



COPERNICUS MARITIME SURVEILLANCE

SERVICE OVERVIEW



THE COPERNICUS PROGRAMME

Copernicus is a European Union Programme aimed at developing European information services based on satellite Earth Observation and in situ (non-space) data analyses.

The programme is managed by the European Commission, and implemented in partnership with the member states and other organisations, including the European Maritime Safety Agency (EMSA). Copernicus services can deliver near-real-time data on a global level to help better understand the planet and sustainably manage the environment we live in. Copernicus is served by a set of dedicated satellites (the Sentinels) and contributing missions (existing commercial and public satellites). Copernicus services address six main thematic areas: Security; Land Monitoring; Marine Monitoring; Atmosphere Monitoring; Emergency Management; and Climate Change.

SECURITY SERVICE

The Copernicus Security Service supports EU policy by providing information in response to Europe's security challenges.

It improves crisis prevention, preparedness and response in three key areas:

- maritime surveillance (implemented by EMSA)
- border surveillance
- support to EU External Action

The Copernicus service for security applications is distinct from other services in the Copernicus programme with regard to conditions of access. Data obtained directly through the Copernicus programme is combined with data from other sources, which may be sensitive or restricted. The end services are then provided directly to authorised national administrations in member states and to a limited number of EU institutions and bodies, in accordance with their access rights.

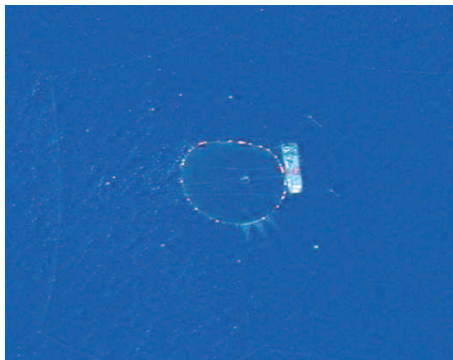


MARITIME SURVEILLANCE SERVICE

The Copernicus Maritime Surveillance Service provides monitoring of human activity at sea.

The goal of the Copernicus Maritime Surveillance Service, implemented by EMSA, is to support its users by providing a better understanding and improved monitoring of activities at sea that have an impact on areas such as:

- maritime safety and security
- fisheries control
- marine pollution monitoring
- law enforcement
- other activities which affect European Union maritime interests.



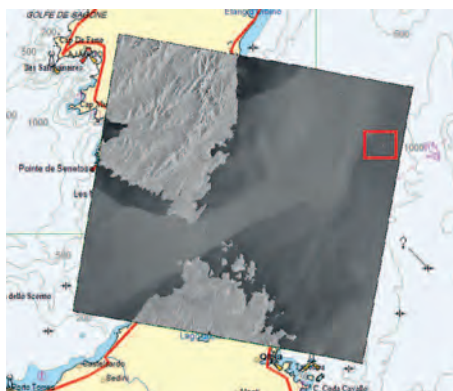
EMSA's service strategy is based on providing end users with the tools they need for effective surveillance by combining data in the best way possible.

Recognising that human activity at sea is intrinsically dynamic, the Copernicus Maritime Surveillance Service provides timely, relevant, and targeted information to member states and EU bodies. A key feature of the service is that data from earth observation satellites can be combined with a wide range of other data, both from EMSA's maritime information applications and from external sources. Vessel position and track information overlaid on satellite images, for example, provides a very powerful tool for checking on vessel activity at sea - including the existence and location of vessels that are not reporting their whereabouts.

Adding a Copernicus component to maritime surveillance services enriches the overall picture and enables users to undertake more in-depth analyses.

Satellite-based images provide a wealth of additional data, which is not available through traditional monitoring systems. Information which can be extracted from images includes, for example:

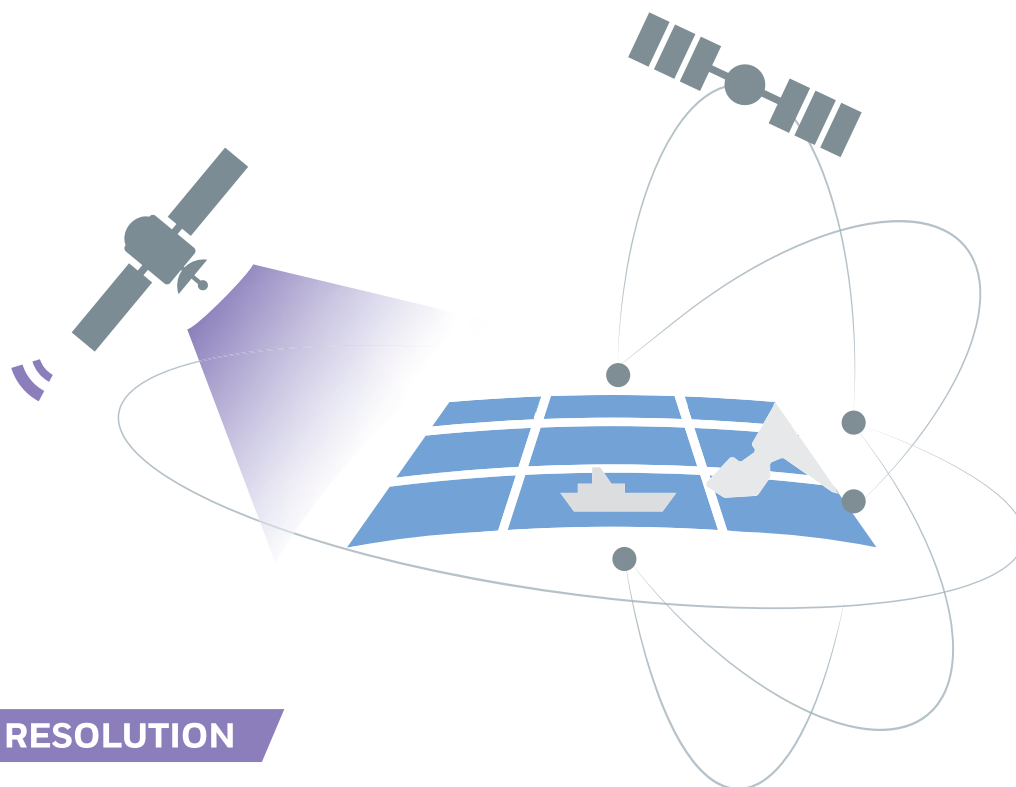
- vessel detection: position, vessel type, size, length, heading, speed
- activity/object detection: location, type of activity or object, size, information on surrounding area.



WHAT COPERNICUS CAN OFFER

Earth observation data can be delivered in a wide variety of formats and can cover small or large maritime areas, offering a detailed overview of what happens at sea, where, and how, under all types of conditions. The earth observation satellites which provide the data exploited by the Copernicus Maritime Surveillance Service are split into two distinct groups:

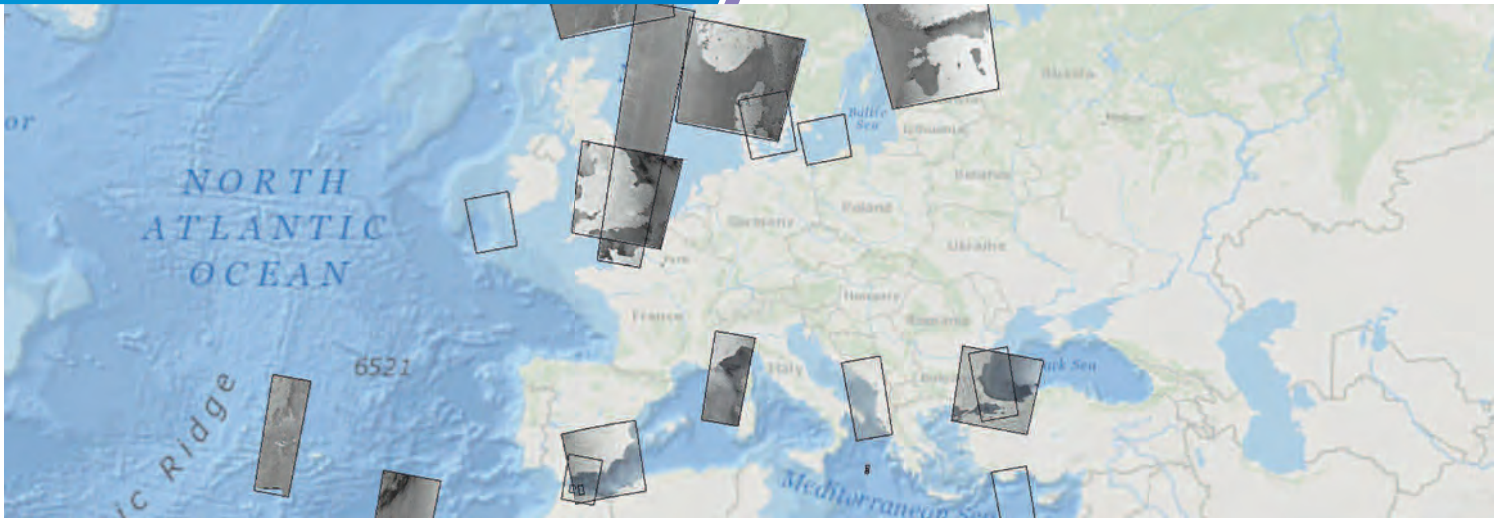
- the Sentinels, which are currently being developed for the specific needs of the Copernicus programme
- the contributing missions, which are operated by national, European or international organisations.



SIZE vs RESOLUTION

There is always a trade-off between the size of the image and the resolution available. Large images are good for monitoring wide areas, but can only detect features of over a certain size. To get more detail, the area captured has to be much smaller. The image below left of the Attica peninsula, Greece, covers 250 x 250 km (62500 km²). Vessels of over 100 metres in length are just visible waiting to enter port. The image on the right has a resolution of 30 centimetres and features on the deck of the ship are clearly visible, but the original image only captured an area of 50 x 50 km (2500 km²).





The type of earth observation data which is most useful in any given maritime operation will depend on the type of monitoring needed. There are two main categories of earth observation data, synthetic aperture radar (SAR) data and optical data:

■ Synthetic Aperture Radar Data

SAR sensors use radar frequencies to construct an image of the sea (or land) surface below. This means that images can be acquired regardless of weather conditions and cloud cover, and at any time of day or night. By measuring the roughness of the sea surface, resulting images display features which stand out against the background; for example, vessels appear as bright spots, while oil spills appear as dark shapes.

SAR is used primarily for vessel detection and pollution monitoring, but can also be used for other purposes such as extracting wind, wave, and ice information.

Images are available with resolution of <1 metre to 100 metres, and scene sizes vary respectively from 5 x 10 km to 400 x 1600 km. For a standard 200 x 200 km image, the full service - from satellite acquisition to the delivery of the processed image to the end user - takes less than 30 minutes.

■ Optical Data

Optical images are more limited when there is bad weather, cloud cover and at night. However, in good conditions, excellent high resolution images can provide a wealth of information in different spectral bands (e.g. visible, infra-red).

Optical images are a good option for vessel detection, but also for a range of other object and activity detection; for example, fish cages and fish traps, rendez-vous at sea, vessel identification.

Images are available with a resolution of <0.3 metres, and scene sizes vary from 50 km² to over 1000 km². Delivery times vary from less than 45 minutes to over 24 hours, depending on the operational needs of the users.





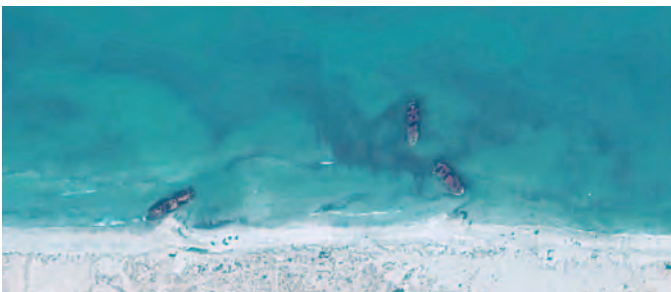
AREAS OF ACTIVITY

The potential of earth observation data to support national authorities in the maritime domain is only just being realised. Oceans and seas cover over 70% of the earth's surface. Whether in areas under national jurisdiction or on the high seas, activities in the maritime domain have typically not been subject to the same level of oversight as activities on land. The sheer extent of the areas to be covered and the logistical barriers to having a significant presence at sea has resulted in a maritime 'blind spot' for many authorities. Now, the increasing availability of satellite data delivered by services such as the Copernicus Maritime Surveillance Service means that even the most remote areas need never be completely out of sight.

New requirements are constantly being identified. Some examples of the services and products which are already or may soon be available under the Copernicus Maritime Surveillance Service are presented in the following pages.

LAW ENFORCEMENT

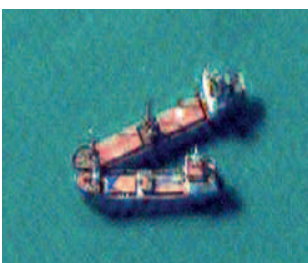
Maritime law enforcement encompasses a wide range of functions, including measures against: trafficking and smuggling of contraband (e.g. narcotics, arms or other goods); piracy and armed robbery; illegal pollution (e.g. oil discharges from ships) and other environmental crimes. What all of these have in common is that the perpetrators do not want to be detected and identified, so unlawful activities often occur in remote locations, and many involve small vessels which do not send position alerts, or larger vessels which have switched off reporting systems.



MONITORING OF SHORELINES

Small boats on deserted beaches may indicate potential landing/launching sites for a wide range of illegal activities.

High resolution optical images provide valuable insight into what kinds of vessels are operating from uncontrolled areas. Contextual information - for example tyre tracks on beaches or warehouses nearby - can also be useful.



SEARCHING FOR SUSPICIOUS TARGETS

If intelligence information indicates that an illegal activity may be taking place in an area, law enforcement officials might want to identify particular types of behaviour. For example: two vessels meeting at sea could indicate a handover of contraband goods; high speed craft going from a larger boat to an unpatrolled beach might be involved in landing drugs.

FISHERIES CONTROL

The EU fishing industry is a big business, and provides over 6.4 million tonnes of fish each year to meet consumer demand. To complement fish supplied by wild fisheries, the aquaculture sector now accounts for over 20% of fish production in Europe.

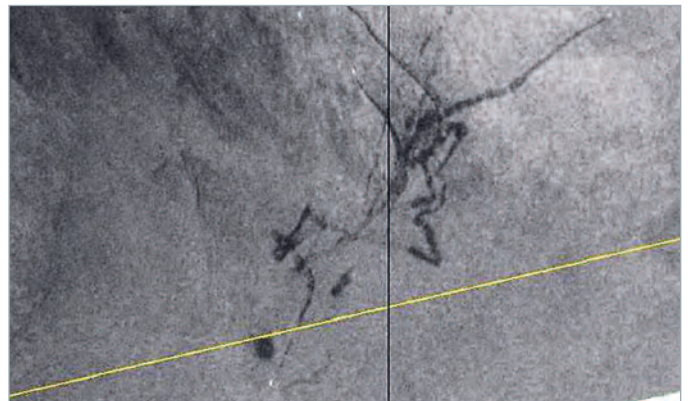
The EU fishing fleet has over 85 000 vessels, ranging in size from under 12 metres to over 100 metres. Small vessels tend to form part of domestic fleets, while larger vessels are likely to be involved in deep-sea fisheries in the high seas. Vessels transmit regular position messages so that control authorities can monitor their voyages and activity, ensuring that fishing is carried out safely and sustainably. Earth observation data can provide valuable additional means for monitoring and surveillance.

There are varied methods of fish farming and other forms of aquaculture, some of which involve raising fish in cages located in coastal areas. This is regulated to ensure proper standards of environmental protection, animal health and consumer safety.

SURVEILLANCE OF FISHING ACTIVITY

Remote fishing grounds covering vast areas can be monitored day or night using earth observation images. These images can, for example, show whether there are vessels present in restricted areas, and detections can be compared with vessel position data to check compliance with reporting obligations.

On the right, a satellite image of a fishing ground in a remote area is overlaid on a nautical chart background. The white spots indicate vessels in the area, while the black trails behind the vessels, possibly fish oil, show the vessels' fishing patterns.



MONITORING OF FISH FARMS AND AQUACULTURE ACTIVITIES

Satellite image data can assist fisheries control authorities by providing a range of information on fish farm and aquaculture operations, including: the exact location of fish farm installations; the number and size of cages; and activities in the surrounding area, such as feed barges transiting between harbour and fish farm, and tugs towing cages.

High resolution SAR radar and optical images can be used to get a close-up of specific areas. In the image on the left, a vessel can be seen approaching a fish cage.

MONITORING OF FISHING PORTS

Determining which vessels are going to which ports to offload catches can be useful, and can be checked to ensure it matches reported activities. Related information can also be determined from images, such as whether transshipments of fish are taking place in an area.

High resolution optical images can be interpreted visually, giving the analyst a wealth of information about what sort of fishing activities have been taking place, in national ports and also in ports of third countries. In the image on the right, there are a number of small fishing vessels measuring under 10 metres.



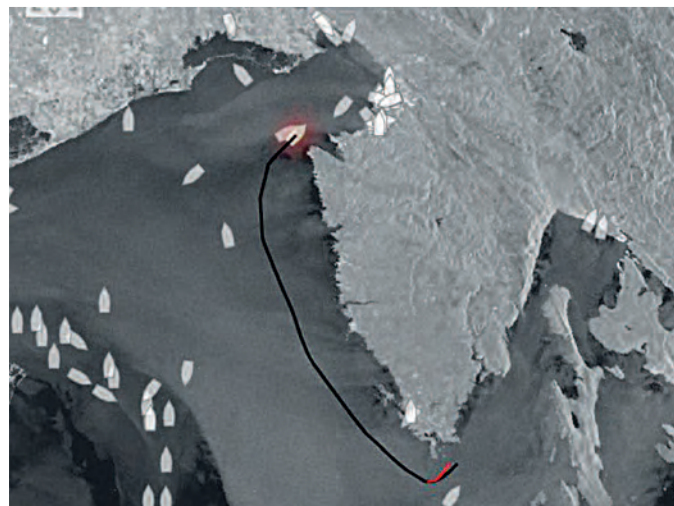
MARINE POLLUTION MONITORING

In order to effectively detect possible pollution at sea, it is necessary to use surveillance systems capable of monitoring wide areas at regular intervals. Radars are able to detect very thin films of oil and similar substances floating on the sea surface, and can help determine the exact nature, location, and extent of a spill or other pollution.

ILLEGAL SHIP-SOURCE DISCHARGES

SAR radar satellite images are appropriate for detecting possible illegal discharges from ships. Oil discharges appear on images as long, linear dark shapes, while vessels and oil platforms appear as bright white spots. Combining images with information from vessel tracking systems can reveal the identity of possibly polluting vessels. On the right, vessel positions are overlaid on an image showing a recent spill.

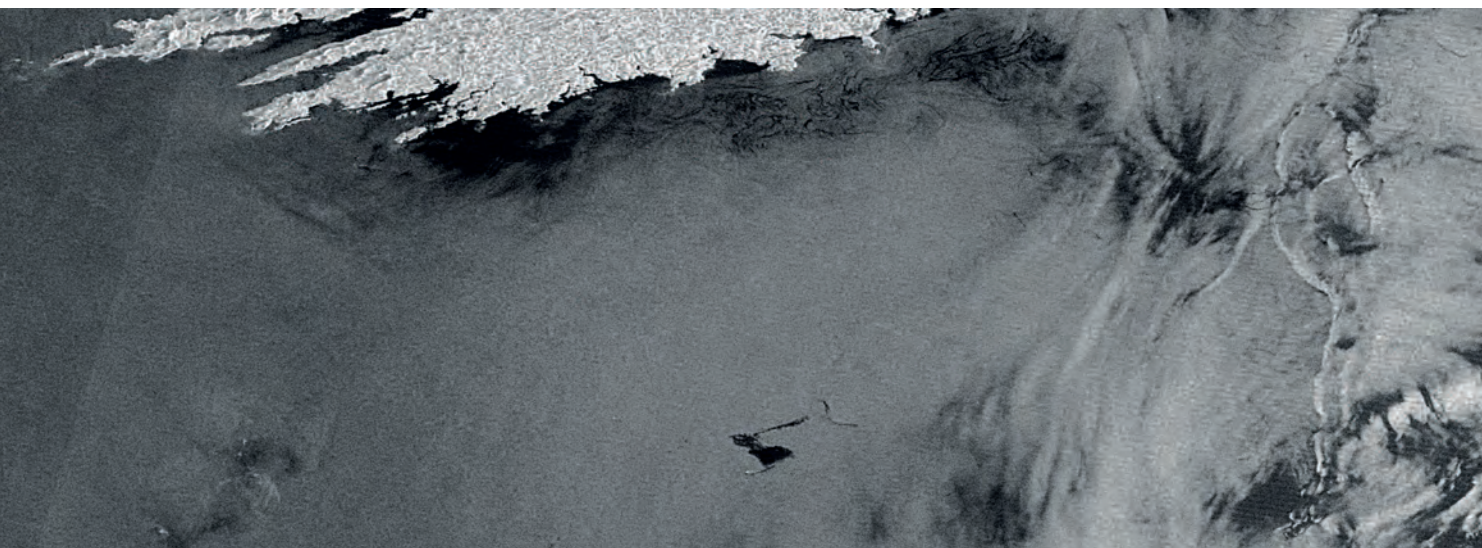
EMSA currently operates the CleanSeaNet Service, which has been providing oil spill and vessel detection in European waters since 2007. Through Copernicus, this service may be extended to new geographic areas, for example overseas territories of EU states.



MONITORING THE SPREAD OF OIL FOLLOWING A LARGE-SCALE ACCIDENT

During large accidental spills, whether caused by vessels or oil platforms, satellites can monitor the spread of oil over a period of time. CleanSeaNet already provides this service in Europe, and now Copernicus may offer an opportunity to provide such support further afield in other areas of EU interest.

Following the CleanSeaNet detection of an oil spill off the coast of Ireland (below), the Irish coastguard sent a helicopter to the site. 4-500 tonnes of oil had been spilt accidentally during a ship-to-ship refuelling operation. Satellite images acquired over the following days monitored the spread of oil to ensure that there was no danger to the coastline.



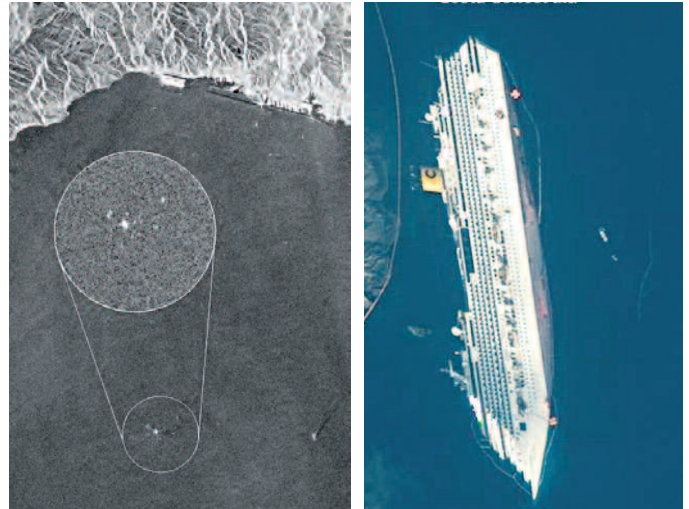
MARITIME SAFETY AND SECURITY

Maritime safety and security operations support the safe transit of vessels, people and goods; and ensures that when necessary, assistance can be provided in the most timely and effective way possible. These types of operation encompass areas of activity as diverse as vessel traffic routing systems, prevention of accidents and collisions, search and rescue, and port security.

MONITORING INCIDENTS

When an incident or accident occurs, authorities need as much information as possible. In remote areas or poor weather conditions, it can be difficult to send human observers, but is often possible to acquire satellite images over the relevant area. Even when the site of the incident or accident is easily accessible, aerial images can provide valuable additional contextual information.

The optical image on the far right is a close-up of the cruise ship Costa Concordia following a grounding in 2012. On the near right is a SAR satellite image of the Costa Concordia being towed by other smaller vessels to the port of Genoa in 2014, following salvage operations.



TRACKING OBJECTS AT SEA

Floating objects at sea, particularly dislodged shipping containers, can pose a serious threat to other vessels, endangering lives and the environment. It is estimated that over 500 containers are lost at sea annually. Despite technological advances in on board systems such as ship radars, collisions occur on a regular basis. Satellite images can help identify and track the movement of containers and other objects, allowing vessel traffic authorities to issue warnings to ship operators, agents, and masters.

The image on the left, taken by the Portuguese authorities, shows a floating container which posed a threat to vessels off the coast of Portugal in December 2015.

VESSEL LOCATING AND IDENTIFYING

If a vessel known to be transiting in an area loses contact and is thought to be adrift, SAR radar satellite images can help search for the vessel over large areas based on last known coordinates. This can provide support to search and rescue operations.

Alternatively, if an unknown vessel remains in a particular location over a period of time and more information is required, high resolution optical images can be used to try and identify distinguishing features.

Markings and objects on the decks of vessels can be clearly visible in satellite images, as shown in the examples on the right.



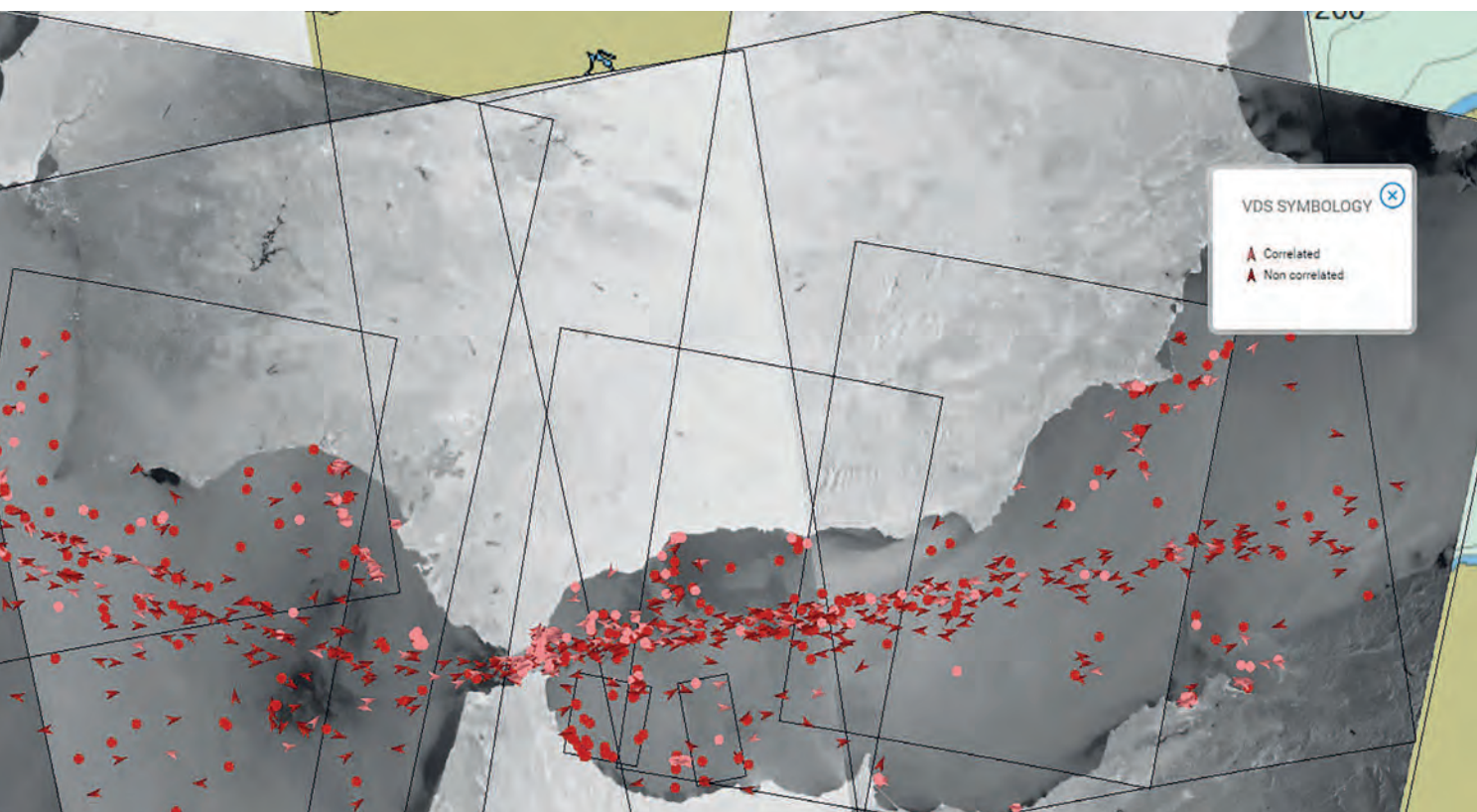


USING COPERNICUS DATA INTELLIGENTLY

The Copernicus Maritime Surveillance Service provides relevant and targeted information on maritime activities.

The Copernicus Maritime Surveillance Service supports maritime administrations across the EU by providing new data possibilities and greater data volume, and by extending the geographical scope of monitoring capabilities. Satellites, and their on board sensors, can provide routine, cost effective, wide area surveillance over all maritime zones. Alternatively, satellites can be pointed to a targeted location for monitoring specific operations or to gather information in response to intelligence information often on smaller and mobile objects.

In this context, using data selectively for the best results possible is more important than ever. EMSA engages with users to ensure that they receive the right kind of earth observation products, and that these are selectively combined with other relevant data sources such as vessel tracking information and user intelligence. Data is delivered in a customised way through a user-friendly web interface. EMSA also has a 24 hour support service to address users' questions and concerns.

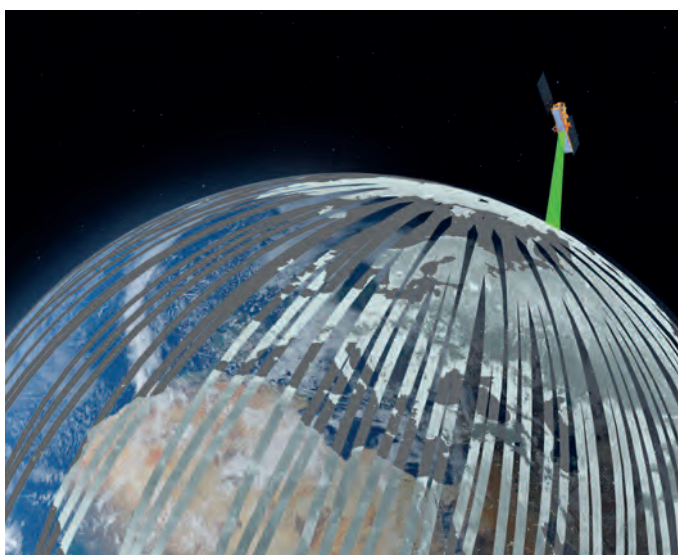




SUPPORTING YOUR ACTIVITIES

The Copernicus Maritime Surveillance Service is available to national authorities and selected EU organisations working in the maritime domain.

Copernicus will reinforce and enhance existing EMSA services by offering new and/or extended earth observation possibilities, and will also enable EMSA to set up and develop entirely new services by identifying emerging opportunities in different maritime areas. As the portfolio of applications expands, new users and user requirements will continue to be added.



FIND OUT MORE

The Copernicus Maritime Surveillance Service can be offered to national administrations and EU organisations based on an evaluation of user functions and service needs.

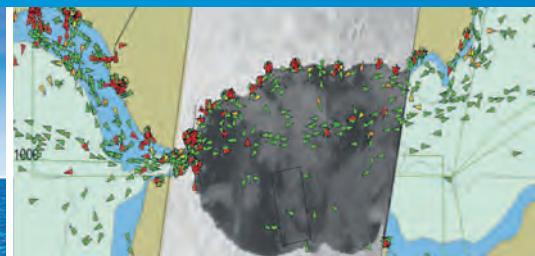
If you are interested in becoming a user, please get in touch with EMSA to discuss this further:

copernicus@emsa.europa.eu

For more information on the Copernicus Programme and on the European Maritime Safety Agency, please visit the following websites:

Copernicus website: copernicus.eu

EMSA website: emsa.europa.eu



ABOUT THE EUROPEAN MARITIME SAFETY AGENCY

The European Maritime Safety Agency is one of the European Union's decentralised agencies. Based in Lisbon, the Agency's mission is to ensure a high level of maritime safety, maritime security, prevention of and response to pollution from ships, as well as response to marine pollution from oil and gas installations. The overall purpose is to promote a safe, clean and economically viable maritime sector in the EU.

ABOUT COPERNICUS

Copernicus is a European Union Programme aimed at developing European information services based on satellite Earth Observation and in-situ (non-space) data analyses. The Programme is coordinated and managed by the European Commission. It is implemented in partnership with the Member States, the European Space Agency (ESA), the European Organisation for the Exploitation of Meteorological Satellites (EUMETSAT), the European Centre for medium-range Weather Forecasts (ECMWF), EU Agencies and Mercator Océan.



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