CleanSeaNet: 10 years detecting marine pollution in Europe

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Introduction

CleanSeaNet (CSN) is the European satellite-based oil spill monitoring and vessel detection service, developed and operated by the European Maritime Safety Agency (EMSA). The service analyses images, mainly from SAR but occasionally also from optical missions, to detect possible oil spills on the sea surface and identify potential polluters. The service was launched in April 2007 and has now been operational for a decade, supporting Member State actions to combat deliberate or accidental pollution in the marine environment.

During the past 10 years, almost 25,000 images have been delivered by the CSN service covering 4,300 million km^2 of sea surface. The number of possible spills detected in European waters has dropped by half during this period, from an average of 11 possible spills per km^2 monitored in 2007 to five possible spills per km^2 monitored in 2017. During this period, CSN also provided support to European coastal States in responding to 31 accidental spills and oil related emergencies. This paper provides an overview of the service, describing the coverage and technical features, and giving relevant statistics on the detected spills during the last decade [R1].

Main Results

CSN currently uses data from five different synthetic aperture radar (SAR) satellites, namely: Sentinel-1A, Sentinel-1B, Radarsat-2, TerraSAR-X and TANDEM-X. Data from these satellites is acquired and processed in near real time (NRT) by a set of distributed ground-stations, and is then transferred to the EMSA Earth Observation data Centre (EODC) for further value adding and distribution to end users. The analysis of the SAR images is semi-automatic, with trained operators that are able to distinguish between natural phenomena and discharges from vessels. Information extracted from these satellite images is combined with EMSA specific datasets (i.e. vessel traffic information e.g. Terrestrial AIS, Satellite AIS, LRIT) and includes: oil spill location and relevant parameters (area, length and confidence level of the detection), potential polluter identification, vessel detections (including estimates of width, length, heading and confidence level of the detection) and wind and swell obtained from the SAR data.

When a possible oil spill is detected in national waters, an alert message is delivered to the relevant country. In cases of high alert level spills (rules to define the alert level are agreed with the end user, on a country basis), the Maritime Support Service (MSS), EMSA's 24/7 operational centre, may also call the coastal state to ensure that the alert has been received and to offer additional support. Analysed images are available to national contact points in less than 30 minutes after the satellite acquisition. The service includes the identification of potential polluters by combining the image taken by the satellite with vessel traffic information.

The CSN community is currently 23 EU Member States, 2 EFTA coastal states and 3 Candidate Countries. Moreover, the service is provided to other countries across the Mediterranean, Black Sea and Caspian Sea, within the framework of the European Neighbourhood programs SAFEMED and BCSEA. These companies operate a network of ground stations distributed worldwide, to ensure Near Real Time delivery.

Currently, the majority of SAR data comes from the Sentinel-1 missions. The operational use of Sentinel in CSN started in the second half of 2015. Typically, the service uses Medium Resolution products (MR1 class: 30m < resolution <= 100 m [R2]) for routine monitoring of Coastal States areas of interest. However, when providing assistance for specific localised operations, like Ship-to-Ship transfer, or in the case of accidents, higher resolution products can be used (HR2 class: 10m < resolution <= 30 m [R2]).

Figure 1 shows the areas which are monitored regularly by CSN. Specific projects relate to orders that are covered by other funds e.g. Monitoring of Greenland. Figure 2 displays the location of the detected spills for 2016. The dots represent the spills which have a higher detection confidence level (class A: in red) and a lower detection confidence level (class B: in green). There were 1586 class A spills and 1582 class B spills in 2016. Finally, Figure 3 provides global statistics on the total number of possible spills detected during the period 2008 - 2016, as well as the average number of detections per million km monitored.

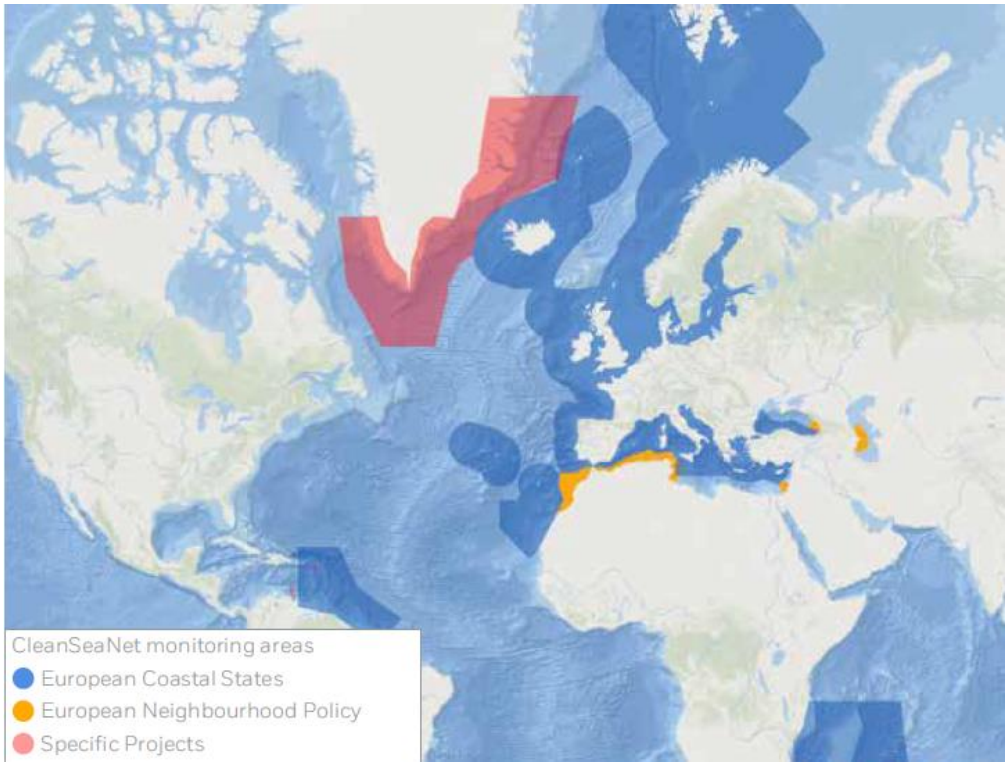

Fig 1: Areas monitored regularly by CSN in 2017.

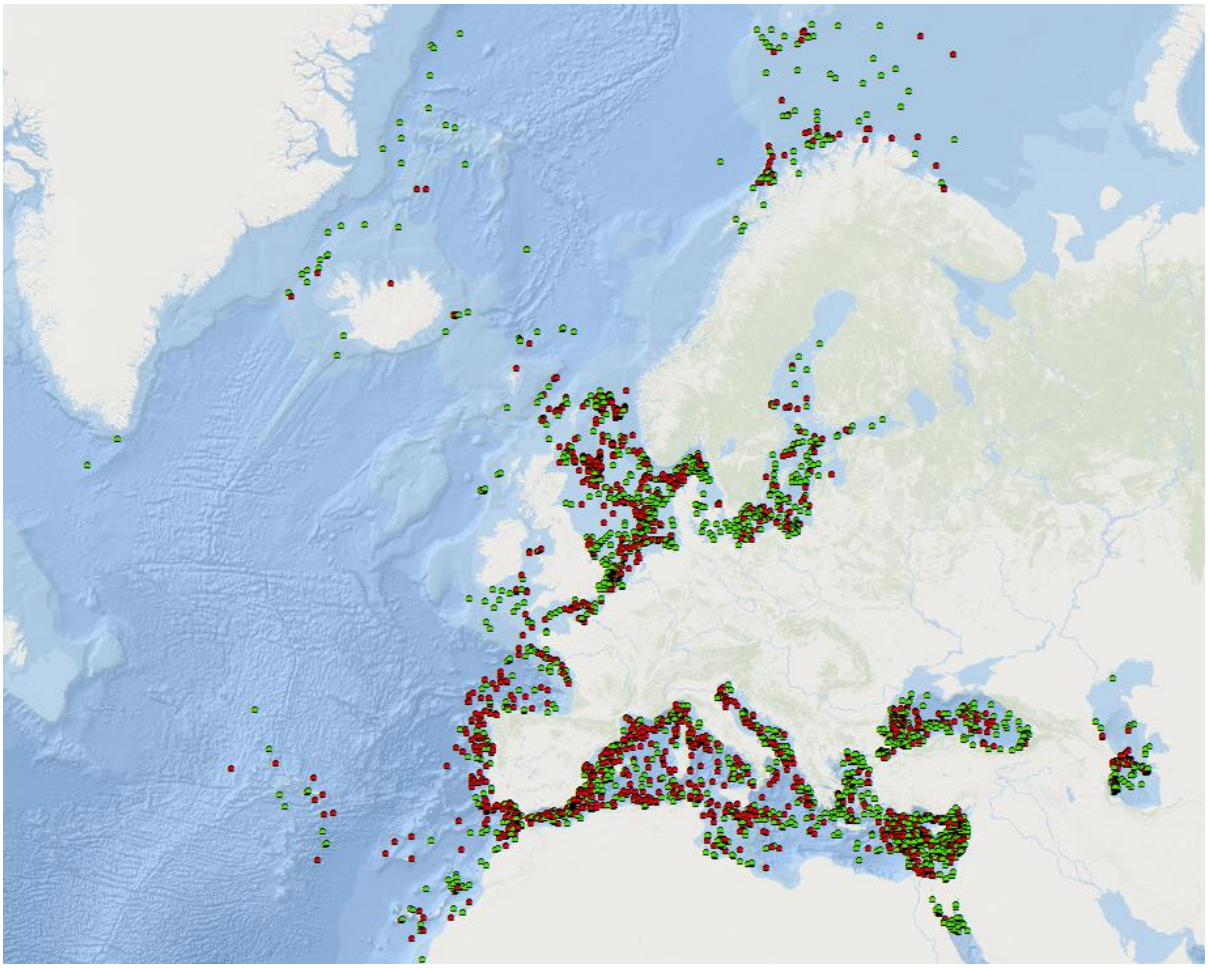

Fig 2: Map of possible spills detected in EU coastal States, Iceland, Norway, Turkey and Montenegro during 2016. Red dots stand for higher, and green dots stand for lower detection confidence level.

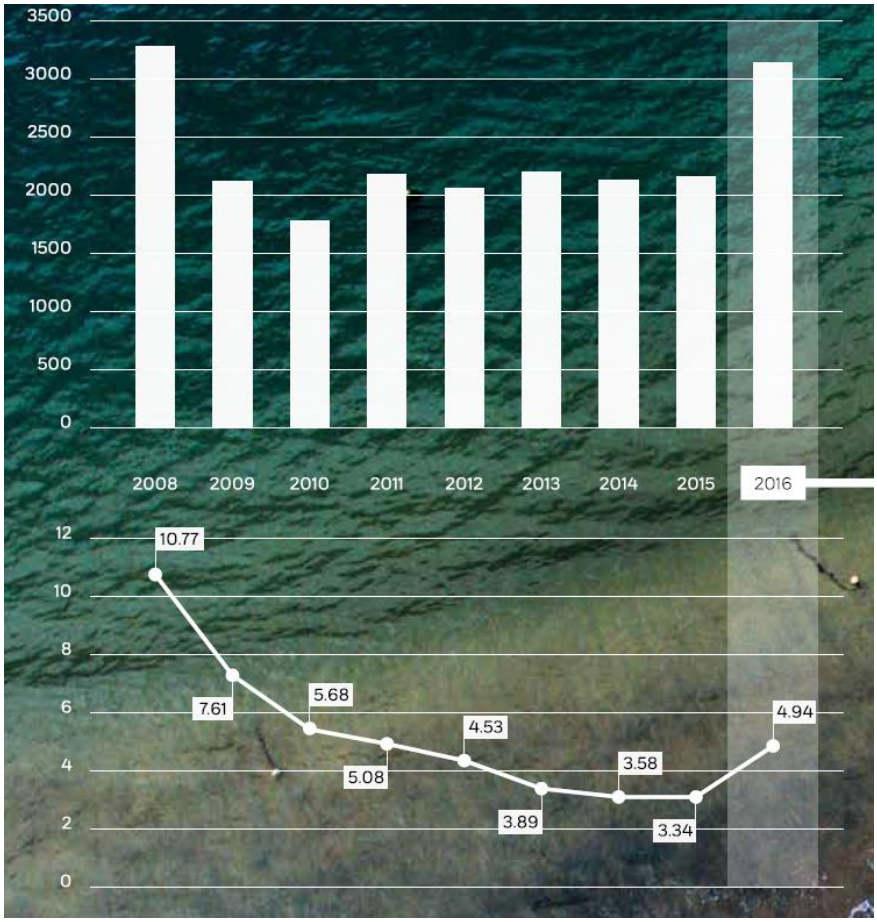

Fig 3: Top: Total number of possible spills detected during the period 2008 to 2016; Bottom: Average number of detections per million km2 monitored.

Conclusion

During the last decade, CleanSeaNet has provided continuous monitoring of the European and neighbouring waters.

The trend over most of the past decade has been a year-on-year reduction in the number of possible spills detected per million km^2 monitored, with a marked decrease per year from 2008-2010 and a more gradual decrease in the period 2010-2015.

In 2016 this trend seemed to be reversed but this can be explained by intensive use of Sentinel-1, which has improved detection capabilities (better resolution than previously used images). The spatial resolution and quality of Sentinel-1 made it possible to detect smaller spills than before: the average size of spills detected in 2016 was 25% smaller than in 2015.

Overall the long-term deterrent effect of CleanSeaNet is robust, and clearly visible in the significant reduction in the total number of spills monitored proving the added value of the service to coastal States administrations and to the European Citizen.

References

[R1] Celebrating the CleanSeaNet service: available online at http://emsa.europa.eu/csn-menu/items.html?cid=122&id=3150

[R2] Copernicus Maritime Surveillance Product Catalogue: avalable online at http://emsa.europa.eu/csn-menu/items.html?cid=122&id=3025