

CleanSeaNet – European Satellite Oil Spill Monitoring and Vessel Detection Service

Introduction to CSN

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SAFEMED III Training for CleanSeaNet Operators – Lisbon– March 2014

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- Service Overview
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Background

European Maritime Safety Agency

- Post *Erika* (December 1999)
- 2002: EMSA established (Regulation 1406/2002) Regulatory Agency of the European Community
- Own legal identity
- Extended mandate
After *Prestige* sinks off Galicia, Spain – November, 2002



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Background: Legal basis

- **Directive 2005/35/EC*** of 7 September 2005 on ship-source pollution and on the introduction of penalties, including criminal penalties, for pollution offences

Article 10

Accompanying measures

2. In accordance with its tasks as defined in Regulation (EC) No 1406/2002, the European Maritime Safety Agency shall:
 - (a) work with the Member States in developing technical solutions and providing technical assistance in relation to the implementation of this Directive, in actions such as tracing discharges by satellite monitoring and surveillance;
 - (b) assist the Commission in the implementation of this Directive, including, if appropriate, by means of visits to the Member States, in accordance with Article 3 of Regulation (EC) No 1406/2002.

* as amended by Directive 2009/123/EC of 21 October 2009

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Service Overview

- CleanSeaNet is The European satellite **oil pollution and vessel detection** and monitoring system
- Linked into national/regional response chain strengthening operational pollution surveillance and response for deliberate and accidental spills.





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Service Overview

Operational use of CleanSeaNet

Routine monitoring of all European waters looking for illegal discharges :

- Detection of possible spills
- Detection of vessels
- Identification of polluters by combining CleanSeaNet and Vessel traffic information available through SafeSeaNet

Supporting enforcement actions by the Coastal States

- On site verification and follow-up
- Inspection of suspected vessels in the next port of call

Supporting response operations to accidental pollution

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Service Overview

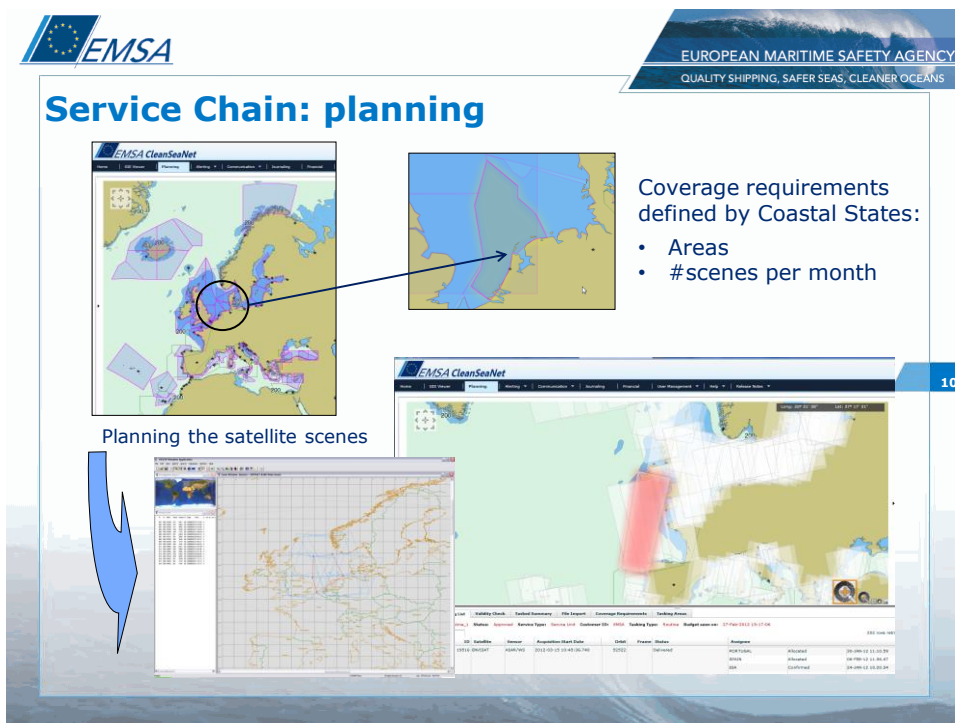
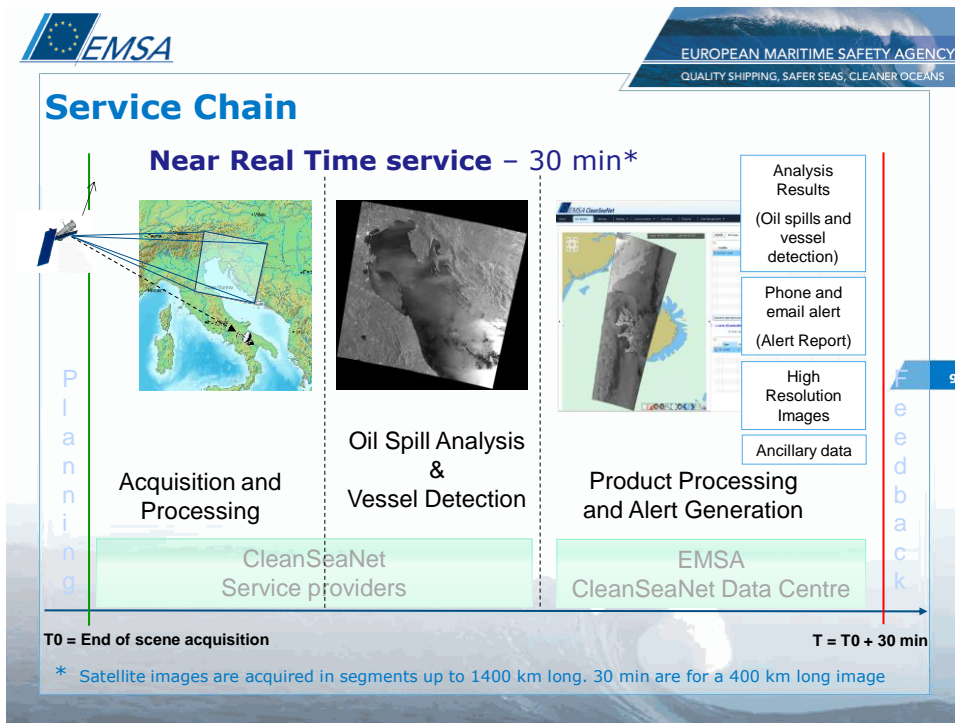
CleanSeaNet Fact Sheet

- Based on the analysis of Synthetic Aperture Radar (SAR) satellite images.
- Operational since April 2007
- 2.100 analysed satellite images per year
- 26 countries (22 EU coastal states, Iceland, Norway, Croatia, and Turkey) - over 400 users
- Complete service chain from the collection of coverage requirements to the provision of operational results.
- Distributed Service-Network approach via regional service providers (acquiring and processing satellite data)
- NRT: 30 minutes* end product delivery
- Alert passed to response authorities (Coast Guard, Customs, Navy, ...)

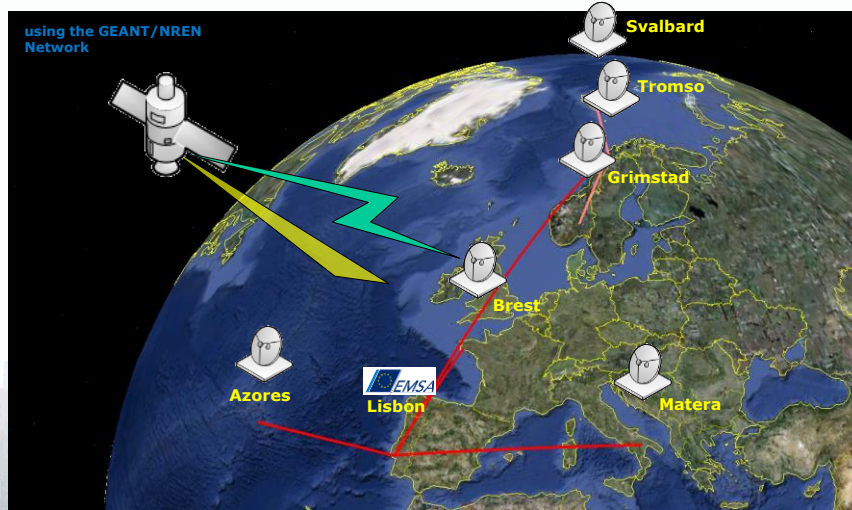
* Satellite images are acquired in segments up to 1400 km long. 30 min are for a 400 km long image

Service Chain: architecture





Service Chain: network of ground stations



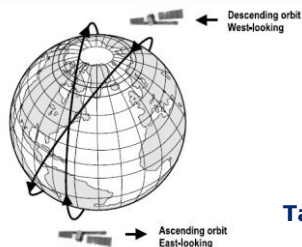
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Service Chain: spatial coverage



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Service Chain: SAR satellite and products



CONTRACTED SATELLITES:

- ENVISAT (01/03/2002- OVER NOW)
- RADARSAT 1 (04/11/1995*- OVER NOW)
- RADARSAT 2 (14/12/2007*)
- COSMOSKYMED (Jun. 2007 to Nov. 2010)

Table of main products used in CSN:

SATELLITE	PRODUCT IDENTIFICATION	Description	Resolution (Range x Azimuth, meters)	Spacing (Pixel x Line, meters)	Swath (Km)
ENVISAT	ASA_WSM_1P	Wide Swath Mode medium-resolution	150 x 150	75 x 75	405
RADARSAT-1	RS1_SNA	ScanSAR Narrow A	50 x 50	25 x 25	300
RADARSAT-2	RS2_SNA	ScanSAR Narrow	50 x 50	25 x 25	300
RADARSAT-2	RS2_SCW	ScanSAR Wide	100 x 100	50 x 50	500

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Service Chain: CSK Usage in CSN

- COSMO-SkyMed is a constellation of **4 satellites** funded by the Italian Ministry of Research and Ministry of Defense, and conducted by the Italian Space Agency (ASI), intended for both military and civilian use. Orbits of circa 100 minutes.



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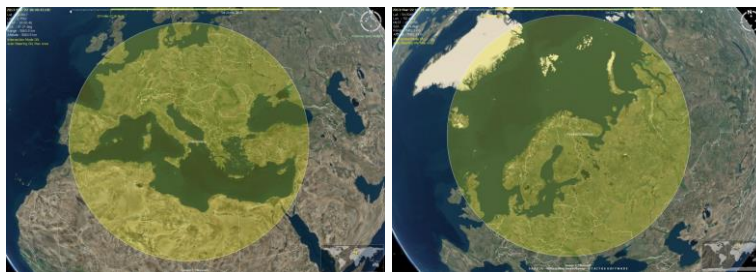
Service Chain: CSK Usage in CSN

- The satellites carry **X-band SAR sensors**, and provide incidence angles and image types which are adequate for oil spill monitoring and vessel detection;
- Timing of acquisitions are similar to Radarsat: around 6:00 AM Local Time for ascending passes and 6:00 PM Local Time for descending;
- With an orbit cycle of 16 days (4 acquisitions with same orbit direction, same look side, same incidence angle) and left and right look capability => **higher revisit capacity** than with Radarsat;
- Our Service Providers now operate 2 stations: in addition to Matera, now agreement with Sodankyla, operated by the Finnish Meteorological Service (FMI):
 - NRT acquisitions on a more vast area for both passes.

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Service Chain: CSK Usage in CSN

Available antennas

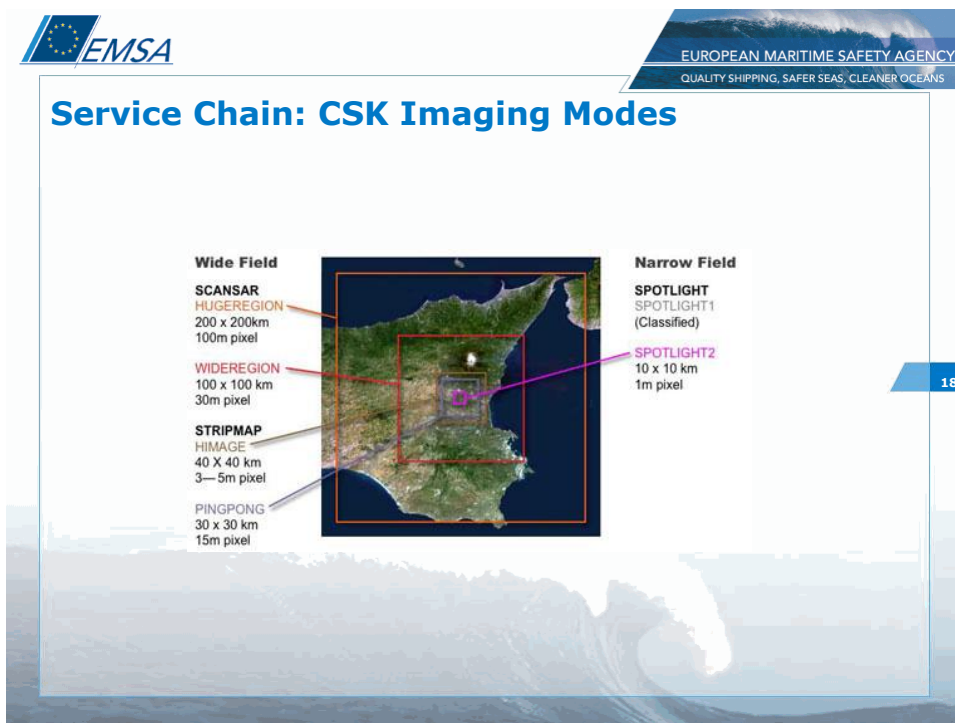
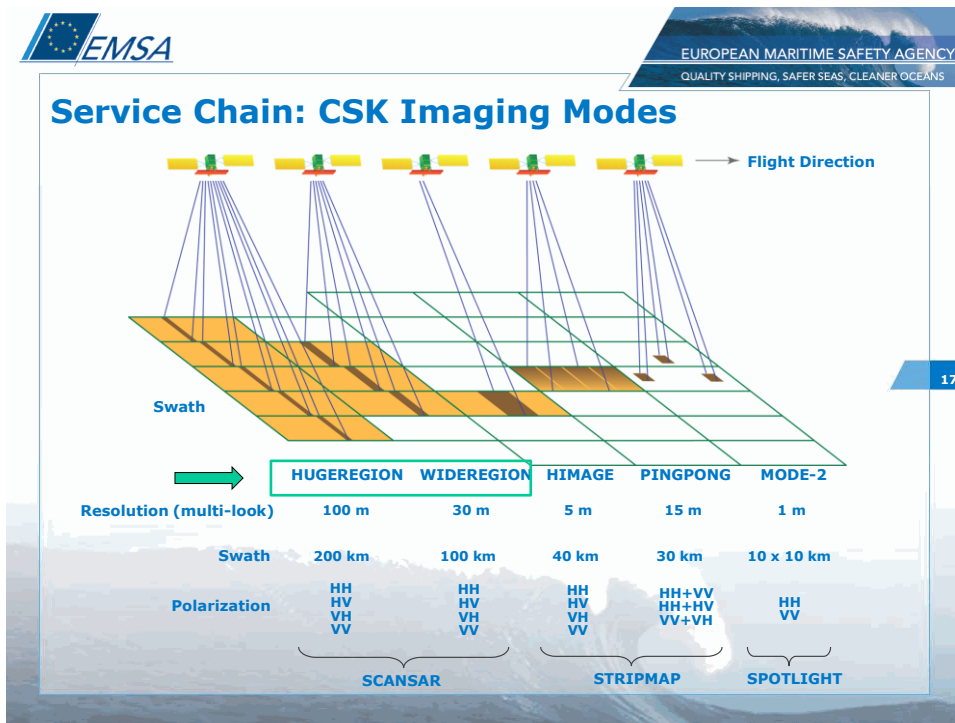


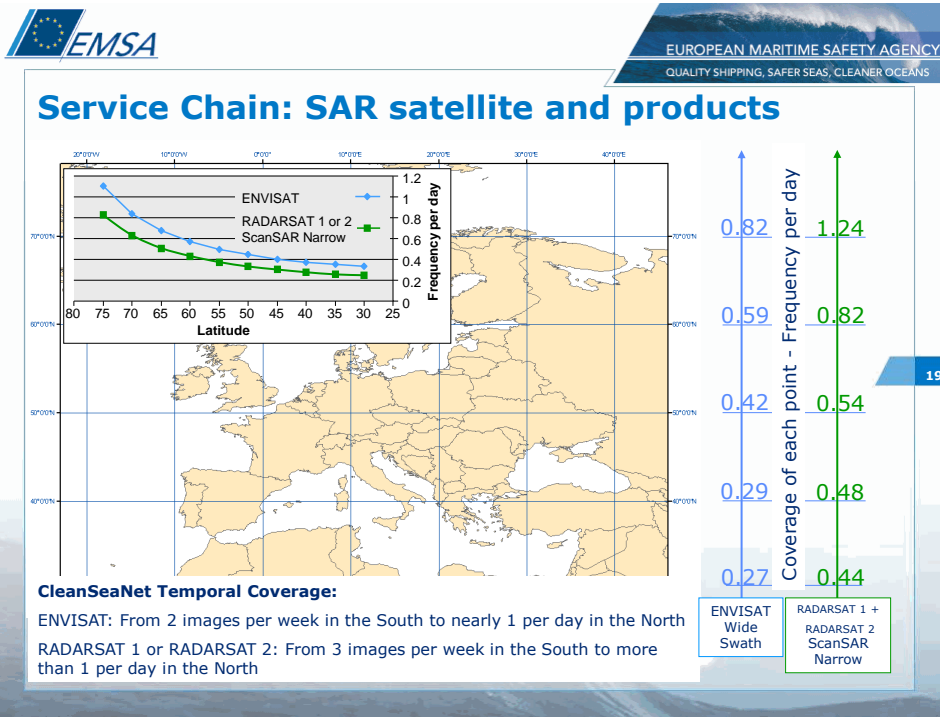
Footprint of the Matera station

Footprint of Sodankyla station

A small extra time (less than 2 minutes for ScanSAR Wide or Huge) for data transfer to Matera, for analysis, is the unique drawback.

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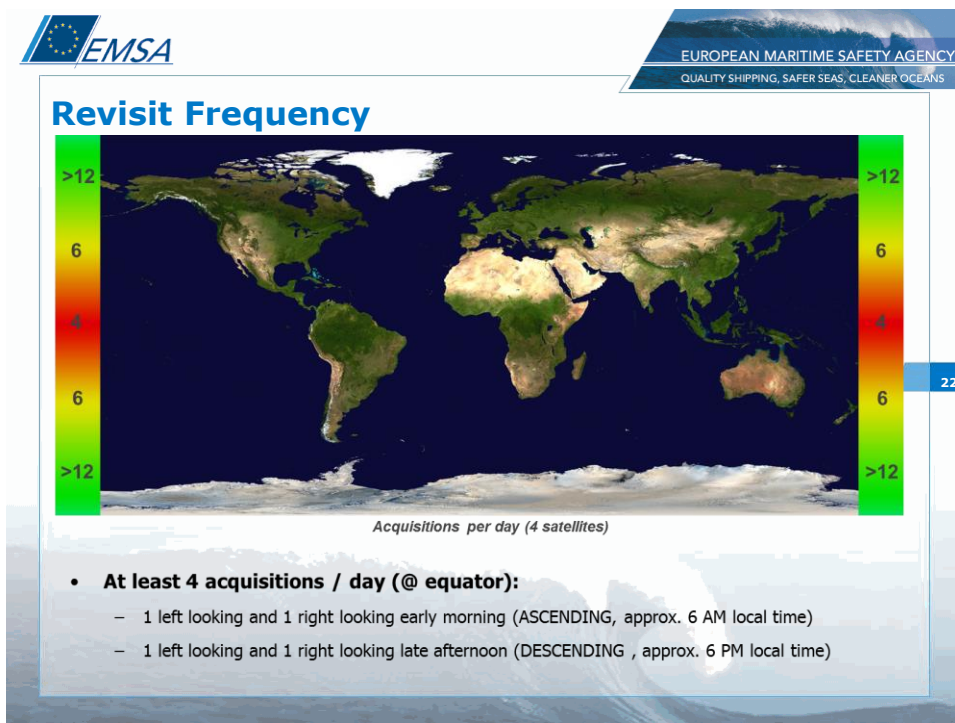
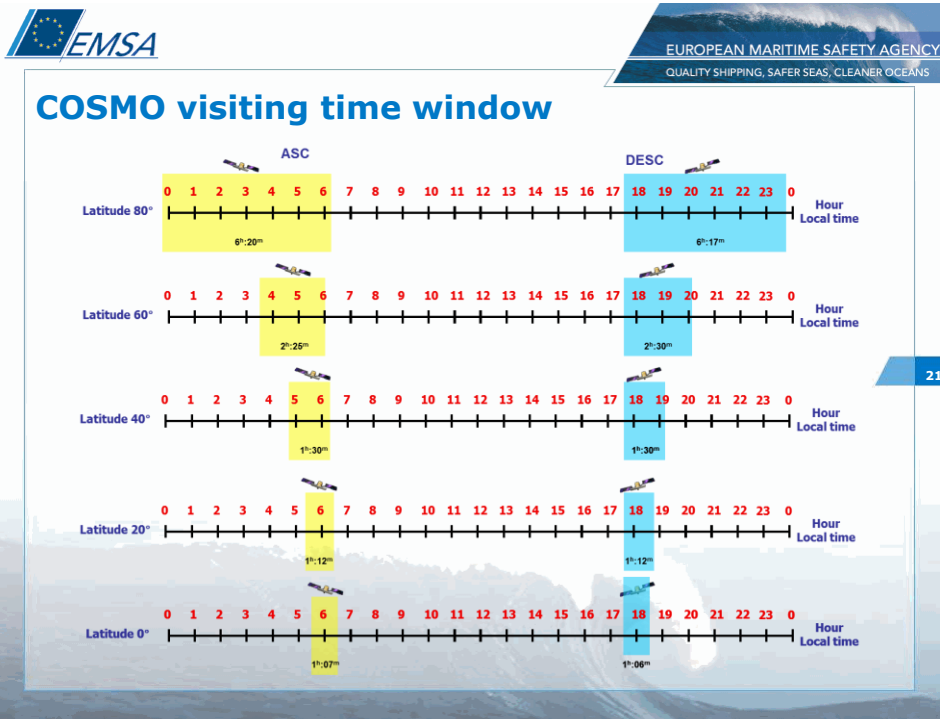




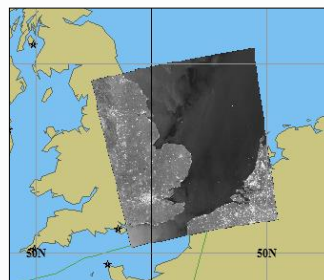
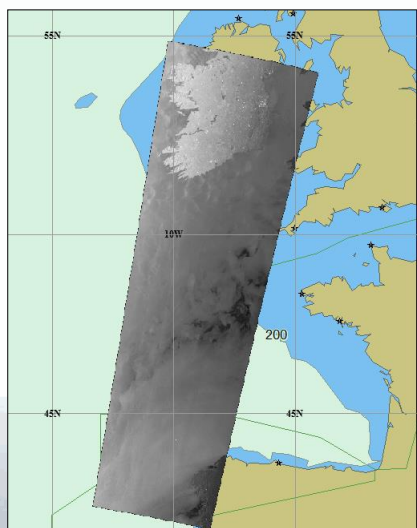
CSK Usage in CSN

In order to **increase the delivery rate**: use new concept of acquisition:

- One acquisition is now = one Data Request
- One Data Request is a group of 1 to 4 Data Take Opportunities (DTO's)
- This implies that instead of a fixed acquisition time, we have a time window, which can be of 20 to 60 minutes
- However, it is known with some hours of advance, which from the possible DTO's will be acquired.
- The difference in area of the footprints between the DTO's in one Data Request is not too large.
- Using this concept, high delivery rates (over 90% could be expected, according to the Service Provider experience so far)



Service Chain: SAR satellite and products



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The service allows the use of segments of variable length up to 1400 km long

Service Chain: acquisition and processing

— Acquisition is normally done by direct real-time downlink when the satellite passes through the Ground Station Mask.

— The main aim of the processing is to make the raw radar data into a usable image with adequate resolution, by applying heavy digital processing and a number of corrections;

— The final format is called Level1b or Native1



Raw data

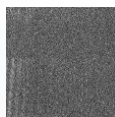


Image after range compression and range migration correction

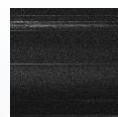


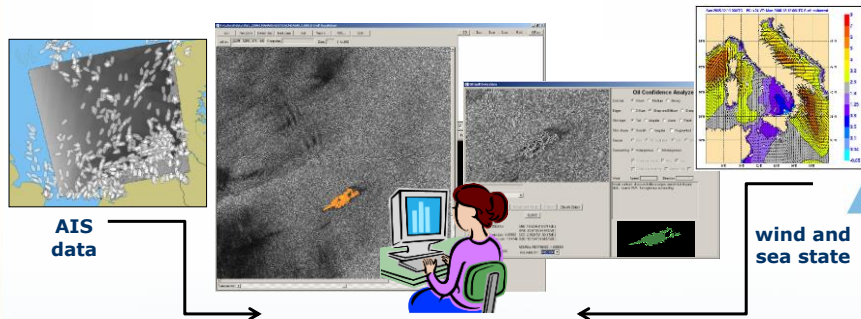
Image after azimuth compression



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Service Chain: oil spill analysis



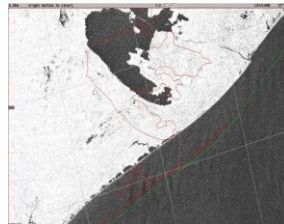
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- Service Providers (SP) Operators, supported by SW tools, manually inspect the images in NRT
- Use AIS data, wind and sea state information and other ancillary information like bathymetry, platforms and wrecks layers, etc

Service Chain: oil spill analysis

When inspecting the image SP operators:

1. In case the image is geographically displaced, correct the position deviation
 - This happens due to the fact that in NRT the orbit parameters of the images are not known in NRT with precision
2. Look for **ongoing discharges** and report them immediately for catching polluter "red-handed"
3. Proceed to **detailed analysis of the full image** and whenever an oil spill is detected:
 - Characterize the spill: position, shape (polygon), area, length
 - Set the confidence level of the detection: Class A (higher confidence) or Class B (lower confidence)
 - Identify possible polluters
 - Assess image quality



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Service Chain: polluter identification

What additional information can we have about vessels?

- LRIT
- AIS /SAT-AIS
- VDS
- SAR detections

In CleanSeaNet, AIS from SafeSeaNet is used for polluter identification

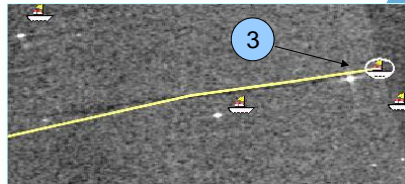
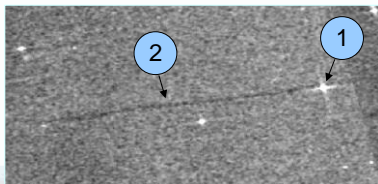
AIS:

- Anti-collision system
- Mandatory for all passenger ships, ships over 500 gross tonnes, ships over 300 gross tones in international trips, fishing vessels over 15 metres (2014).
Based on GPS and VHF
Position is broadcasted
- Positions reported at least every 6 minutes

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Service Chain: polluter identification

- Ship detected on SAR image (Bright Spot) ①
- Possible spill matches the track of the vessel ②
- Vessel identified using AIS information ③



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Remark: Similar vessels in vicinity at similar course and speed => not a wake

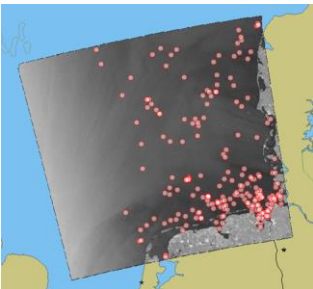
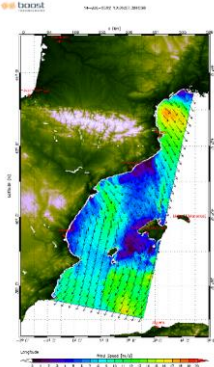


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Service Chain: Vessel Detection and SAR wind/sea state

SP Operators also monitor the automatic generation of vessel detection and SAR extracted wind/sea state information

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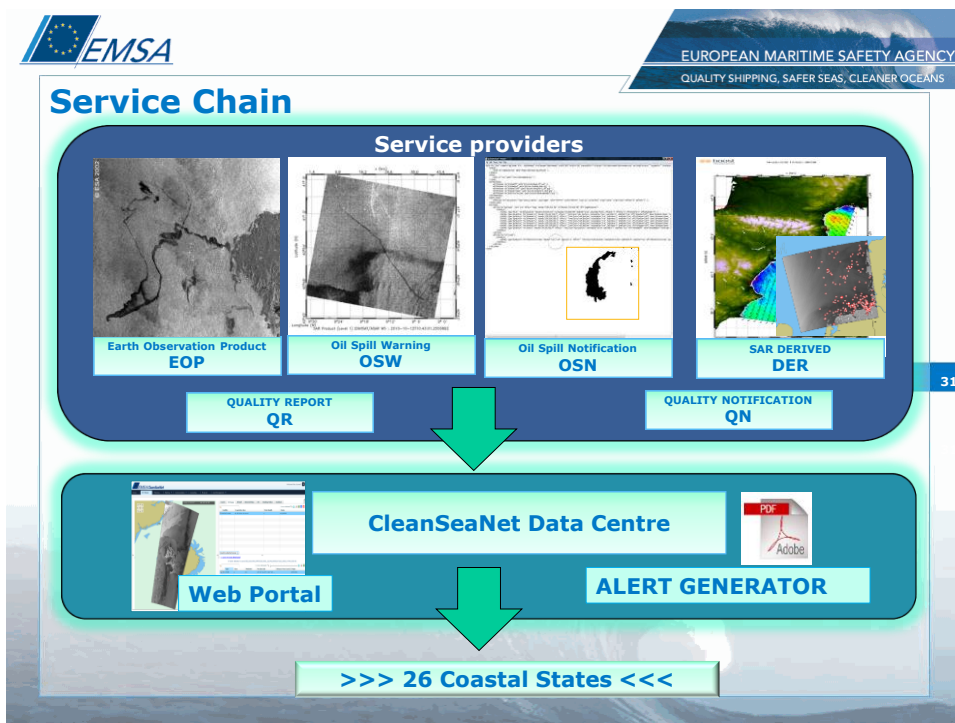
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Service Chain

- As a result of the analysis, SP deliver a number of products to the CleanSeaNet Data Centre;
- The products are grouped into packages;
- There are 6 different package types;
- Packages typically contain files in *xml* format, and images;
- The timeline for package deliver depends on the package type, as well as on the image length:
 - Longer segments -> less stringent time requirements

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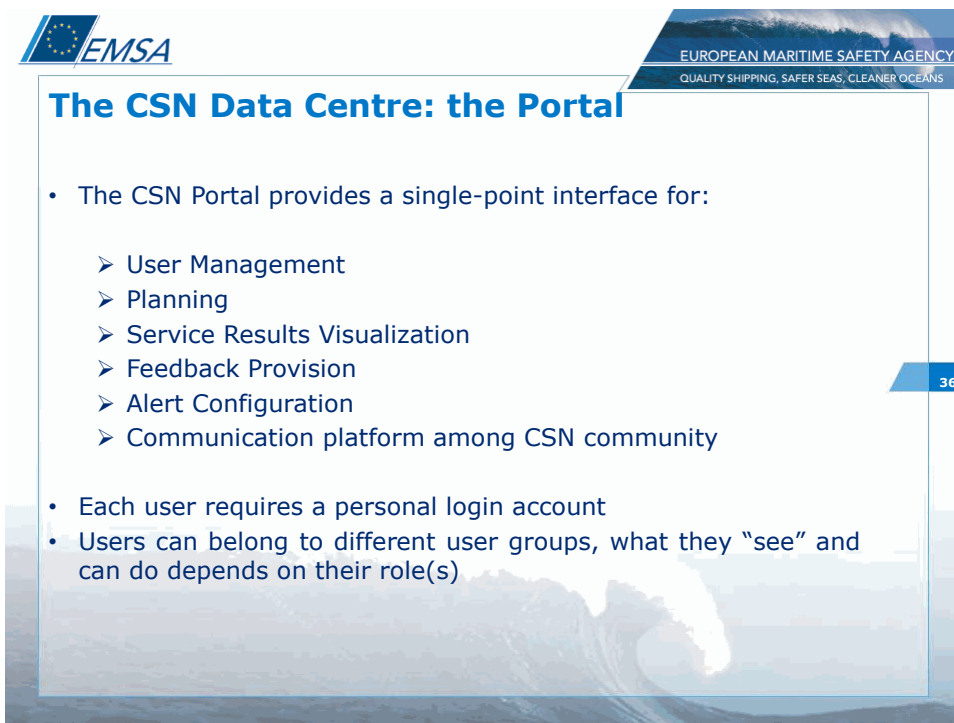
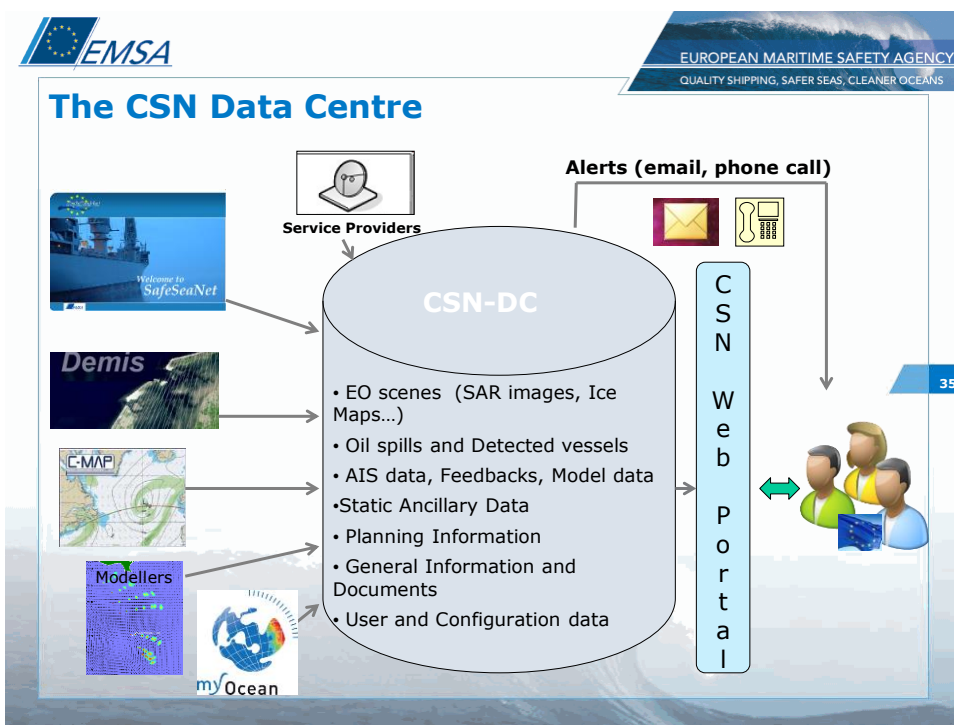
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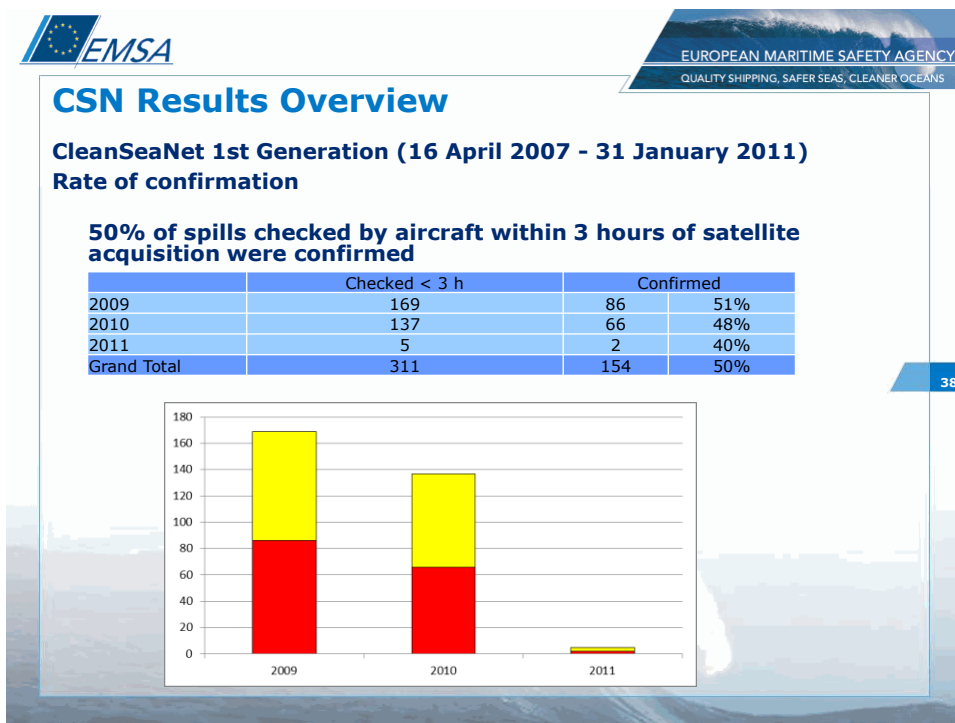
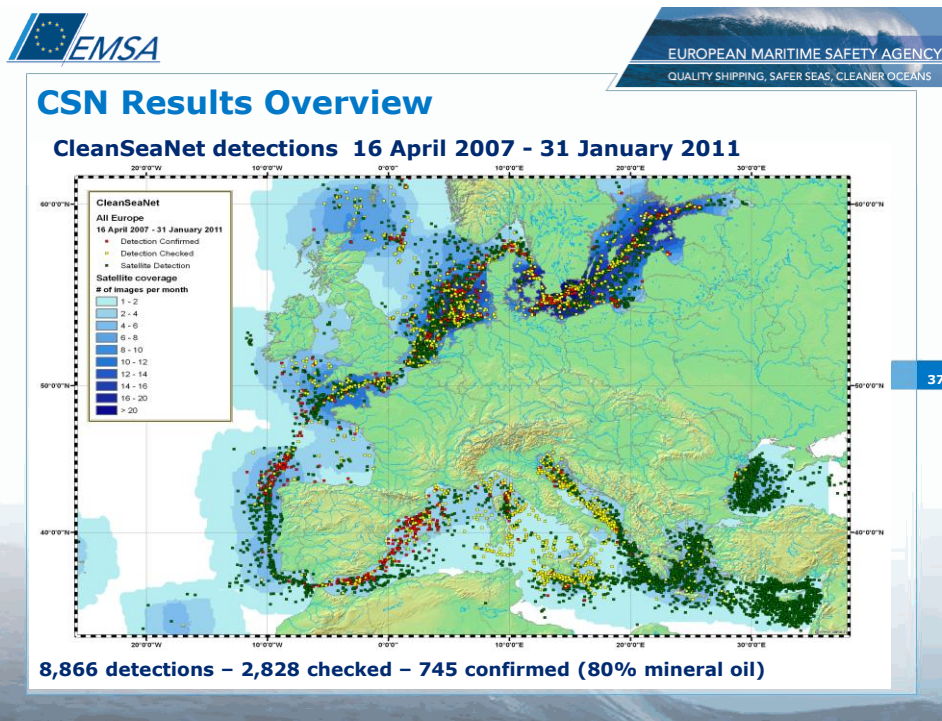
The CSN Data Centre

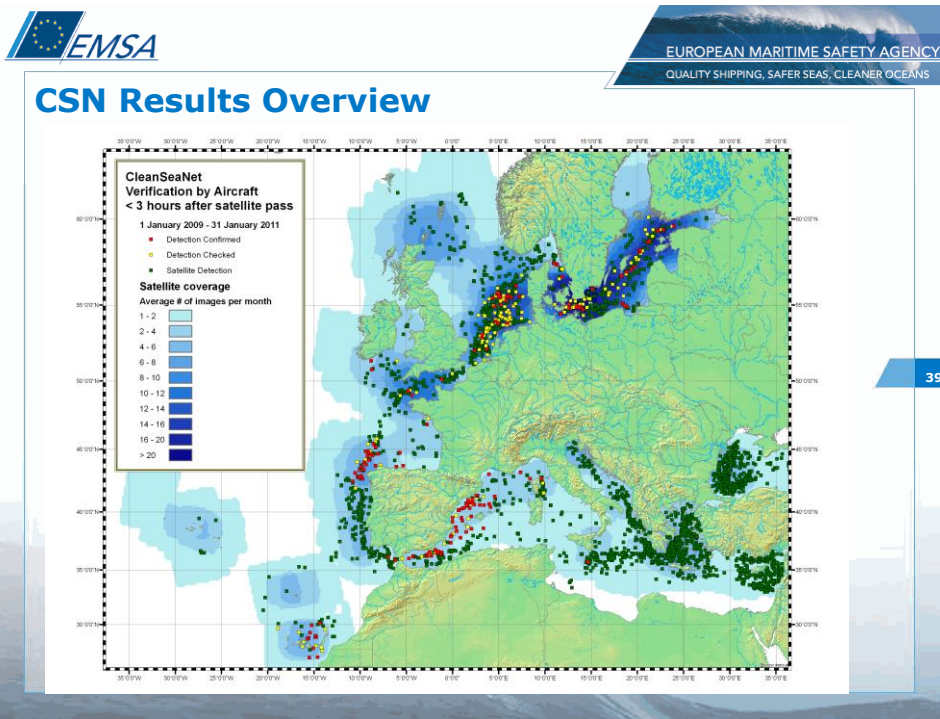
- The **CSN Data Centre** (DC) is the core of the service and is hosted at EMSA premises
- Central element for data reception, management, storage, archiving, fusion and dissemination to the users
- Currently, we have CSN DC release version 1.4.5
- The service is provided to the end-user by means of:
 - The **CSN Web Portal** at:
<https://csndc.emsa.europa.eu/group/cleanseanet/homepage>
 - Alert phone calls** performed by EMSA 24/7 MSS Duty Officers (optional)
 - Alert emails** containing pdf documents, the alert reports

IMPORTANT: Portal and Alerting are independent mechanisms; it is possible for example to have the Portal unavailable and still receive the alert emails

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CleanSeaNet Emergency Assistance

- EMSA provides support in the case of oil spill emergency upon request of:
 - National Maritime Administrations;
 - EC Monitoring and Information Centre of DG ECHO (MIC).
- Satellite images are provided via:
 - CleanSeaNet emergency ordering;
 - International Charter for Space and Major Disasters.
- In case the Charter is activated by the MIC, EMSA acts as Project Manager co-ordinating the provision of satellite images to National Administrations.

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Using CSN

CleanSeaNet Conditions of Use

Obligations regarding follow-up, verification and **feedback**:

4.7 The Participating State will ensure follow-up on CleanSeaNet detections and verify spills as extensively as possible. Therefore, the Participating State will take the coordinated satellite monitoring schedule into account for the planning of national or regional response, monitoring and surveillance resources (e.g. aircrafts, vessels).

4.8 As feedback is essential for monitoring quality and improving service reliability, the Participating State will provide information regarding verification of possible oil spills reported by CleanSeaNet.

4.9 The Participating State will provide information on observed spills that, although visible on the satellite image, were not reported by CleanSeaNet. In addition, the Participating State may provide information to the system on other spills detected by any surveillance means.

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Specific data access conditions

6.1 Some CleanSeaNet products available via the CleanSeaNet User Portal are subject to special "End User Licence" conditions and/or restricted "Access Rights" which have to be followed by the Participating State.

6.2 Special end users licence conditions and access rights policy for CleanSeaNet products currently available in CleanSeaNet are published on the CleanSeaNet User Portal.

Using CSN

Entry point at EMSA:

for problems with a specific service, during operational activities, please contact EMSA 24/7 MSS Duty Officers by email or phone:

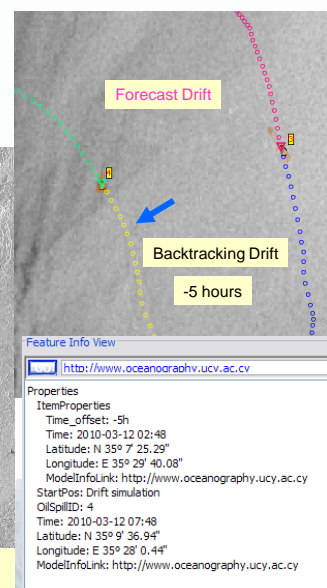
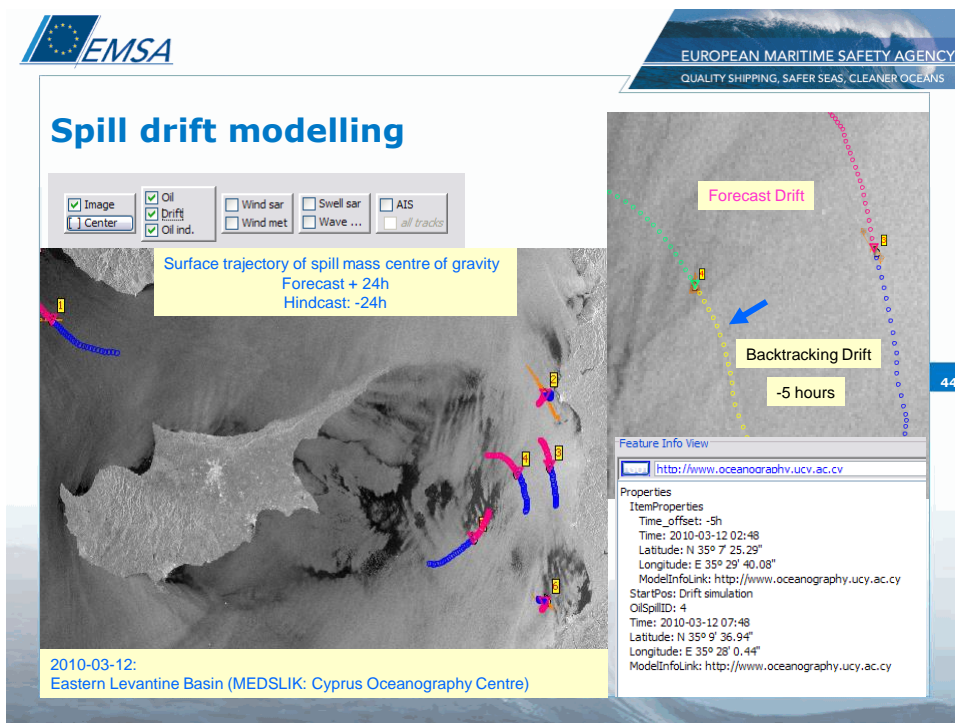
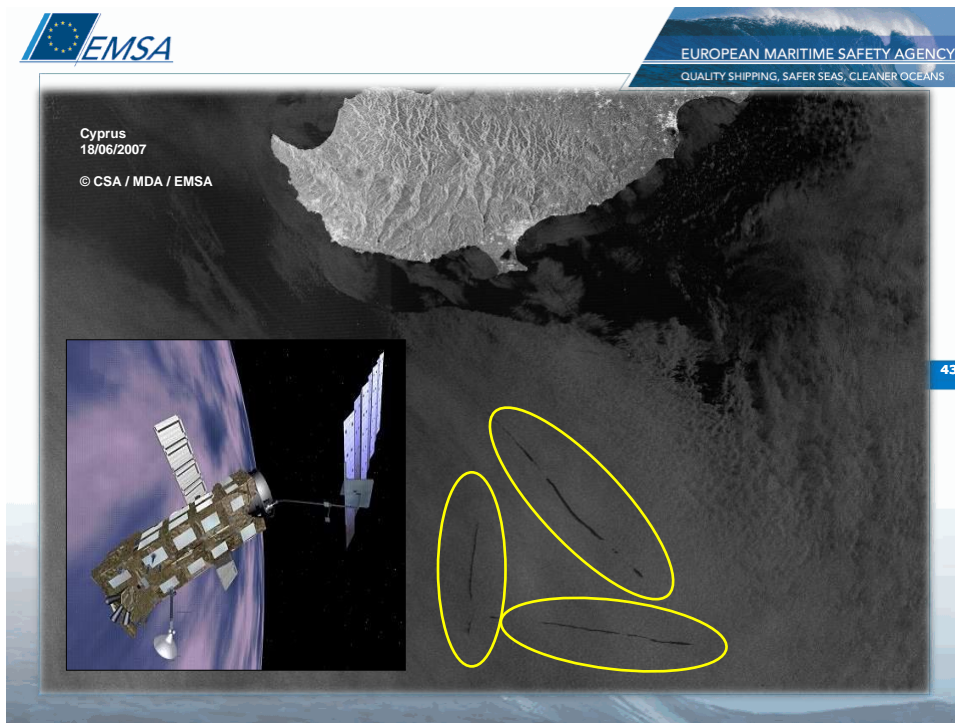
MaritimeSupportServices@emsa.europa.eu

+351 21 1209 415

For general support, quality issues, information, issue reporting or features request:

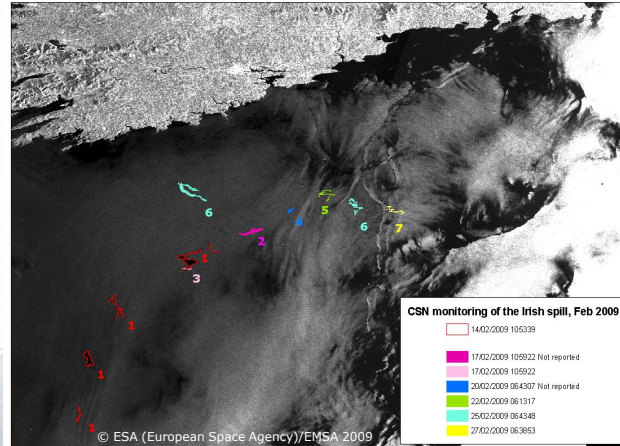
Satellite.Coordinators@emsa.europa.eu

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Monitoring the spill in Irish waters - February 2009

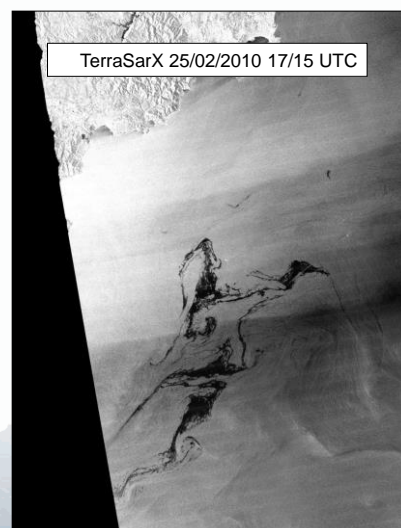
- CSN alert on four possible oil slicks sent to Irish Coast Guard and to MCA on 14/02/09
- Mineral oil spill (at least 300m³ of heavy fuel oil) confirmed by aerial surveillance
- Spill was due to failure during refueling at sea operation involving Russian Navy vessels
- 7 satellite images acquired over the area
- Oil still visible on 27/02/2009



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Access to other sensors via GMES for emergency support

- **CosmoSkyMed**
- **TerraSarX**
- **Medium and High resolution Imagery**



Example: support to French authorities in February 2010:

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