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European Maritime Safety Agency *CleanSeaNet* Activities in the North Sea

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Abstract

The transport of goods and people both within, and from outside, of the European Union (EU) depends heavily on it seas and oceans, and the ports located on Europe's coasts. The European Maritime Safety Agency (EMSA) plays a significant role in monitoring and protecting those maritime regions of Europe from pollution, and also in areas such as maritime safety and maritime security. Since its establishment in 2002, the role of EMSA has developed so that it offers a broad range of implementation and operational services to the European Commission and to EU Member States. The operational tasks of EMSA include providing a pollution prevention service, for example, and earth observation services using satellite imagery. In particular its *CleanSeaNet* (CSN) Service offers a European satellite-based oil spill and vessel detection service to help identify pollution entering the marine environment from ships in EU waters. This chapter provides an overview of the activities of EMSA in general, and then considers in more detail the CSN Service. It examines data on satellite imagery for the period 2007-2011 for the North Sea region of Europe, and identifies how those images have contributed to monitoring the region to identify oil inputs to the sea.

Keywords

European Maritime Safety Agency, CleanSeaNet, satellite monitoring, oil pollution, North Sea

Contents

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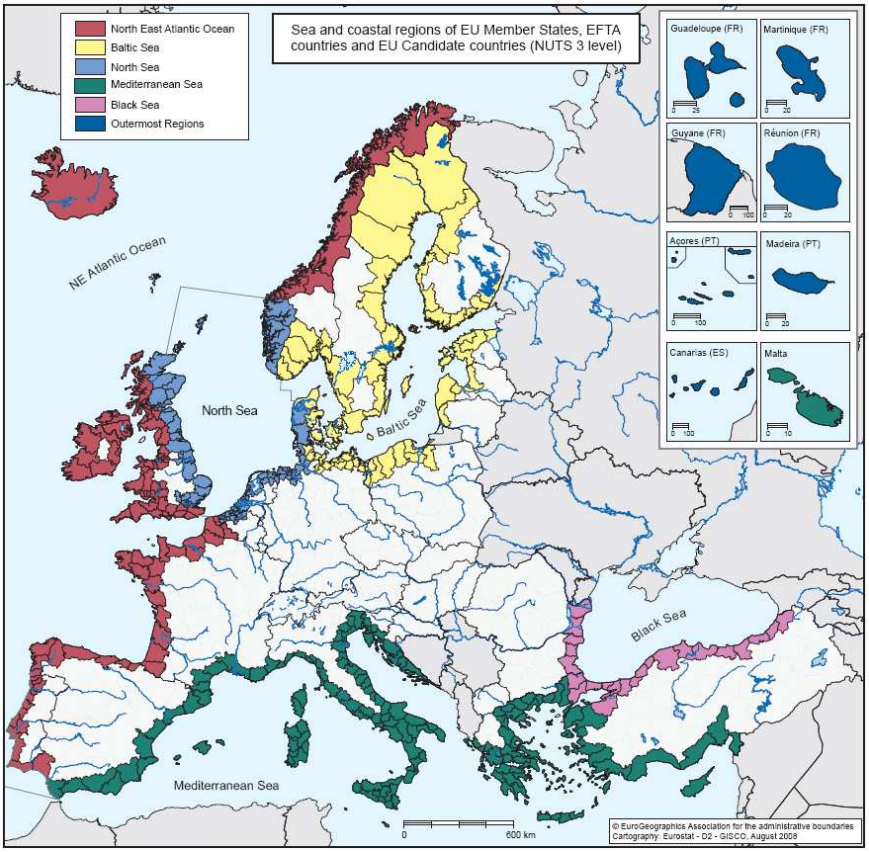
1. Introduction

The seas, oceans and coastal regions of Europe provide a vital link in the transport of goods and people both within the European Union (EU) and globally (see **Fig. 1**). The EU's Member States have over 12,000 commercial ports and over 100,000 kilometres of coastline between them [1]. Very large numbers of ships operate in EU waters and in 2008, for example, 22,752 merchant ships called into European ports and there were over 694,500 movements in ports by ships sailing in EU waters [1].

The European Maritime Safety Agency (EMSA) is the body which facilitates cooperation between EU Member States and the European Commission in a number of areas to monitor and protect Europe's marine environment, and help maintain the safety and security of maritime traffic in the region.

This chapter presents an overview of the history of EMSA and its role in helping to protect Europe's maritime regions. It then briefly outlines some of EMSAs operational activities relating to maritime safety though its Vessel Reporting Service, Integrated Maritime Services and Pollution Response Service. Next it considers in more depth at the EMSA Earth Observation Service, particularly as it relates to marine environmental protection from oil pollution. The chapter then examines EMSA data on oil spills in the North Sea, based on satellite imagery from its *CleanSeaNet* (CSN) Service for the years 2007 to 2011. Finally, some conclusions are presented on the benefits that EMSA *CleanSeaNet* provide to monitoring oil pollution in the region.

Figure 1: Europe's Sea and Coastal Regions



Source: Eurostat (2009), Figure 1 [2]

2. History of the European Maritime Safety Agency

The European Maritime Safety Agency (EMSA) is based in Lisbon. It was established following the sinking of the oil tanker "*Erika"* off the coast of France in December 1999. Following on from that sinking, the European Commission put forward two sets of measures relating to Europe's maritime safety policy. Within three months of the sinking, in March 2000, the Commission adopted its so-called *Erika I* measures through a Communication on the Safety of the Seaborne Oil Trade (COM (2000) 142 final) [3]. That communication included proposals for measures on international standards for ship safety and pollution prevention and a proposal for a Regulation (No. 417/2002) on accelerated phasing-in of double-hulled oil tankers. That Regulation entered into force in February 2002 [4].

In December 2000 the Commission set out a second set of measures on maritime safety, in a Commission Communication known as *Erika II* measures [5]. That communication (COM (2000) 802 final) set out: a Proposal for a Directive on Community monitoring, control and information systems for maritime traffic; a Proposal for a Regulation establishing a compensation fund for oil pollution damage; and, in relation to this Chapter, a Proposal for a Regulation establishing a European Maritime Safety Agency. The objective of the proposed Regulation was to establish a specialised agency, able to provide Member States and the Commission with the necessary technical and scientific support to properly apply community legislation relating to maritime safety, and also able to monitor implementation of that legislation and assess its effectiveness [5].

EMSA was subsequently established in 2002 under Regional (EC) No. 1406/2002 of the European Parliament and of the European Council [6]. Article 1 of that regulation sets out the main purpose of EMSA as being to ensure uniform and effective maritime safety and prevention of pollution from ships operating in EU waters. In order to do so, Article 2 identified that EMSA was to provide objective, reliable and comparable information and data so that Member States could to take steps to improve both maritime safety and prevent marine pollution.

2.1 EMSA Structure

EMSA is managed by an Executive Director whose duties and powers are defined in Article 15 of its establishing Regulation [6]. Those duties include preparation of the EMSA work programme which, after consultation with the European Commission, is submitted to the Administrative Board. Once that work programme is agreed, the Executive Director is responsible for ensuring that all its requirements are properly carried out, and will report annually to the Administrative Board on the work of EMSA.

The Administrative Board of EMSA is led by a Chairperson, selected from among the membership of the Board. That membership is made up of one representative from each of the 28 EU Member States, 4 representatives from the European Commission, 4 non-voting members who are independent professionals in different sectors of the maritime industry with experience of maritime safety and pollution prevention, and 2 non-voting members from Iceland and Norway. The Administrative Board works under a set of Rules of Procedure [7] and supervises the work undertaken by the Agency and the Executive Director. In particular, the Administrative Board adopts the Agency's Work Programme, budget and establishment plans.

The Executive Director is supported by three Heads of Department, a policy advisor, together with communications, accounting and auditing functions. EMSA has 9 units, under 3 departments: Department A: Corporate Services; Department B: Safety and Standards, which covers visits and inspections, ship safety, marine environment and port state control; and Department C: Operations. Department C is responsible for the 4 EMSA Operational Tasks discussed in this Chapter, i.e. its integrated maritime, vessel reporting, earth observation, and pollution response services.

2.2 The developing role of EMSA

In recognition that about 20% of global discharges of wastes and residues to the sea come from shipping the EU, during the late 1990s, developed a Directive on Port Reception Facilities for ship generated waste and cargo residues (published in 2000 as Directive 2000/59/EC, PRF Directive) [8]. That Directive, which entered into force in December 2002, required ports in the EU to put in place adequate reception facilities in place in order to reduce the discharges of ship-generated waste into the sea, especially illegal discharges from ships using EU ports [9]. A large number of EU ports located in the North Sea region already had port reception facilities in place [10], in order to meet the requirements under various Annexes of the MARPOL Convention [11].

One of the earliest responsibilities of EMSA was to assist the European Commission and Member States by: establishing appropriate information and monitoring systems to identify ships that did not deliver their waste according to the PRF Directive; monitoring operational implementation of the Directive; assessing systems applied in Member States; and proposing common criteria for a harmonised EU approach [12]. This role is still ongoing as one of EMSAs Implementation Tasks relating to the marine environment.

Among its Implementation Tasks, EMSA has a role in accident investigation relating to marine casualties and incidents. That includes casualties involving ships such as capsizing, collisions, groundings and strandings, and fire or explosions, for example. It also covers occupational accidents relating to injuries or loss of life of crewmembers, for example.

Other Implementation Tasks of EMSA include: monitoring the functioning of Port State Control operations in EU ports (PSC, see 3.2) under which ships sailing in EU waters and entering its ports are inspected against a range of international standards. EMSA also runs training sessions, workshops and produced training material in areas including maritime surveillance, marine accident investigation, and oil pollution response exercises, for example.

EMSA also has a range of Operational Tasks and these are discussed in sections 3 and 4 of this Chapter.

3. EMSA Operational Tasks

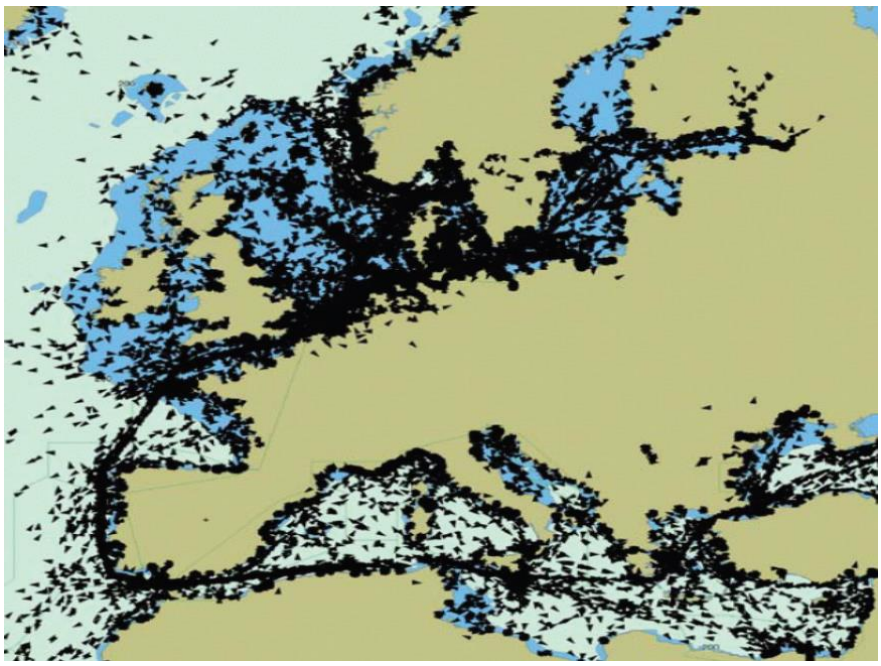
EMSA has a range of Operational Tasks[1] under the headings of Vessel Reporting Services, Earth Observation Services, Integrated Maritime Services, and Pollution Response Services. This section provides an overview of three of these operational tasks, the Vessel Reporting, Integrated Maritime and Pollution Response Services. The activities conducted by EMSA under its Earth Observation Services are discussed in greater detail in Section 4.

[1] For further information on all of the Operational Tasks of EMSA, see: http://emsa.europa.eu/operations.html

3.1 Vessel Reporting Service

One of the operational tasks of EMSA is vessel reporting and, as part of that task, ship movements are monitored under SafeSeaNet (SSN), a network for maritime data exchange across Europe (all EU Member States, Norway and Iceland). SSN uses automatic identification systems (AIS, a maritime broadcast system, based on the transmission of very high frequency radio signals) to track ship movements. It also provides information on ship type, course, speed and destination, together with information on hazardous cargoes being carried by a ship. This contributes to the enhanced safety and efficiency of maritime traffic, helps reduce accidents or potentially dangerous incidents, and can assist with search and rescue activities in Europe's seas and coastal waters. The position of around 17,000 vessels can be located in near-real-time using AIS which transmits a signal from a ship to the various maritime authorities of the EU (see **Fig. 2**).

Figure 2: SSN Vessel Tracking Screenshot



Source: EMSA (2011) [13]

As part of its vessel reporting service, EMSA also facilitates the long-range tracking of vessels, outside the range of coastal AIS systems, through its Long-Range Identification and Tracking System (LRIT). This is a mandatory international system which can track ships around the world.

3.2 Integrated Maritime Services

The European Commission's Integrated Maritime Policy (IMP) set out the need for greater cooperation in policy development and decision making relating to how Europe relates to the seas around it [14]. As a result it identified a number of areas where action should be taken to develop a coherent policy framework. Those areas included a European Maritime Transport Space, a European network for maritime surveillance, and the reduction of CO_2 emissions and pollution by shipping, for example.

EMSA offers a number of services to support the IMP through vessel traffic reporting under SSN and LRIT, satellite monitoring under *CleanSeaNet* (CSN, see section 4) and via Port State Control through its Hybrid European Targeting and Inspection System (Thetis) an information system supporting measures for ships to be inspected in ports[2].

Specific operational activities conducted under the Integrated Maritime Services function of EMSA include: traffic monitoring, search and rescue, pollution monitoring, maritime border control, anti-piracy, fisheries monitoring, and anti-drug trafficking [15].

3.3 Pollution Response Service

In relation to marine pollution preparedness and response, EMSA provides operational assistance and information to Member States though a number of different activities. EMSA has, for example, a network of over 20 stand-by oil spill response vessels and equipment located at various points on the European coastline (see **Fig. 3**), available to deal with oil recovery within 24 hours of an accident [16]. Covering the northern North Sea are two vessels (product tankers) based in Sunderland (UK), each with oil detection systems and carrying sweeping arms, booms and skimmers for oil collection, together with oil storage capacity of over 5,000 m^3 on board. There are also two smaller vessels (hopper dredgers) based in Ostend (Belgium) covering the southern North Sea with similar equipment on board and storage capacity of just over 1,800 and 2,700 m^3 respectively.

The EMSA pollution response service uses CSN information to assist in responding to ship-source pollution (both oil pollution and hazardous and noxious substances). It has, since March 2013, also had a mandate to respond to marine pollution from oil and gas installations [17]. Information relating to chemical spills at sea is provided through the MAR-ICE (Marine Intervention in Chemical Emergencies) Information Service.

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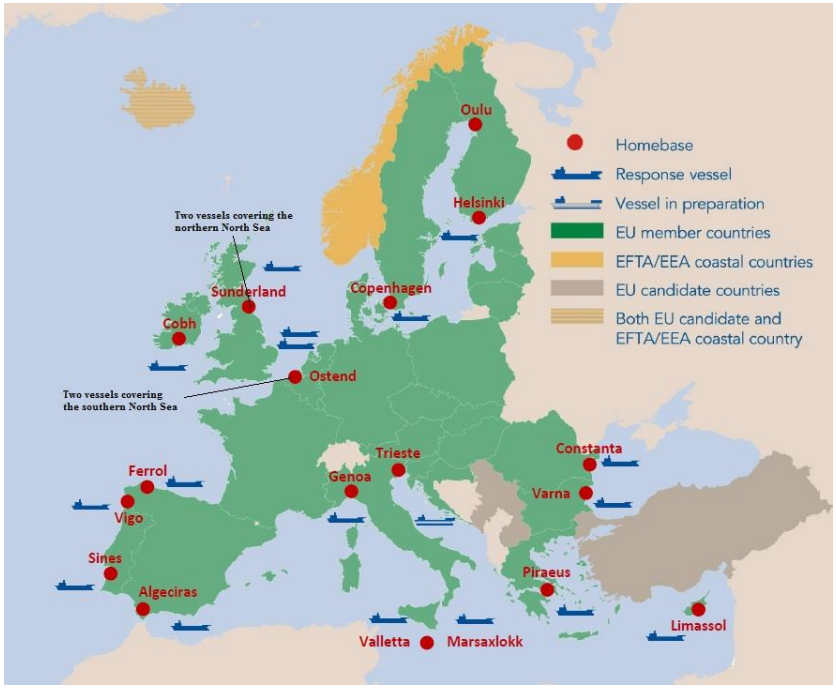
[2] Ships are inspected under the aegis Paris Memorandum of Port State Control to ensure they meet relevant international standards for safety, crew training, and pollution prevention measures, for example. Further information on the Paris MOU is available at: https://www.parismou.org/

Figure 3: Locations of EMSA Oil Spill Response Vessels and Equipment in 2014



Source: EMSA (2014 (a)), page 7 [16].
Note: Map has been adapted to highlight the location of ships covering the North Sea

In relation to technical cooperation on pollution preparedness and response, EMSA also works with international bodies such as the International Maritime Organization (IMO) where it is part of the European Commission delegation to the IMO Marine Environment Protection Committee on Oil Pollution Preparedness, Response and Cooperation – Hazardous and Noxious Substances (MEPC OPRC/HNS) [18]. It also works with regional bodies including the Bonn Agreement (North Sea), Helsinki Commission (HELCOM, Baltic Sea), the Barcelona Convention (Mediterranean Sea) and the Bucharest Convention (Black Sea Commission) [18].

4. EMSA Earth Observation Services

4.1 Integrated Maritime Services Activities

The Earth Observation Services operational task of EMSA is divided into two components. One of these is Earth Observation for Integrated Maritime Services which includes aspects of vessel detection and target activity detection using high resolution radar and optical satellite images. This uses a range of information

sources to identify vessels that might be involved in illegal activities and so it supports EU maritime border control activities under FRONTEX, a system under which the European Borders Agency monitors the EU's external borders, including its sea borders and seaports, and support Member States in responding to the illegal trafficking of migrants, for example [19]. It also supports anti-piracy activities undertaken by EU Naval Forces (EU NAVFOR) in areas around the Horn of Africa, off the coast of Somalia and in the Indian Ocean, for example [20].

4.2 CleanSeaNet Service

CSN is the second element of the Earth Observation Service [21]. CSN a European satellite-based oil spill and vessel detection service and fulfils the requirements of an EU Directive on ship-source pollution dated September 2005 (Directive 2005/35/EC) [22]. Article 10 of that Directive set out specific requirements for EMSA to work with Member States to develop technical solutions and provide technical assistance in areas including: development of information systems for the effective implementation of the Directive; establishment of common practices and guidelines in areas such as monitoring and early identification of ships discharging polluting substances in violation of this Directive, and reliable methods of tracing polluting substances in the sea to a particular ship [22]. This can assist relevant agencies in the identification, and potentially prosecution, of polluters.

A number of satellites and their on-board sensors provide wide-area surveillance across all EU maritime zones, and can also be targeted to monitor specific locations or activities. CSN supplements existing surveillance systems nationally and regionally. In the North Sea, for example, this means CSN satellite data supports the activities of the Bonn Agreement Secretariat which undertakes aerial surveillance in the region, and also makes use of satellite imagery to identify potential oil spills. Images are available from a number of national satellite programmes operated by Norway, Sweden, and a tripartite programme between the UK, Germany and the Netherlands, for example. For further information on how CSN supports the Bonn Agreement and national agencies in monitoring oil pollution in the North Sea region see Chapter X of this volume [23].

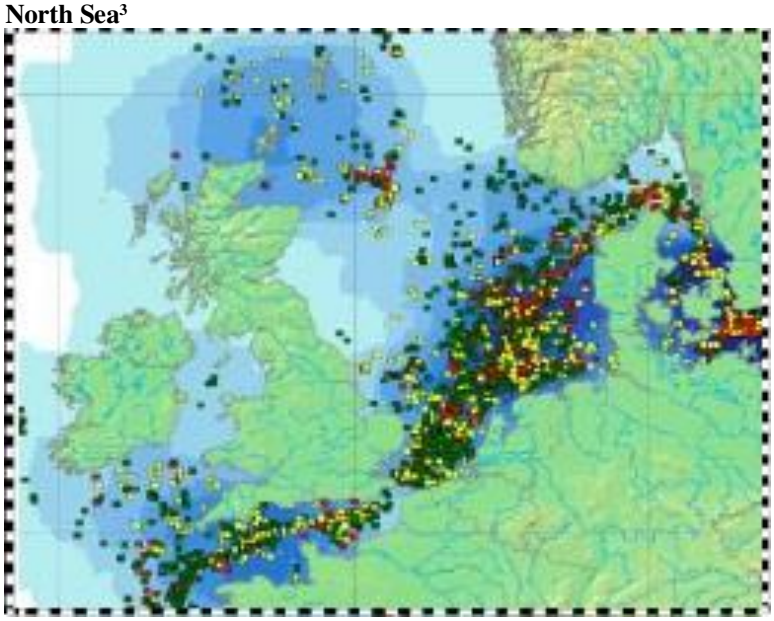
Across the EU, around 2,000 satellite images are analysed each year and, when a possible oil spill is detected, an alert is sent to the relevant country in whose waters it is located. Between 16 April 2007 and 31 January 2011 the CSN First Generation service was based on 3 polar orbiting SAR (synthetic aperture radar) satellites – the European Space Agency's ENVISAT and the Canadian Space Agency's RADARSAT's 1 and 2 [24]. During that period, across the whole of Europe, over 1,000 million km^2 of sea area was monitored and 8,866 possible spills were detected and reported by CSN. 2,828 possible spills were checked on site, 50% of which were checked within 3 hours using aerial surveillance. 80% of spills (over 590 out of 745 spills) were confirmed as being mineral oil; the remaining 20% being confirmed as other substances [24].

The ENVISAT satellite was used until 8 April 2012; RADARSAT1 until 29 March 2013. After those dates there was no more ASAR (advanced synthetic aperture radar) or SAR data from those satellites. RADARSAT-2 satellite images

continue to be used for northern European waters, in conjunction with Member States' own national satellite programmes. EMSA has also, since 2012, obtained some SAR images from the Italian Space Agency's COSMO-SkyMed (CSK) satellites. The use of CSK for routine pollution detection is limited as priority is given to providing images for defence purposes. CSK does, however, provide images for specific surveillance operations and supports response operations in case of accidental spills [24].

Fig. 4 illustrates the CSN satellite coverage for the countries bordering the North Sea. There were 1-2 satellite images per month covering pale blue areas; more than 20 per month in the darkest blue areas. Green squares represent satellite detections, yellow are detections which were checked and red are confirmed detections.

Figure 4: Sea Area Coverage of EMSA CleanSeaNet for countries bodering the North Sea[3]



Source: Adapted from EMSA (2011), page 8 [25]

[3] This figure has been adapted to show the area bordered by North Sea states. For Norway, satellite images extend to the north of the country, into the Barents Sea, for example. For Germany and Denmark, coverage includes their sea areas in the Baltic Sea.

5 EMSA CSN First Generation Data by North Sea State, 2007-2011

This section examines EMSA CSN First Generation data for North Sea states which covers the period 16 April 2007 to 31 January 2011. **Table 1** identifies the number of satellite images acquired via CSN annually [25]

In the case of Denmark, Germany and Sweden, the number of acquisitions included images covering their Baltic Sea regions, while for Norway they also covered the north of the country, including the Barents Sea. For Norway, this means that the CSN data covered the areas of oil and gas production located in both the North Sea and Barents Sea (discussed in Chapter X of this volume [23]).

Table 1: Annual number of image acquisitions for North Sea States, 16 April 2007 – 31 January 2011

Year / Country	2007	2008	2009	2010	2011	Totals by country: 16.04.07-31.01.11
Belgium	86	136	105	107	6	440
Denmark	320	621	581	594	65	2181
Germany	273	497	485	544	56	1855
Netherlands	197	334	264	281	35	1111
Norway	85	383	373	333	44	1218
Sweden	365	628	631	591	42	2257
UK	343	590	508	582	55	2078

In **Table 1**, it should be noted that images ordered by neighbouring countries may have partially covered the area of another country and so counted towards the total of that other country, even though it did not request an image. For example, an image ordered by the UK may have partially covered the area of interest of the Netherlands, and would therefore be included in the Netherlands total.

Table 2 shows the number of satellite detections by North Sea state for the period 16 April 2007 to 31 January 2011 and the average number of spills per image (figure in brackets).

For Denmark, satellite detections were distributed across its entire maritime area of interest, in both the North Sea and the Baltic Sea. Detections were checked and confirmed as spills across the entire maritime area [25, page 20].

For Germany, a much large number of satellite detections were located in its North Sea area, far fewer in its Baltic Sea area, although satellite coverage (average number of images per month) was higher in its Baltic Sea area. Confirmed spills were located in both German maritime areas [25, page 28].

Table 2: Annual number of satellite detections for North Sea States and average number per image, 16 April 2007 – 31 January 2011

Year / Country	2007	2008	2009	2010	2011	Totals by country: 16.04.07-31.01.11
Belgium	5 *(0.06)*	12 *(0.09)*	5 *(0.05)*	6 *(0.06)*	0	28
Denmark	62 *(0.19)*	131 *(0.21)*	92 *(0.16)*	86 *(0.14)*	1	372
Germany	59 *(0.22)*	117 *(0.24)*	61 *(0.13)*	50 *(0.09)*	2	289
Netherlands	80 *(0.41)*	189 *(0.57)*	121 *(0.46)*	109 *(0.39)*	2	501
Norway	13 *(0.15)*	82 *(0.21)*	39 *(0.10)*	23 *(0.07)*	1	158
Sweden	99 *(0.27)*	178 *(0.28)*	121 *(0.19)*	48 *(0.08)*	9	455
UK	142 *(0.41)*	241 *(0.41)*	185 *(0.36)*	136 *(0.23)*	14	718

Note: As the figures for 2011 are for one month only, no average number of detections per image is provided.

For Norway, the majority of satellite detections were located to the south and to the north of the country. There were, however, areas along its western coastline where there was no satellite coverage. Very few detections were checked or confirmed as spills in Norwegian waters [25, page 44].

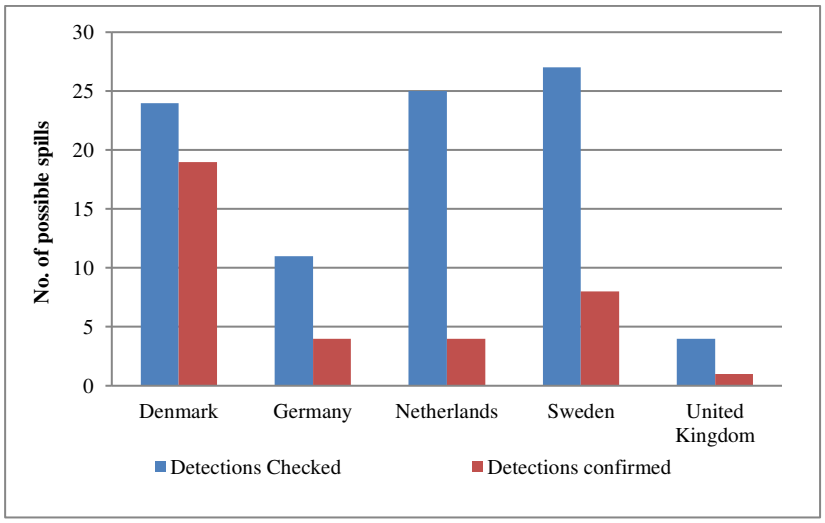
For Sweden, there were many more satellite detections in its Baltic Sea area, of its south and east coasts, with far fewer in the North Sea off its western coast. For detections which were checked, all were in the Baltic Sea area where there level of satellite coverage (average number of images per month) was also higher [25, page 56].

For the remaining North Sea states, detections covered only the North Sea. For the Belgian maritime area, there were few detections per satellite image annually (minimum 5; maximum 12), and only a single confirmed spill in 2010. The highest average number of detections per satellite image for the period between 2007 and 2010 were in the Dutch and UK areas of the North Sea.

Fig. 5 illustrates the number of possible spills detected in the waters of Denmark, Germany, the Netherlands, Sweden and the UK in 2009. In that year no spills were detected in the waters of Belgium or Norway. The highest number of satellite detections checked and verified by aerial surveillance within 3 hours of detection that were confirmed as spills was in Danish waters at 80%. For the other North Sea states the number confirmed as spills were: Germany 36%; the Netherlands 16%; Sweden 30%; and the UK 25%.

In 2010 there were 20 aircraft verifications within 3 hours in Danish waters and 7 of those verifications were confirmed as spills. For Germany the figures were 19 verifications of which 5 were confirmed spills; for the Netherlands 20 verifications and 3 confirmed spills; and for Sweden 2 verifications and 2 confirmed spills.

Figure 5: Number of possible spills checked and confirmed by aircraft verification within 3 hours, 2009



No specific data for the North Sea is available for the period from February 2011 onwards. However, in 2011 there were 2141 detections across all EU waters (5.08 detections per 1,000 km^2). In 2012 there were 2069 detections (4.53 per 1,000 km^2) and in 2013 they were 2176 detections (3.89 per 1,000 km^2). This is a fall from 3311 detections in EU waters in 2008 at a rate of 10.77 detections per 1,000 km^2 and it is clear that there has been a reduction in the number of possible spills detected from those figures [24, page 44].

6. Conclusions

This Chapter has presented an overview of the development of the European Maritime Safety Agency and its role in supporting the European Commission and EU Member States in areas such as maritime safety and security, and more specifically marine environmental protection.

The EMSA CleanSeaNet Service, in conjunction with other services such as SafeSeaNet, play a major role in helping detect pollution entering Europe's marine areas and in identifying the source of that pollution, for example. It also plays a role in providing an emergency response within 24 hours to support efforts to clean up accidental oil spills at sea.

Satellite imagery is an important tool in identifying oil (and other) pollutants on the sea surface, and CSN images from EMSA support international and regional activities relating to pollution prevention. Those satellite images, in conjunction with images generated by national satellite programmes, monitor over 1 million km^2 of sea area across Europe.

Detailed information on the number of satellite images provided to North Sea states and the annual number of satellite detections is only available for the North Sea for a short period (April 2007 – January 2011). However, in combination with more general data for the whole EU for the years 2008 to 2013, it is apparent that there has been a reduction in the number of spills, including confirmed oil spills, observed using satellite imagery, both in the North Sea and across the whole EU. CSN therefore has an important role to play in the continued monitoring of Europe's seas to prevent illegal pollution from taking place.

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