



Detecting and deterring illicit discharges

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Satellite Monitoring and Assessment of Sea-based Oil Pollution

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What we are aiming at? (I)

Basic Features of a system for detection of oil pollution and law enforcement

<i>TASK</i>	<i>SAT</i>	<i>AERIAL/ NAVAL</i>
Detect the potential presence of oil	+	+
Identify oil spills	-	+
Determine oil volume and type.	-	+/-
Detect potential presence of a likely pollution culprit	+	+
Identify the likely pollution culprit	-	+

What we are aiming at? (II)

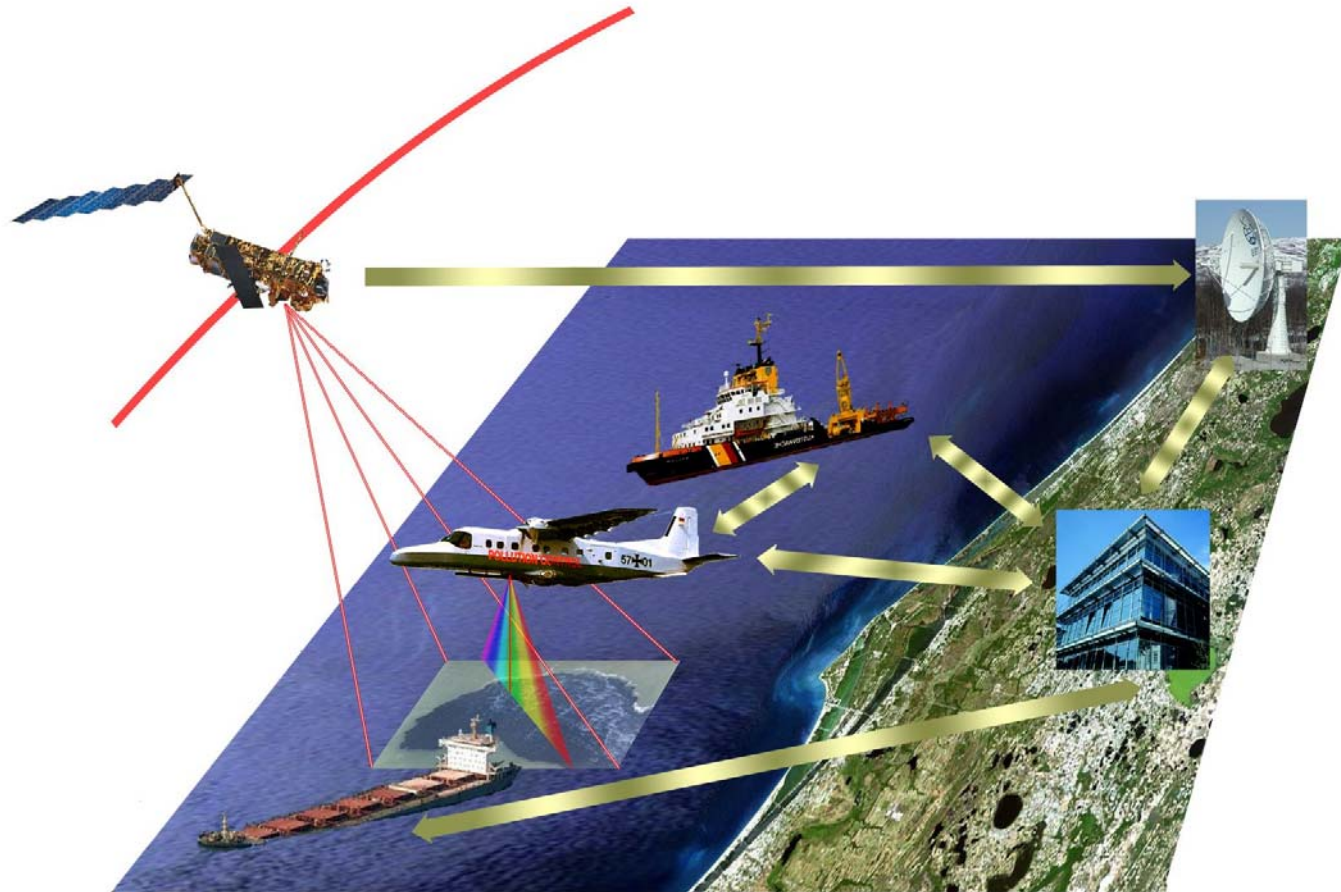
Can the satellite imagery support the efforts for law enforcement in the field of sea-based oil pollution?

The answer is YES provided that:

- The information has a real operational value (Near Real Time data).
- The coverage is wide enough.
- The system is sustainable.
- The information is reliable.
- The information is provided in a standardized suitable format.

What we are aiming at? (II)

How a system, integrating information from satellite imagery, could look like?





Where we are? (I)

Operational value

Objective: Making information on oil spill detection in satellite imagery available to On-scene Operators within about 30 minutes from the acquisition (NRT).

- Mainly a technological problem depending on the capability of the Satellite Receiving Station to deliver the specific service.
- Feasibility already demonstrated in some areas where the service is operational and offered on a commercial basis.
- A special infrastructure for fast data exchange may be necessary.

Where we are? (II)

Coverage

The extension of all the European Seas is covered by different Satellite Receiving Stations. Not all of them are able to deliver the NRT service.

The situation for Europe is summarized in the table below:

	North	Baltic	W-Med	E-Med	Black
Radarsat	++	++	+	+	+
Envisat	++	++	+	-	-

Legenda: ++ Feasibility demonstrated at an operational stage;
+ Feasible; - Not yet feasible.



Where we are? (III)

Information reliability

Objective: Measure the reliability of satellite oil spill detection in terms of False Positive Rate (FPR).

- The most recent experiments aiming at verifying satellite detection with aircraft are not conclusive and have very different results:
 - Swedish Study in the Baltic Sea (2004): FPR ~ 85%.
 - Bonn Agreement (summary of activities in the North Sea for 2004): FPR ~ 80 %
 - Oceanides Project in the Baltic and North Seas (2003 - 2004): FPR ~ 50 % to 15 % (depending on the confidence level of the detection)

Where we are? (IV)

Information reliability

The OCEANIDES Project experiment (I)

year 2003	Potential oil slicks (SAR frames)	Slicks checked by aircraft	Slicks confirmed by aircraft
Finland	34 (20)	8	3 (38 %)
Germany	97 (40)	61	34 (56 %)

Where we are? (V)

Information reliability

The OCEANIDES Project experiment (II)

year 2003	Total	High confidence	High and Medium confidence
Germany	56 %	83 %	75 %

Where we are? (V)

Information reliability

The OCEANIDES Project Benchmarking

Detection Analysis average time

	RADARSAT (min)	ENVISAT (min)
KSAT (manual)	9	10
Qinetic (semi-aut)	20	18
NR (2GHZ Linux) (aut)	3	1.45



Where we are? (VI)

Information reliability

The OCEANIDES Project - Benchmarking main conclusions

- Good agreement for high-contrast slicks.
- Differences in detection of low-contrast slicks.
- In some cases, linear slicks with good contrast have been reported as oil by all algorithms but verified as algae by aircraft or not found.
- Variations in the confidence assigned by the different algorithms and operators.
- More consistent rules for assigning confidence should be investigated.



What we still need (I)

- Demonstrate the feasibility at Pan-European level.
- Complete the work on harmonization and standardization of the reporting system.
- Enhance reliability of satellite detection
 - Define the concept of confidence level
 - Integrate auxiliary info
 - Run systematic validation exercise

What we still need (II)

Confidence level

- A satellite detection is usually made according to a probability to be an oil slick (confidence level).
- The concept of confidence level is usually difficult to be defined in a 'measurable way'.
- Regardless the definition, experiments show that as the confidence level increases the FPR decreases.
- A simplified confidence level (Yes/No) needs to be defined for the specific aim of supporting law enforcement.



What we still need (III)

Integrate auxiliary info

- Synergetic use of auxiliary data can improve information reliability by increasing discrimination capabilities.
- A more systematic approach (including development of appropriate GIS tools) is necessary to enable a real-time use of such data.
- Data of interest are of different nature and include (among others):
 - Static (bathymetry, main maritime routes, location of relevant installations, hot-spots, susceptibility to natural phenomena);
 - Dynamic (Sea Surface Temperature, wind field, currents, meteo conditions)

Towards a comprehensive monitoring system

Joint Research Centre

