



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 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.

THE 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. 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 and to a limited number of EU institutions and bodies, in accordance with their access rights.



THE COPERNICUS MARITIME SURVEILLANCE SERVICE

The Copernicus Maritime Surveillance Service supports improved monitoring of activities 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:

- fisheries control
- maritime safety and security
- law enforcement
- marine environment (pollution monitoring)
- support to international organisations.



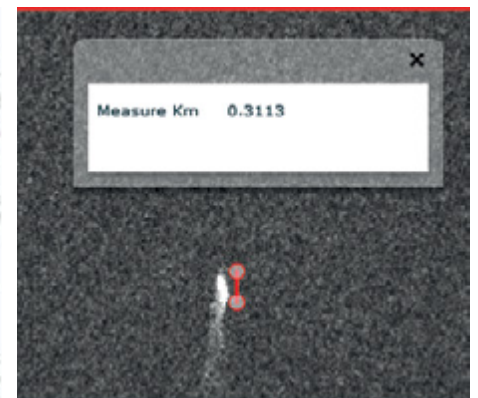
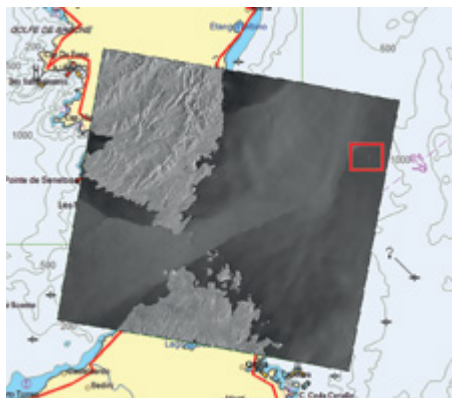
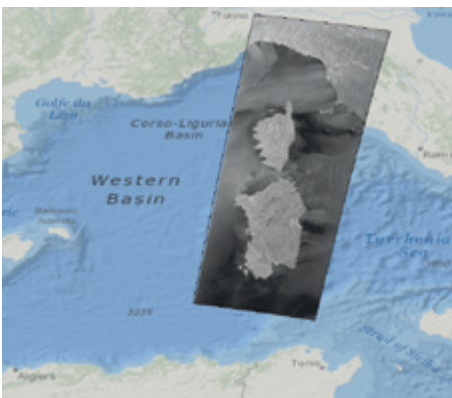
Providing end users with the tools they need for effective surveillance by combining data in the best way possible.

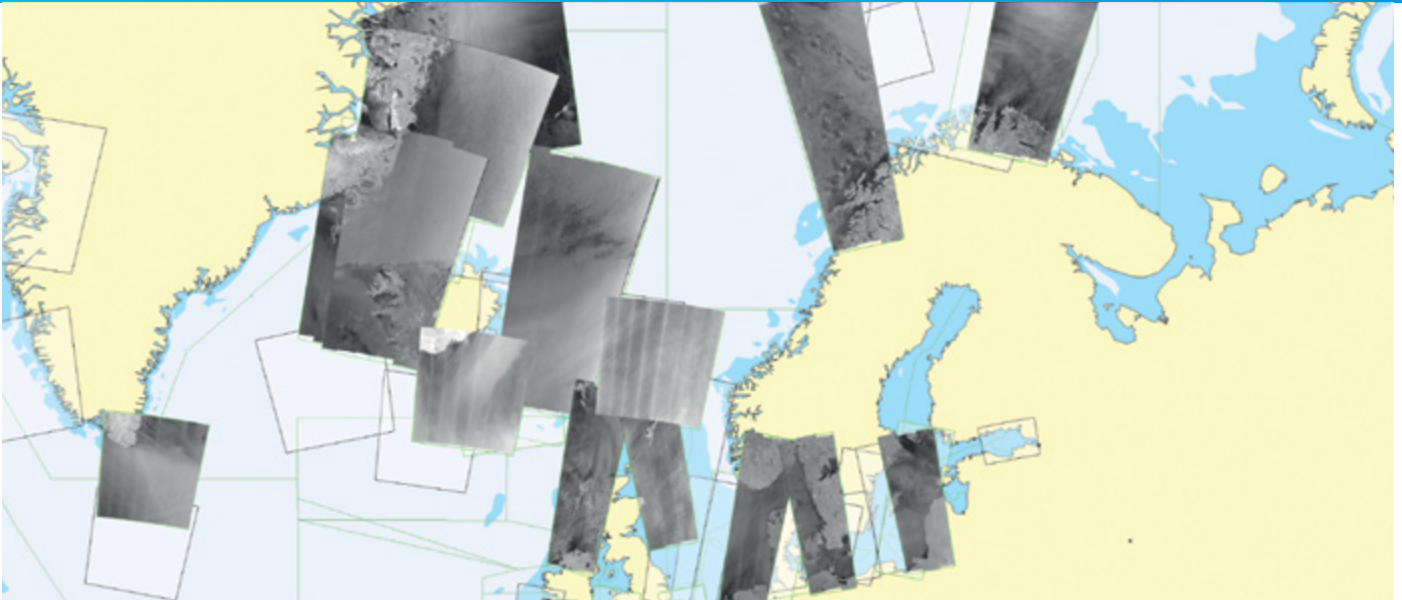
Recognising that human activity at sea is intrinsically dynamic, the Copernicus Maritime Surveillance service provides timely, relevant, and targeted information to member states and EU bodies. A key feature of the service is that data from earth observation satellites can be combined with a wide range 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 additional data, which is not available through traditional monitoring systems, to obtain an overview of what is happening in the maritime domain. 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





EARTH OBSERVATION DATA

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. 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, certain features stand out against the background; for example, vessels appear as bright spots, while oil spills appear as dark shapes.

■ Optical Data

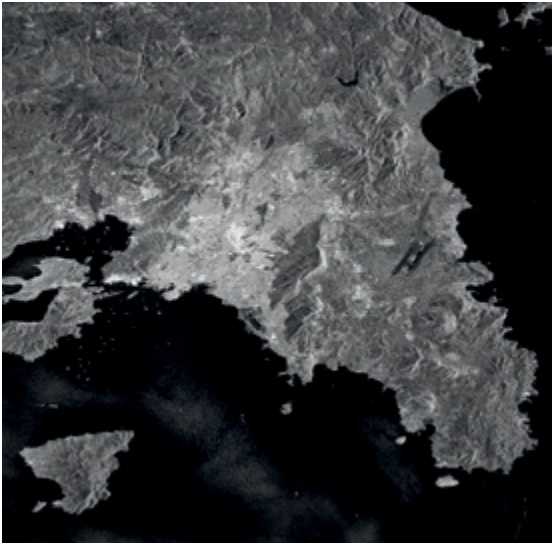
Optical images are more limited when there is bad weather, cloud cover and at night. However, in good conditions, high resolution images can provide a wealth of information in different spectral bands (e.g. visible, infra-red).

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.



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).

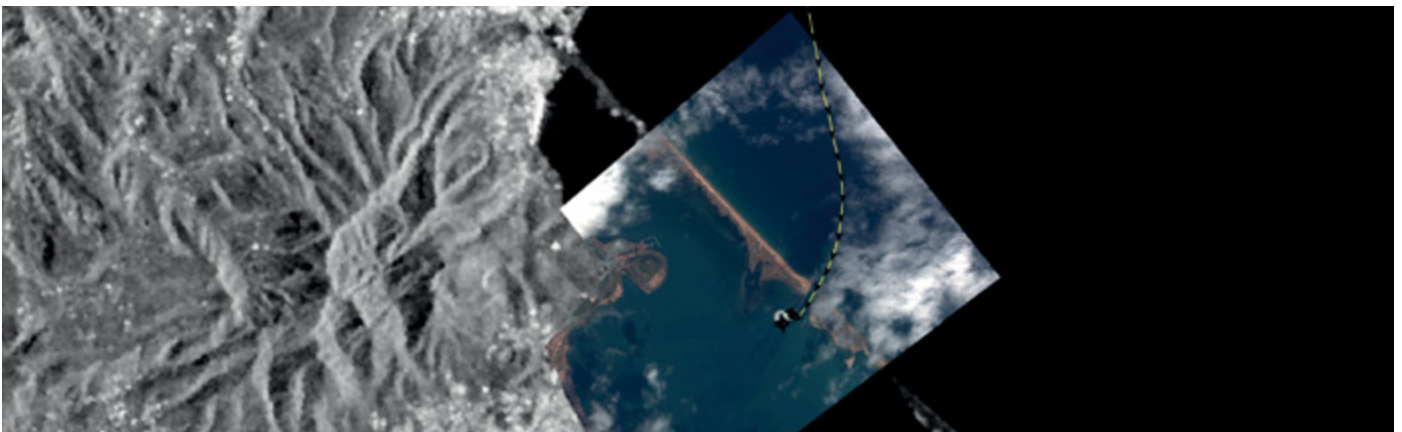


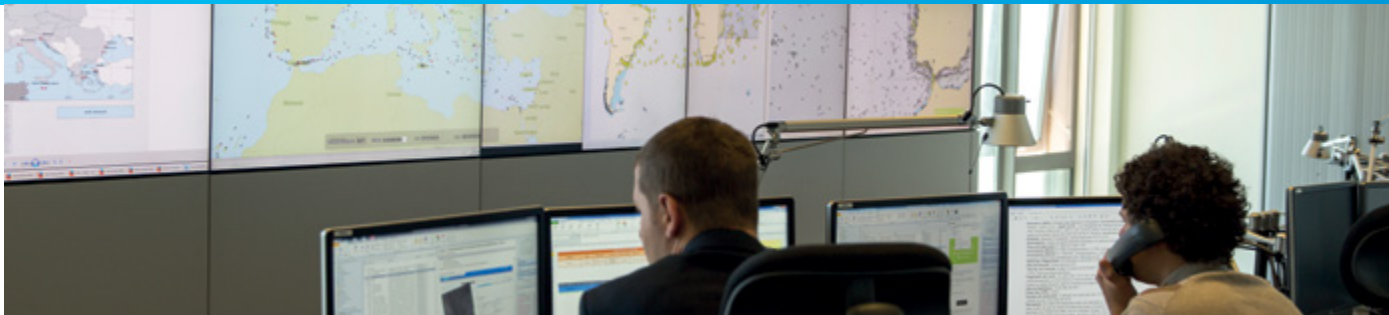
USING COPERNICUS DATA INTELLIGENTLY

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 secure, user-friendly web interface.





SUPPORTING YOUR ACTIVITIES

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

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. 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 has resulted in a maritime 'blind spot' for many authorities. Now, even the most remote areas need never be completely out of sight.

FISHERIES CONTROL

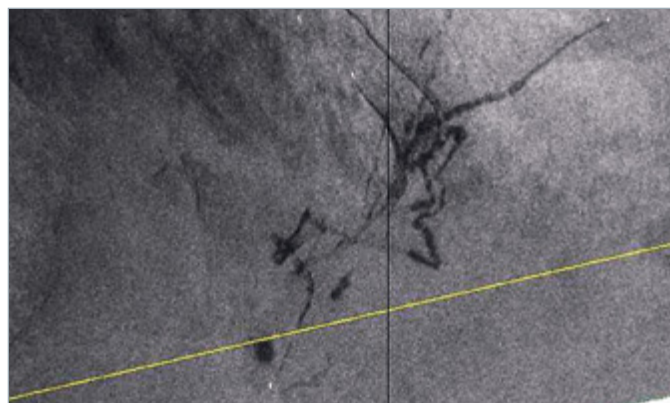
The EU fishing industry is a big business, and provides over 6.4 million tonnes of fish each year to meet consumer demand. To complement fish supplied by wild fisheries, the aquaculture sector now accounts for over 20% of fish production in Europe.

Fishing vessels transmit regular position messages so that control authorities can monitor their voyages and activity, ensuring that fishing is carried out safely and sustainably. Fish farming and other forms of aquaculture also need to be regulated to ensure adherence to proper practice. Earth observation data can provide valuable additional means for monitoring and surveillance.

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.

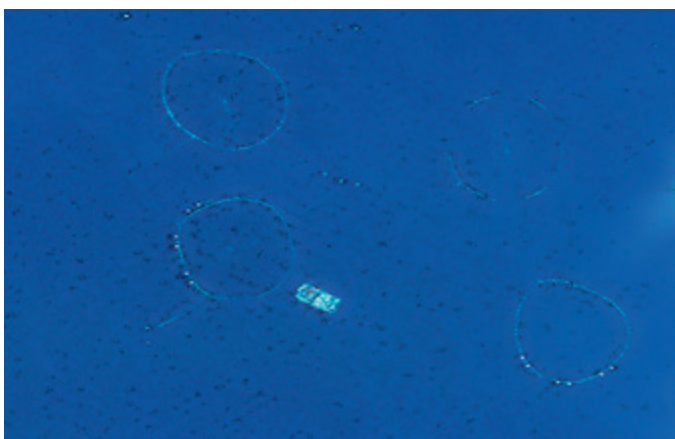
On the right, a satellite image of a fishing ground in a remote area is overlaid on a nautical chart background. The white spots indicate vessels in the area, while the black trails behind the vessels, possibly fish oil, show the vessels' fishing patterns.



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.



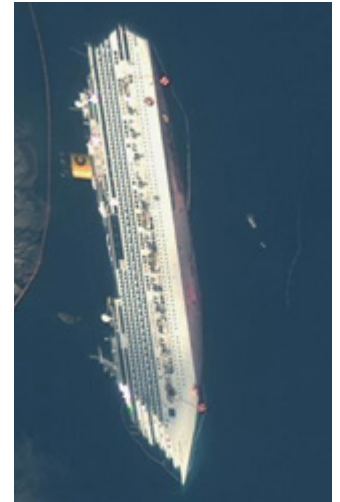
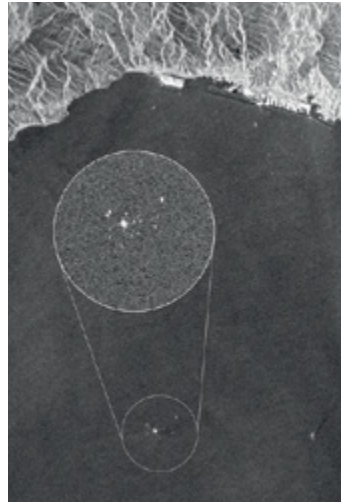
MARITIME SAFETY AND SECURITY

Maritime safety and security operations support the safe transit of vessels, people and goods; and ensure 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, for example icebergs and dislodged shipping containers, can pose a serious threat to other vessels, endangering lives and the environment. 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 objects posing a danger to the safety of navigation, allowing vessel traffic authorities to issue warnings to ship operators, agents, and masters.

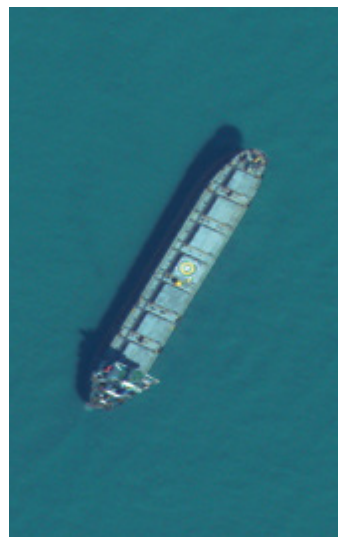
The image on the left shows a floating container posing a threat to the safety of navigation.

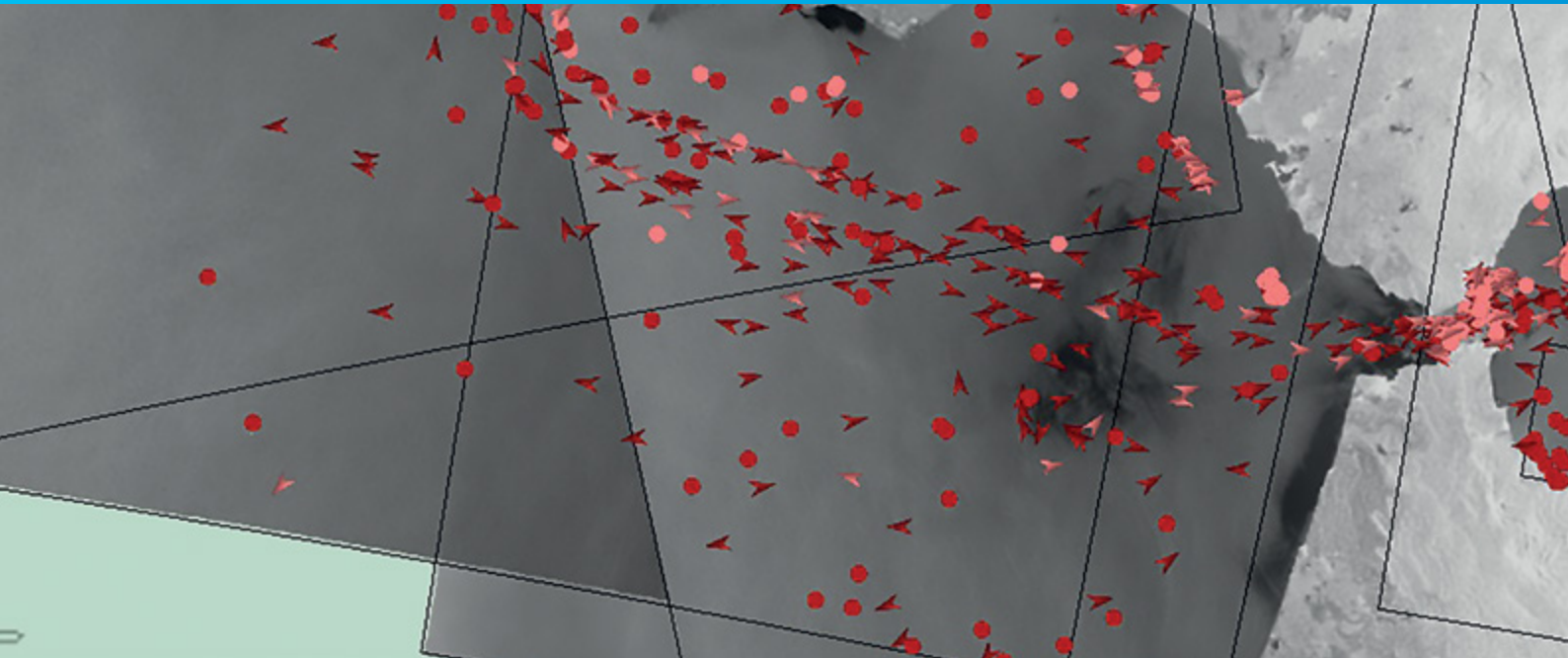
VESSEL LOCATING AND IDENTIFYING

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.





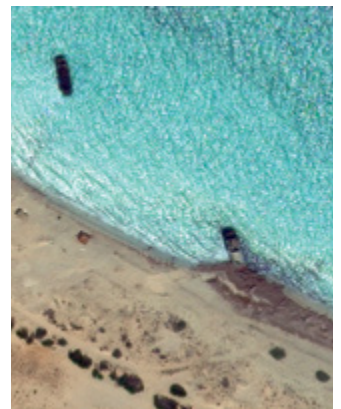
LAW ENFORCEMENT

Maritime law enforcement encompasses a wide range of functions, including measures against: piracy and armed robbery; trafficking and smuggling of contraband (e.g. narcotics, arms or other goods); 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 AND PORTS

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 be useful.

Surveillance of ports and marinas to check whether suspect vessels have arrived or departed is also an important indicator for authorities of whether illegal activity is taking place.

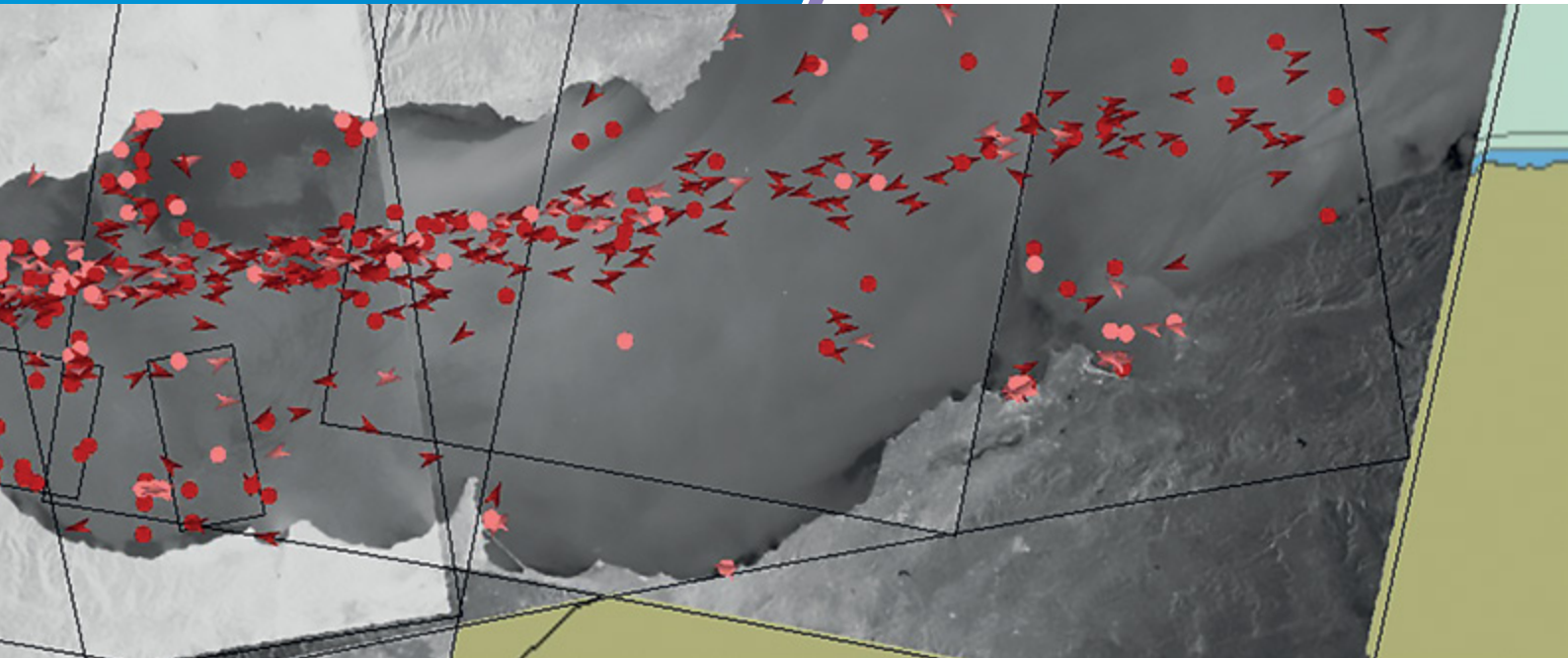


SITUATIONAL AWARENESS

There may be occasions when law enforcement authorities need more control than usual over a particular area. If an event is occurring at sea or in port which may be subject to acts of terrorism or civil unrest, additional monitoring can be beneficial for maintaining security.

If a vessel has been hijacked by pirates, satellite images can be used to confirm the location of the vessel, and may even provide additional information on the condition of the vessel, objects on deck, or other vessels or infrastructure in the vicinity.





CUSTOMS

Customs authorities aim to ensure that legitimate trade can flow freely, whilst preventing trafficking and smuggling of illegal or dangerous goods (including counterfeit goods, firearms, explosives, drugs, cash and even protected wildlife species). Many items are transported by criminal maritime networks. Authorities are interested in monitoring key links in the supply chain, such as the transport and entry of such goods into the EU. Satellite image and value-added products reinforce authorities' capacity to maintain oversight of goods transported at sea, and particularly to detect and intervene when criminal activity is suspected.

MONITORING SHIP-TO-SHIP TRANSFERS

Contraband is often transported for long distances in large vessels, but taken to shore in smaller ones. If two vessels en route halt their voyages to meet at sea, this could suggest that goods are being transferred between two vessels.

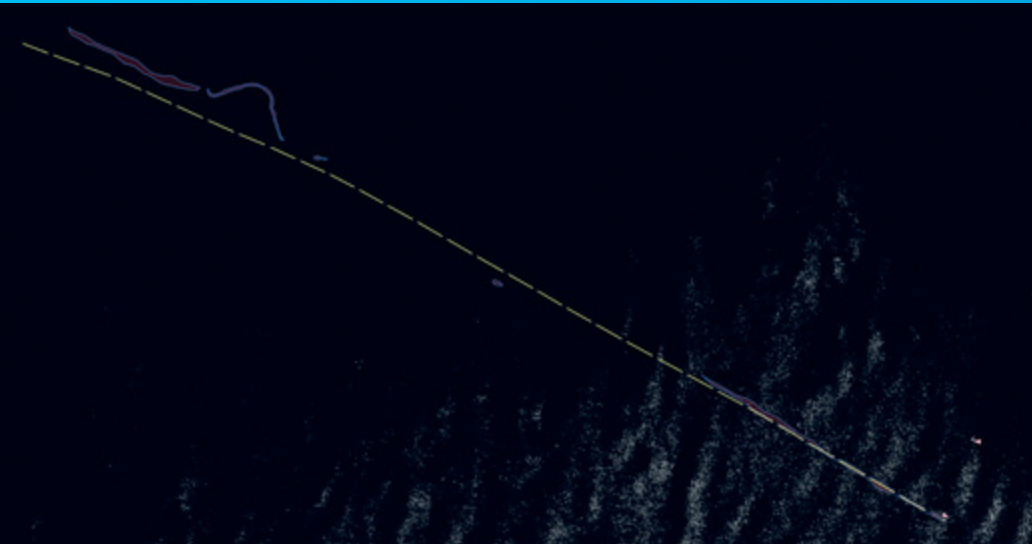
When a handover location is known, CMS data can be used to provide confirmation of vessels meeting and obtain more information on the types of vessels involved. This is especially useful for example if the identity of the 'mother ship' is known, but not that of the vessel taking illegal goods ashore.



SEARCHING FOR SUSPECT TARGETS

If intelligence information indicates that an illegal activity is taking place at sea, law enforcement officials need to detect and identify suspected vessels. Satellite images can be used to search for types of vessels most typically used for transport of illicit goods, or even for a specific vessel based on basic information (e.g. size, colour). SAR images are able to search for the presence of vessels across large areas, identifying where exactly a vessel is located within a broad search area; optical images can provide analysts with additional detailed information about targeted vessels.





MARINE ENVIRONMENT (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 has been extended to new geographic areas, for example overseas territories of EU states.

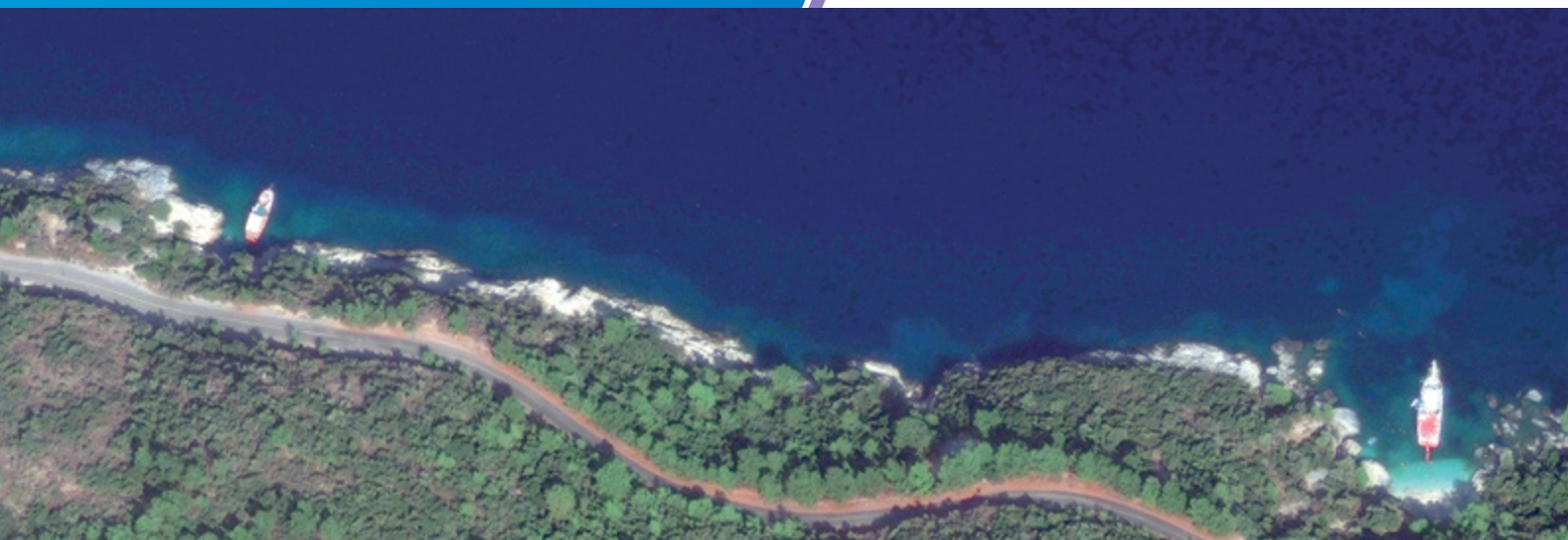


MONITORING THE SPREAD OF OIL FOLLOWING A LARGE-SCALE ACCIDENT

During large accidental spills, whether caused by vessels or oil platforms, satellites can monitor the spread of oil over a period of time.

The image (left), acquired the day following a collision between two vessels, shows an oil spill spreading from the scene. Additional data from vessel reporting systems is available at EMSA to verify the identity of the vessels. Satellite images acquired over the following days monitored the spread of oil, and optical images were acquired as it approached the coastline.



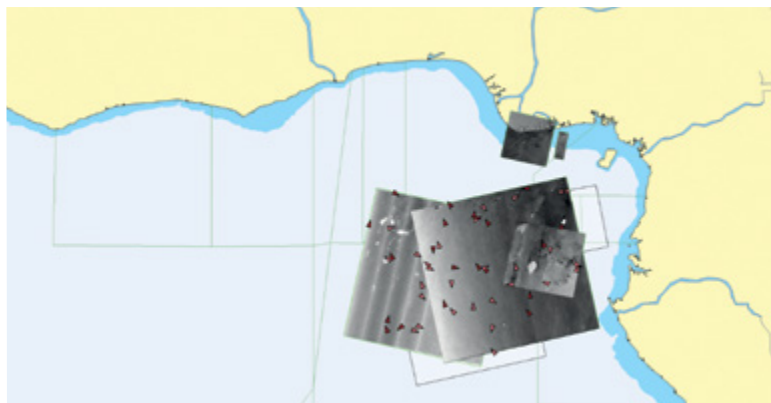


SUPPORT TO INTERNATIONAL ORGANISATIONS

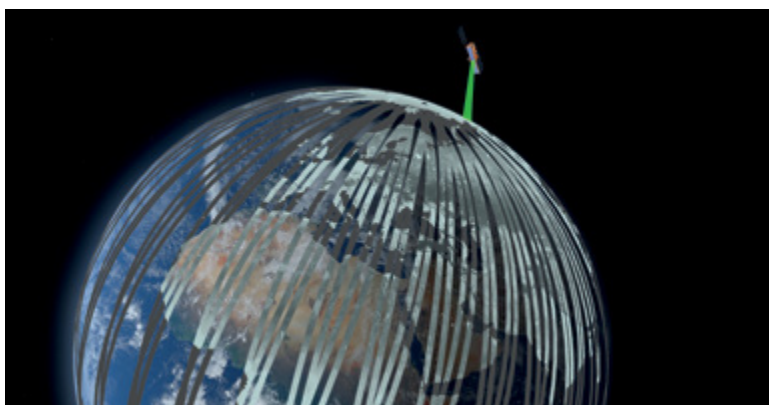
Activities in the maritime domain are often inherently transboundary, and successful operations rely on mutual cooperation and the exchange of data – including earth observation data – and intelligence to address issues of regional or global concern. The Copernicus Maritime Surveillance (CMS) service provides maritime surveillance support to international organisations promoting the European Union's Common Foreign and Security Policy (CFSP) and related policies and strategies, in consultation with and based on the approval of DG-GROW and the European External Action Service (EEAS).

WIDE AREA SURVEILLANCE

International organisations are often interested in cross-border crime and maritime crime occurring in areas of the world where monitoring capabilities are limited. Covering large areas with few resources, it is important that the assets available are deployed in the best possible way. Vessel detection through CMS is one way of ensuring that assets are sent to areas where they will be most effective, and of selecting which vessels should be prioritised for example for boarding and inspections.



FIND OUT MORE



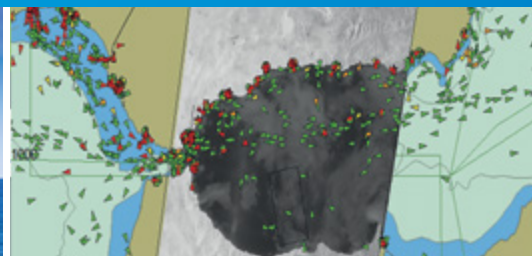
The Copernicus Maritime Surveillance Service can be offered to national administrations and EU organisations based on an evaluation of user functions and service needs.

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

copernicus@emsa.europa.eu

Copernicus Maritime Surveillance

Twitter [CopernicusCMS](https://twitter.com/CopernicusCMS) / copernicus@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.



Get in touch for more information

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