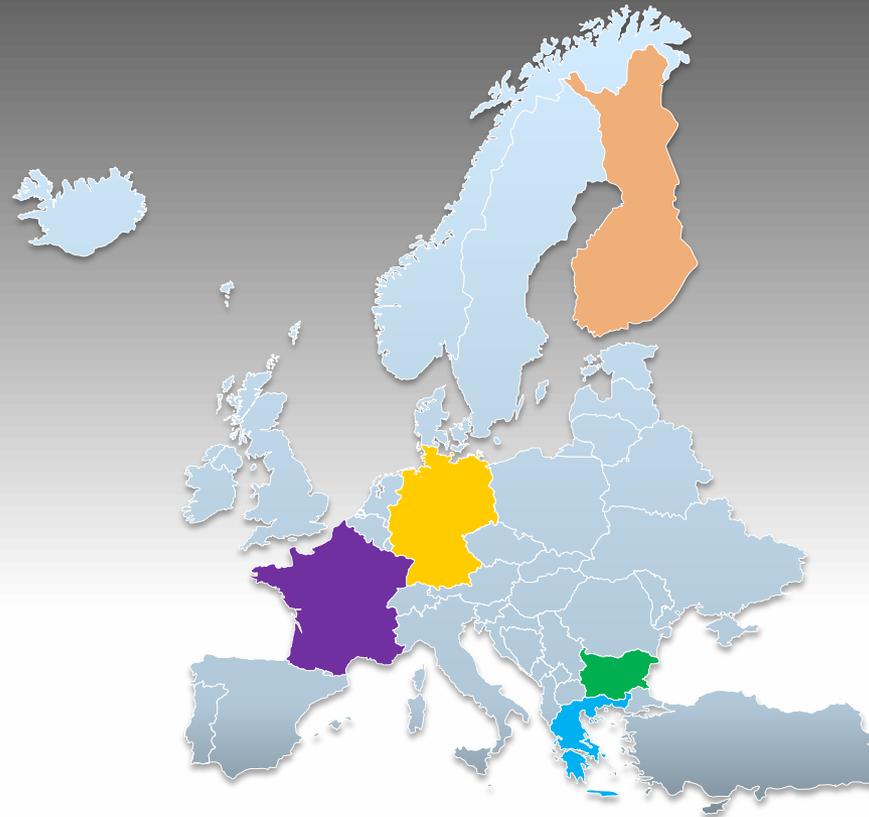


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-  Bulgaria
-  Germany
-  Greece
-  Finland
-  France

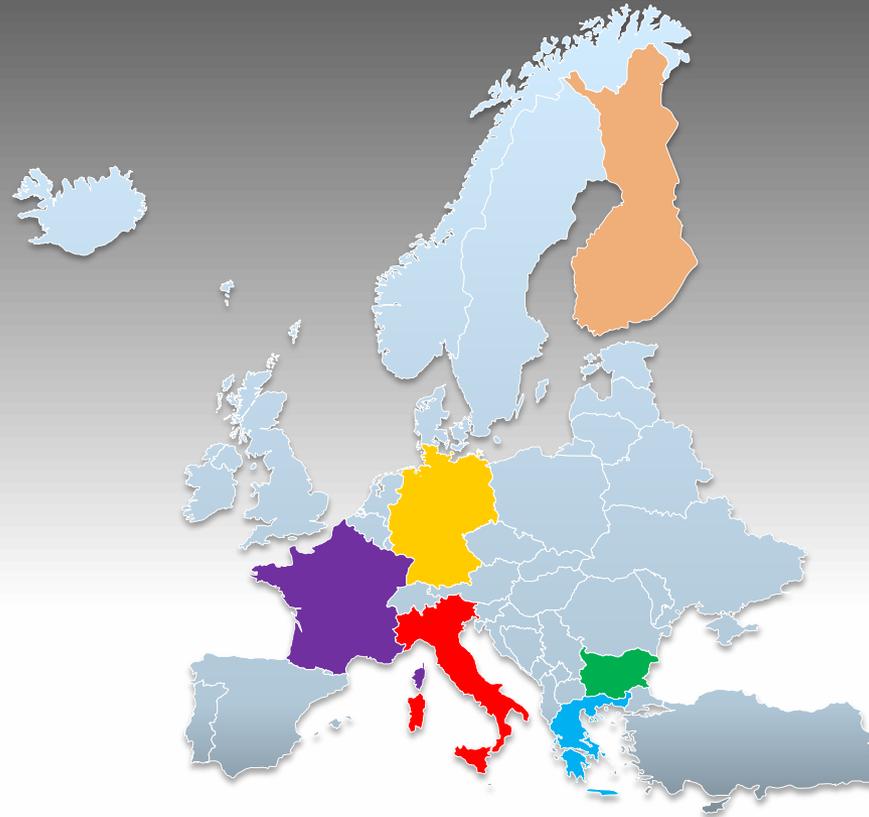


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-  Bulgaria
-  Germany
-  Greece
-  Finland
-  France
-  Italy

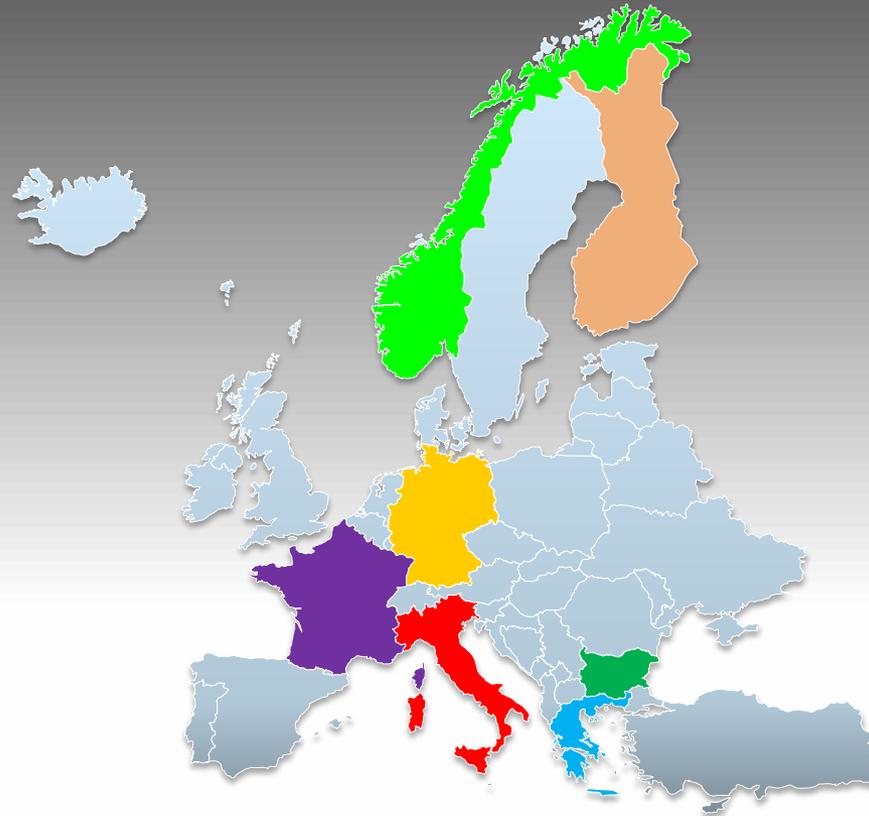


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-  Bulgaria
-  Germany
-  Greece
-  Finland
-  France
-  Italy
-  Norway

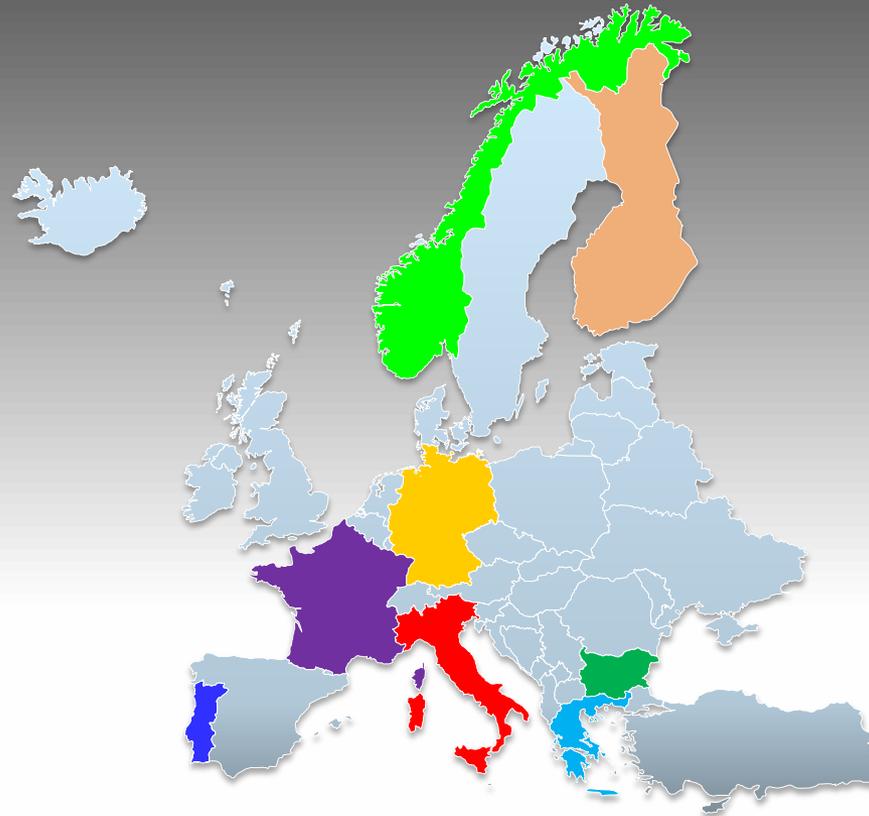


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-  Bulgaria
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-  Greece
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-  France
-  Italy
-  Norway
-  Portugal

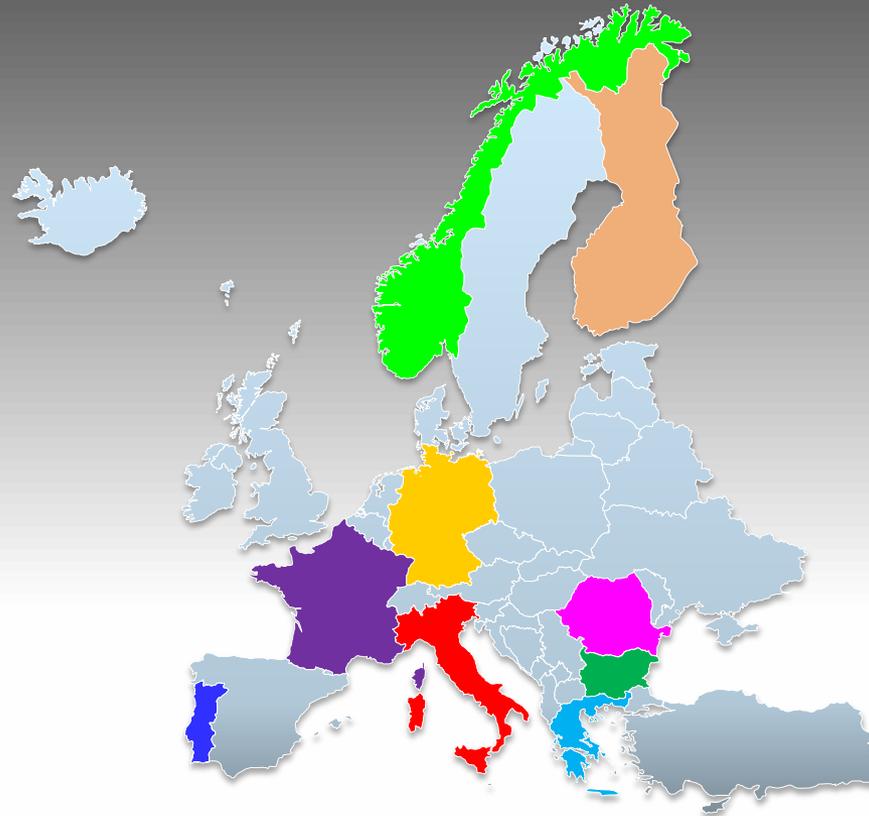


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-  Bulgaria
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-  France
-  Italy
-  Norway
-  Portugal
-  Romania

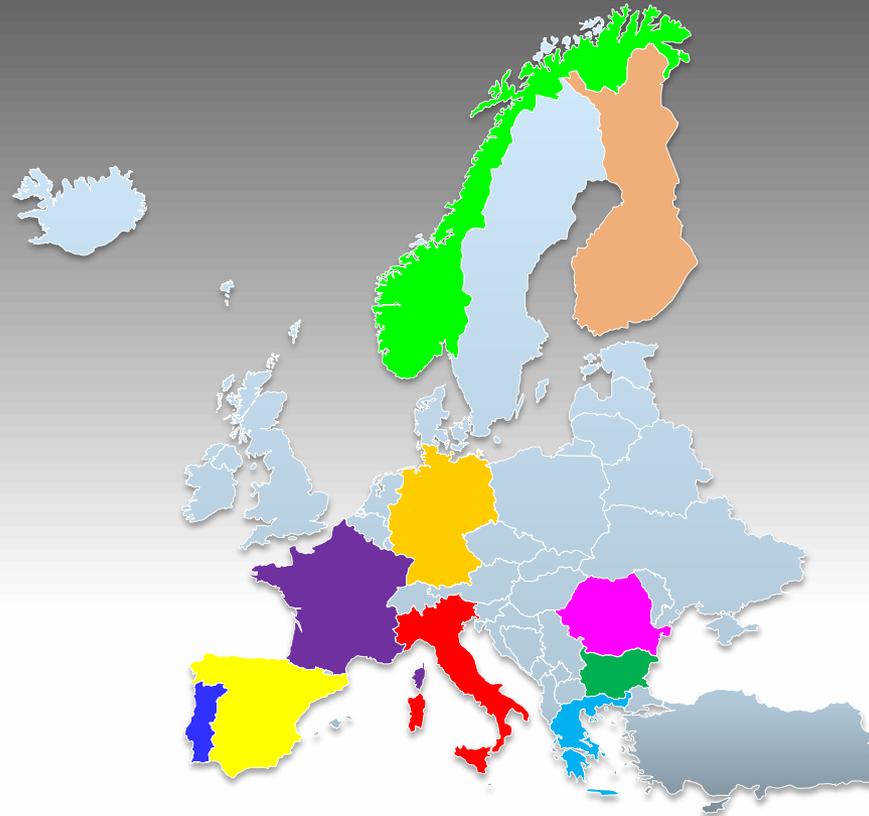


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-  Bulgaria
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-  Greece
-  Finland
-  France
-  Italy
-  Norway
-  Portugal
-  Romania
-  Spain

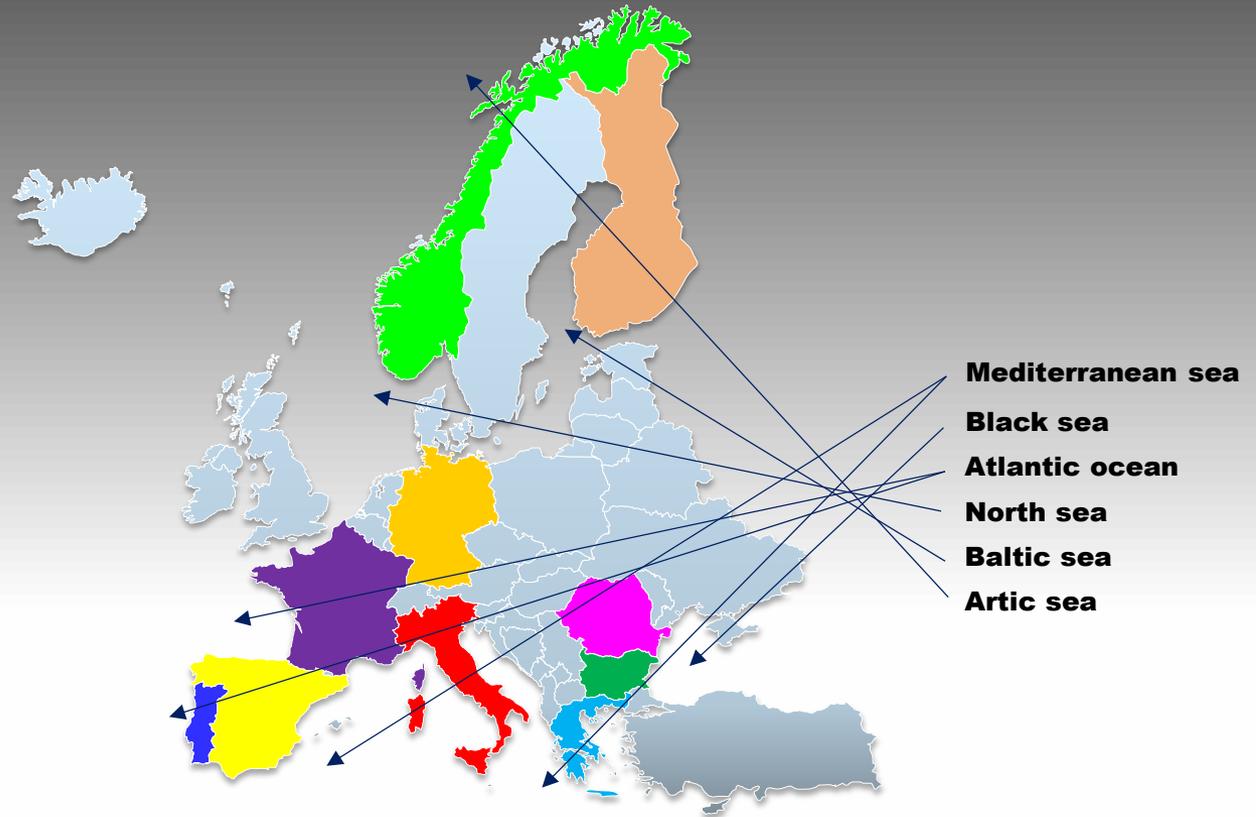


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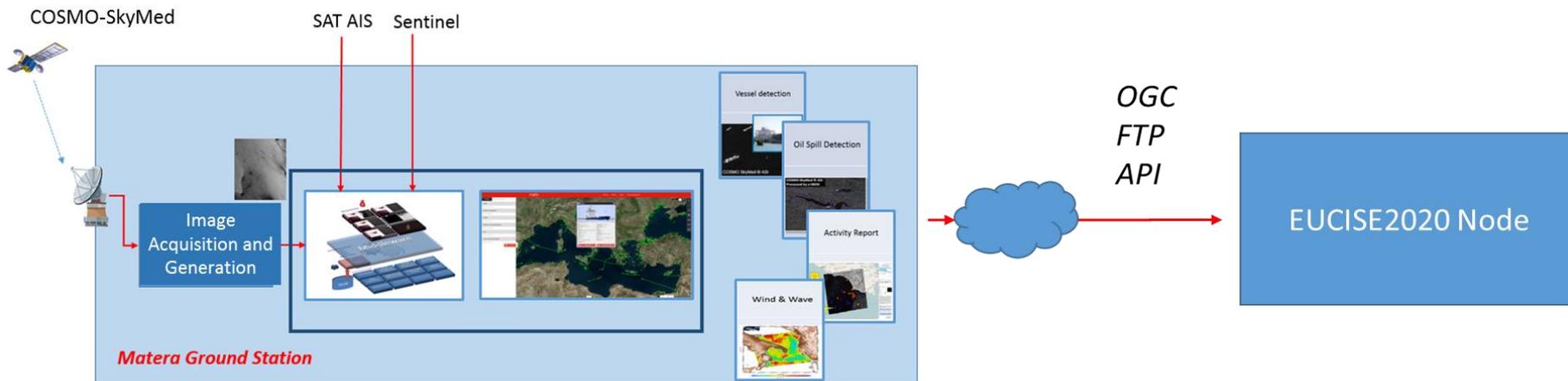


-  Bulgaria
-  Germany
-  Greece
-  Finland
-  France
-  Italy
-  Norway
-  Portugal
-  Romania
-  Spain



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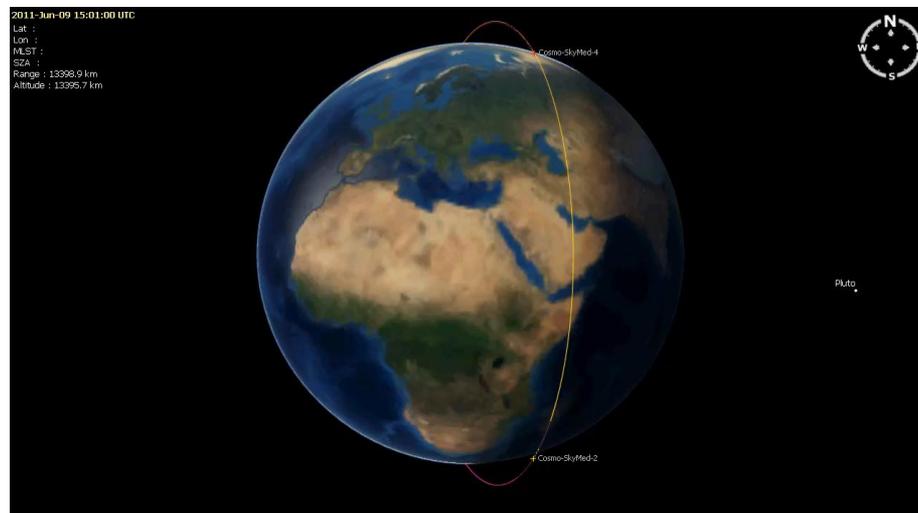


## UNCLASSIFIED Node (Open Data)

1	Vessel detection
2	Oil Spill
3	Wind & Wave
4	Image Quicklook

## CLASSIFIED Node (Restricted Data)

1	Change detection
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ACQUISITION MODE = STR\_HIMAGE

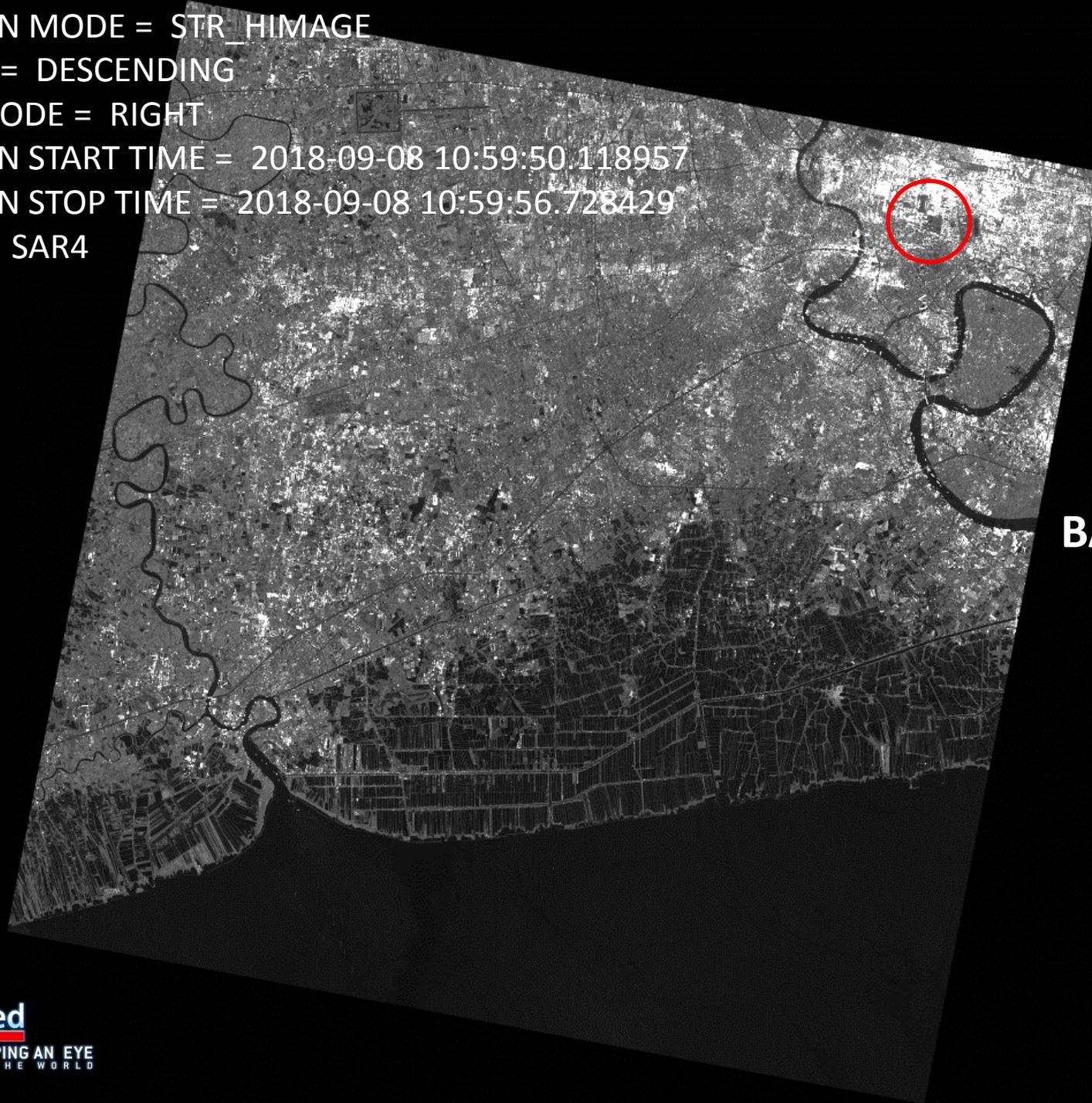
ORBIT PASS = DESCENDING

LOOKING MODE = RIGHT

ACQUISITION START TIME = 2018-09-08 10:59:50.118957

ACQUISITION STOP TIME = 2018-09-08 10:59:56.728429

SATELLITE = SAR4



**BANGKOK**

ACQUISITION MODE = SP\_ENHANCED  
ORBIT PASS = DESCENDING  
LOOKING MODE = RIGHT  
ACQUISITION START TIME = 2018-09-13 10:53:47.385284  
ACQUISITION STOP TIME = 2018-09-13 10:53:54.871978  
SATELLITE = SAR4



**BANGKOK**