

QUALITY SHIPPING, SAFER SEAS, CLEANER OCEANS

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CleanSeaNet: "The New Generation"

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Background

European Maritime Safety Agency

- Post Erika (December 1999)
- 2002: EMSA established (Regulation 1406/2002)
- Extended mandate after *Prestige* sinks off Galicia, Spain November, 2002:

Directive 2005/35/EC states

that EMSA shall: 'work with the Member States in providing technical assistance in actions such as tracing discharges by satellite monitoring and surveillance';



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Contents

- Overview of the CleanSeaNet service
- The "New Generation" system
 - The Alert system
 - The Web Portal
- Examples from the service



CleanSeaNet

- The European satellite based oil and vessel detection operational service
- Provides routine monitoring of all European waters, supporting the identification of polluters by combining information from SAR images and Vessel traffic information available through SafeSeaNet
- Linked into national/regional response chains, strengths the surveillance and response to deliberate and accidental spills.











CleanSeaNet Fact Sheet

- CSN operational since April 2007
- Since 1 February 2011 -> "CSN New Generation", hosted at the Agency
- 2.100 analysed satellite images per year
- 26 countries (22 EU coastal states, Iceland, Norway, Croatia, and Turkey)
- NRT: 30 minutes end product delivery;
- Alert passed to response authorities (ex: Coast Guard, Navy)
- Service free of charge but by signing the Conditions Of Use, CS accept to:
 - a) "provide information (feedback) regarding verification of possible oil spills reported by CleanSeaNet and ensure follow-up"
 - b) "provide information on spills that were not reported"

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CleanSeaNet Coverage Density: 16/04/2007 – 31/01/2011





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CleanSeaNet detections: 16/04/2007 - 31/01/2011





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CleanSeaNet Rate of Confirmation

- Spills weather out rapidly => TIME IS CRITICAL
- Timely Use of Aerial Surveillance essential for:
 - Catching polluters in the act
 - Collecting on-site actionable evidence
- Evidence can be collected ON SITE AND/OR IN PORT





CleanSeaNet Rate of Confirmation: 16/04/2007 – 31/01/2011

50% of spills checked by aircraft within 3 hours of satellite acquisition were confirmed

	Checked < 3 h	Con	firmed
2009	169	86	51%
2010	137	66	48%
2011	5	2	40%
Grand Total	311	154	50%



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CleanSeaNet Detection trends

Trend: global reduction in the number of possible spills per image

	2007	2008	2009	2010	2011	Total
Number of detections	1590	3311	2106	1766	2141	10914
Average per image	1.22	1.38	1.00	0.75	N/A	
Average per 1,000 Km x 1,000 Km square	N/A	10.77	7.61	5.68	5.08	

Average number of detections per image indicator substituted by number of detections per million Km² Indicator not anymore dependent of image size



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CleanSeaNet : Near Real Time service - 30 min*



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



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CleanSeaNet : Near Real Time service





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CleanSeaNet Spatial Coverage



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CSN service architecture in "New Generation"





Oil Slick Detection in SAR images

- Radar signal emitted by SAR systems is bounced back by sea ripples created by the wind
- SAR sensor measures the level of the backscattered signal
- Oily films
 - smooth the sea surface
 - reduce the backscattered signal
 - appear as darker areas
- Detection Capability depends, among other factors, on wind speed
- High number of phenomena create similar signatures: Lookalikes





SAR satellite and SAR products used in CSN



CONTRACTED SATELLITES:

- ENVISAT (01/03/2002*)
- RADARSAT 1 (04/11/1995*)
- RADARSAT 2 (14/12/2007*)

Table of main products used in CSN:

Area Resolution Spacing Coverage PRODUCT (Range x SATELLITE Description (Pixel x Line, (Range x **IDENTIFICATION** Azimuth, meters) Azimuth, meters) Km) Wide Swath Mode medium-ASA_WSM_1P **ENVISAT** 150 x 150 75 x 75 405 x 405 resolution RADARSAT-1 RS1 SNA ScanSAR Narrow A 50 x 50 25 x 25 300 x 300 RADARSAT-2 RS2 SNA ScanSAR Narrow 50×50 25 x 25 300 x 300 **RADARSAT-2** RS2 SCW ScanSAR Wide 100 x 100 50 x 50 500 x 500

* Launch dates

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SAR satellite and SAR products planned for the future

COSMO-SkyMed: ScanSAR Huge: Swath ~200 Km, Res: 100x100 m ScanSAR WIDE: Swath ~ 100.x 100. Km, Res: 30x30. m

TerraSAR-X SentineI-1: ExtraWide Swath VV and the need of updating the observation scenario on a 6-9 months



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Products delivered by CleanSeaNet

- Satellite images in **Full resolution**
- **Oil spill detection** (shapefiles) and **alert reports**: 30 minutes for 400km length, increasing 5 minutes per extra 200 km
- Immediate reporting of on-going spills for catching polluter 'redhanded' -> Oil Spill Warning: 20 minutes for 400 km length, increasing 5 minutes per extra 200 km
- Vessel detection information
- Possible polluter Identification
 - AIS information via EMSA SafeSeaNet service
- Electronic Nautical Charts
- Ancillary data:
 - meteorological wind and wave data,
 - SAR derived wind and swell data



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Identification of Discharging Vessels

AIS information from SafeSeaNet overlaid on SAR images



SafeSeaNet Figures

727 AIS coastal stations

2.326 data providers and 556 authorized users in 22 EU coastal states, Norway and Iceland

20.000 ships tracked in European waters: average of over 100.000.000 AIS positions per month



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Service Chain: planning





Coverage requirements defined by Coastal States:

- Areas
- #scenes per month





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Service Chain: oil spill analysis



- 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
- Correct the position deviation; analyse of the full image, characterizing the spills: position, shape (polygon), area, length; set the confidence level of the detection: Class A (higher confidence) or Class B (lower confidence);Identify possible polluters



Service Chain: Vessel Detection and SAR wind/sea state





SP Operators also monitor the vessel detection and SAR extracted wind/sea state information generation As a result of the analysis, SP deliver a number of products to the CleanSeaNet Data Centre;



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Service Chain





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Welcome

CSN Web Portal

https://csndc.emsa.europa.eu/group/cleanseanet/homepage

EMSA CleanSeaNet

Welcome to CSNDC Public Community

Welcome to CleanSeaNet 2nd generation



CleanSeaNet is the Near Real Time European satellite based **oil spill monitoring** and **vessel detection** service, set up and operated by the EMSA since April 2007. The service provides aggregated products on possible oil spill's, pollution alerts and related information to the operational maritime administrations within 30 min. after satellite acquisition to allow an effective use of the data for follow up activities. The information is visualised by a specific web application supplemented by a day-to-day operational support by the Agency. With vessel traffic information being available in CleanSeaNet, the service is able to detect and identify vessels that are discharging. CleanSeaNet is a recognised <u>GMES</u> service. Find more information on CleanSeaNet <u>here</u>.

CleanSeaNet services

A distributed network of CleanSeaNet services providers process and analyse images on a routine basis from ENVISAT, RADARSAT 1 and 2 and in future from the SENTINEL-1 satellite.

Service timeliness and quality control is an incentive to guarantee best service. CleanSeaNet has the capacity to acquire image segments from 200 km long up to 1400 km with a nominal "Near Real Time" performance of 30 minutes for a 400 km long acquisition.

Based on rules decided by the Member States, CleanSeaNet disseminates specific alerts to the national users; the alert level is defined for each spill by combining likelihood information, culprit information and impact information.

When a recent or ongoing spill is detected with a potential source connected to it or in its vicinity, the relevant authorities in are informed immediately. CleanSeaNet combines the oil spill detections with vessel information from <u>SafeSeaNet</u> and backtracking models from national and regional centers to help identify the source of pollution.

The CleanSeaNet Data Centre

The CleanSeaNet Data Centre (CSN-DC) is the core system to receive, manage, distribute and visualize the data products of the CleanSeaNet service: oil spill and vessel detection data, new satellite missions on an ad-hoc basis, Electronic Nautical Charts (ENC) and additional information layers - also provided by the user community.

The CSN-DC provides a single user interface (GIS viewer)

· for web based image planning and allocation by the Member States,

for accession images and the analysis results



The CSN Data Centre: the Portal

- The CSN Portal provides a single-point interface for:
 - User Management
 - Planning and Ordering
 - Service Results Visualization and Feedback Provision
 - Alert Configuration: report content and recipients, alert levels
 - Communication platform among CSN community
 - Product Subscription



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CSN Web Portal



Important features:

- Different means of data distribution: ftp transfer, download of high resolution SAR image (GeoTIFF) and oil polygon (shapefile)
- Variable length image segments
- Integration of Meteo Oceanographic data from MyOcean data provider: Chlorophyll, SST, Sea ice, Currents

Compliant with Open Geospatial Consortium 27
 (OGC) standards





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Alerting principles

- Coastal States must be alerted when a possible spill is detected in their alerting area:
 - Immediately without waiting the end of image analysis if ongoing or recent spill detected with a possibility to catch a polluter in the act: Oil Spill Warning
 - Within NRT delays for other spills: full Alert report containing all spills detected in the alert area
- Coastal States must be notified when no spill is detected in their alert area:
 - Clean Sea Notification sent within NRT delays



Alerting Principles – Alert Areas



For each alert area:

- Coastal States can configure different email recipients and one phone number
- Define specific alert rules



Alerting principles – Oil Spill Centric Approach



Each time a satellite image is covering even partially one national Alert Area, the Coastal State will receive:

- A "CleanSeaNet Alert Report" if at least one spill polygon is intersecting one national Alert Area
- a "CleanSeaNet Notification" of Clean Sea if no spill intersects the national Alert Areas

CS A and CS B will receive an Alert Report CS C will receive a CleanSeaNet Notification CS D will not be alerted



Alert Level of Spills Reported

Based on 3 factors:

Likelihood

- Confidence of the reported spill being oil
- 2 values: classification A or classification B
- Information provided by CleanSeaNet service providers
- Culprit
 - Probability that a clear culprit can be identified
 - Information calculated by CleanSeaNet data centre based on culprit rules defined by Coastal States for each alert area
 - 3 values: High, Medium, or Low
- Impact
 - Level of potential damage to the environment
 - Information calculated by CleanSeaNet data centre based on impact rules defined by Coastal States for each alert area
 - 3 values: High, Medium, or Low



Alert Level of Spills Reported - Culprit

Parameters to define Culprit Alert Rules

- Vessel connected
- Possible Polluter Identified
- Vessel track matches spill's shape
- Distance to TSS, Rigs, Pipelines
- Traffic Density





Alert Level of Spills Reported - Impact

Parameters to define Impact Alert Rules



- Surface area
- Distance to Sensitive Areas
- Distance to Shoreline



Alert Level of Spills Reported

Three Alert Levels: GREEN, YELLOW, and RED calculated by the CleanSeaNet Data Centre via the Alert Matrix

	_			Imp	pact		
		Hi	igh	Med	dium	La	ow.
	Lligh	A		А		А	
	Figh	В		В		В	
Culorit	Madium	A		А		А	
Culprit	Medium	В		В		В	
	Low	A		А		А	
	LOW	В		В		В	

Consequently, if the same spill affects 2 countries, the alert level will be calculated separately based on the alert level configuration of each country.







Spills reported in the Alert report - Example



List of possible spills

Spill #	Spill Identifier	Centre	Position	Area	Length	Width	Alort	Oil Spill	Possible	Source
on map	Spin identitier	Latitude	Longitude	(km²)	(km)	(km)	Alen	Issued	Detected	Identified
1	OS_16203_1	39° 33' 56" N	012° 54' 22" E	12.81	8.718729	1.469035	Green	N/A	Yes	No
2	OS_16203_2	35° 31' 11" N	012° 24' 39" E	29.30	37.16071	0.788332	Green	N/A	Yes	No

Note: Possible spills outside alert area are presented on map as

Additional spills may also have been reported outside the map - Please consult GIS Viewer

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Mail: MaritimeSupportServices@emsa.europa.eu

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Spills reported in the Alert report - Example

	Clea	anSeaNet Aler	t Report		ITA	LY	Ac	quisition:	2011-12	-02 09:18:21 UTC
<u> </u> E/	ISA Scene	ID: 16203	ENVISAT	- ASAR/W	S				List of Spills	GIS Viewer
			Details of possible S	pill n°2 - OS	_16203_2					
Centre	Position	SAR Wind	d at Center	Area	Length	Width	Class	Alert	Number of	Oilspill
Latitude	Longitude	Direction (From)	Speed (m/s)	(km²)	(km)	(km)	(A/B)	Level	slicks	Issued
35° 31' 11" N	012° 24' 39" E	304	2.7	29.30	37.16071	0.788332	В	Green	2	Unkown
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			Possible sour	rce informa	tion					
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EMSA Maritime Su	pport Services 24/7 - Tel.: +	351 21 1209 415 - Fax: +35	1 21 1209 480	м	ail: MaritimeSu	upportServices(@emsa.europ	a.eu	F	Page 4 of 5



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Examples alert reports



List of possible spills

Spill #	Spill Identifier	Centre	Position	Area	Length	Width	Alort	Oil Spill	Possible	Source
on map		Latitude	Longitude	(km²)	(km)	(km)	Alen	Issued	Detected	Identified
1	OS_22517_1	36° 32' 41" N	034° 24' 42" E	1.10	3.551056	0.309767	Red	NO	Yes	Yes
2	OS_22517_2	35° 48' 44" N	031° 08' 04" E	6.74	15.00237	0.449262	Red	NO	Yes	Yes

Note: Possible spills outside alert area are presented on map as

📥 - Additional spills may also have been reported outside the map - Please consult GIS Viewer



Examples alert reports

	Clea	anSeaNet Aler	t Report		TUR	EY	Ac	quisition:	2012-06-	03 03:55:01 UTC
	ISA Scene	ID: 22517	RADARS	AT-2 - SAR	R				List of Spills	GIS Viewer
			Details of possible Sp	oill n°1 - OS	_22517_1					
Centre I	Position	SAR Wind	at Center	Area	Length	Width	Class	Alert	Number of	Oilspill
Latitude	Longitude	Direction (From)	Speed (m/s)	(km²)	(km)	(km)	(A/B)	Level	slicks	Issued
36° 32' 41" N	034° 24' 42" E	45	1.5	1.10	3.551056	0.309767	Α	Red	1	NO
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	36°31		A. A. 200	D ~	\sim		Com	ments fron	n Service Provide	ŗ
RSAT-2 - 20	012-06-03 03:55:46	3	¢.							

Possible source information

N.	Detected	Dist.(Km)	Identified	Туре	IMO	Name	MMSI	C/S	Latitude	Longitude	Time (UTC)	Track
1	Unknown	53.5	Yes	70	7632644	CRYSTAL SUN	514180000	XUDB5	36° 10' 12" N	034° 00' 20" E	03:55:46	N/A

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CleanSeaNet Alert Level





Alert Level defined per Coastal State

			List of pos	sible spill	5					
Spill #	Spill Identifier	Centre	Position	Area	Length	Width	Alort	Oil Spill	Possible	Source
on map	Spin identilier	Latitude	Longitude	(km²)	(km)	(km)	Alen	Issued	Detected	Identified
1	OS_16203_2	35° 31' 11" N	012° 24' 39" E	29.30	37.16071	0.788332	Red	N/A	Yes	No
Note: Pos	sible spills outside alert area are p	presented on map as	Additional	spills may a	lso have be	en reported	d outside the	e map - Ple	ase consult GIS	Viewer

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Same possible spill: Red alert for Malta – Green for Italy



Oil Spill Warning - Example





CSN Web Portal The GISViewer

GES Viewer	Planning	Alerting 👻 Communica	ition 🔻 Journaling	Financial User Ma	inagement 🔻 Help 🔻	Release Notes 👻		
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CSN GISViewer

- Visualisation of the service results and Auxiliary Maritime Data
- Electronic Nautical Charts (ENC) and DEMIS topography layers as possible background maps
- Improved Search capabilities: Possibility to define queries by using for e.g.
 - Geographical criteria
 - Time windows
 - Type of image
- Possible to search for images, oil spills, vessels, feedbacks.





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CSN GISViewer

New layers from servers, if compliant to Open Geospatial Consortium (OGC) standards, can be dynamically added by any user and visualized. However, this requires previous configuration at EMSA side.

Home GIS Viewer	Add an OGC Service to the List X	
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CSN GIS Viewer

Example: Norway datasets with oil and gas installations.



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CSN GIS Viewer Example of available layers after a query to a SAR image in the CSN-DC – MyOcean Ice Map

CSNDC SIBILLA JSP CSNDC SIBILLA JSP



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CSN GIS Viewer

Case 1 - Feedback on spills reported by CleanSeaNet

Type Satellite Acquisition time Total of Image: State Stat	14 rows retrieved & Ita Oispils Satus 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACQUIRED 0 Red/0 Yellow/0 ACHIVED 0 Red/0 Yellow/0 ACHIVED 0 Red/0 Yellow/0 ACHIVED 0 Red/0 Yellow/0 ACHIVED 0 Red/0 Yellow/0 ACHIVED
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	05_094309_000000992104_00022_50194_0001.N1.00000
	/lat) Distance From Coast Origin
	32.04" / 042º 01' DETECTED
	38.52" / 042º 40' DETECTED
	13.80" / 042° 34' DETECTED
	04.80" / 042º 42' DETECTED
	32.04" / 042º 01' DETECTED
	13.80" / 042° 34' DETECTED
	56.52" / 039° 05' DETECTED
VI VIEK B NO 006*3	52.44" / 039° 09'
K V S THER B	



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CSN GIS Viewer

Case 1 - Feedback on spills reported by CleanSeaNet

report the results of an observation on site: Observation form





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CSN GIS Viewer

Case 1 - Feedback on spills reported by CleanSeaNet

report a **possible source** identified by the end user

		Possible Spill Details
1	2 rows retrie	Possible Spill ID 14082_ASA_WSM_1PNACS20111006_201933_000001163107_002 Reported by EMSA
ate	Compiler	Detection date and time 2011-10-06 20:19: Method CleanSeaNet Possible spill position 024° 15' 19.80" N / 037° 44' 11
11/10/10	KOTSIFACOS	
11/10/07	KALE	
		2011/10/12 10:48:34 - asdfasdfasd Add Source V
		Organisation Austria Feedback access rights Public V
		Compiler asdfasdfasd
		<pre><pre><pre><pre><pre><pre><pre><pre></pre></pre></pre></pre></pre></pre></pre></pre>
	_	New Possible Source
		Type Connected Aligned Name IMO# MMSI Confirmed Inspected Follow-up description
		Type Connected Anglied Name 1969 Minut Conninted Inspected Follow of description

Case 2 - Feedback on spills not reported by CleanSeaNet



Example: sandbank confused with oil spills





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Example: wake confused with oil spill





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Example: wake confused with oil spill





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CSN cases: pollution from platforms



Radarsat-2 image acquired 27/03/2012 17:27:57 UTC: 14 oil spills

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CSN cases: pollution from platforms





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CSN cases: pollution from platforms





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CSN cases: polluter identification



SEASAR 2012 – The 4th International Workshop on Advances in SAR Oceanography - 18-22 June – Tromso, Norway



CSN cases: polluter identification



22718_RS2_SWB_20120615: Spain/France



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Thank-you





Monitoring accidental spills: CSN also provides Emergency assistance Example: spill in Irish waters in February 2009

- CSN alert on four possible oil slicks was sent to Irish Coast Guard and to MCA in UK on 14/02/2009
- Aerial surveillance confirmed the mineral oil spill that was at least 300m³
- The heavy fuel oil spill was due to failure in bunkering operation of Russian aircraft carrier Admiral Kuznetsov
- CSN monitored the area and oil was still detected on 27/02/2009



Under the GMES/Data Access Grant, CSN can also provide access to third party mission data



Access to other sensors via GMES for emergency support

- CosmoSkyMed
- TerraSarX
- Medium and High resolution Imagery

Example: support to French authorities in February 2010:

