Joint Research Centre (JRC)

**JRC Vessel Detection System (VDS)**  
*Developed for fisheries monitoring and control*

*Juan Ignacio Cicuendez, Marte Indregard, Marlene Alvarez*

**IPSC - Institute for the Protection and Security of the Citizen**  
*Maritime Affairs Unit*  
*Ispra – Italy*  
*http://ipsc.jrc.ec.europa.eu/*  
*http://www.jrc.ec.europa.eu/*
Index

- JRC Vessel Detection System – developed for fisheries monitoring and control
- Support surveillance operations in near-real-time
- Results from VDS campaign in NEAFC waters
Satellite image that is used for VDS in the NEAFC area

RADARSAT-1 ScanSAR
North-West Atlantic

300 km swath
50 m resolution
Downlink

Acquisition

Processing Image

Ship detection

VMS

AIS

Correlate with VMS and AIS

Total: 30 min

Suspect positions to authorities

Coal | Lon  | Lat  | xPixel | yPixel | MavV/3 |
---   |------|------|--------|--------|--------|
0     | -5.50008 | 44.38575 | 4401   | 722    | 14532  |
1     | -4.90772 | 44.16931 | 7673   | 3103   | 11996  |
2     | -5.20007 | 43.67082 | 5689   | 4615   | 10598  |
3     | -5.81170 | 44.60533 | 1600   | 6283   | 11656  |
4     | -5.99174 | 43.71924 | 520    | 5627   | 37031  |
Support surveillance operations in near-real-time (satellite data in combination with patrol aircraft/vessels)

- report suspect targets found in satellite images to patrol aircraft/vessels for further checking

Support monitoring through satellite data only

- Can provide information when neither aircraft nor patrol vessels are available
- Monitor areas closed for fisheries and report number of VDS targets not reported by other means (VMS, AIS)
- Assessment of vessel-traffic patterns
Satellite images and inspection plan need to be coordinated

Some limitations with planning of satellite acquisitions

Images need to be planned in advance
- 3 days for Radarsat and 14 days for Envisat
- Possible down to 29 hrs (Radarsat-1) and 12 hrs (Radarsat-2) but pay more

Satellite coverage are limited to certain times of day
- Radarsat; the morning and afternoon
- Envisat; noon and midnight

Not possible to have satellite images every day in all areas

Conflict with other users
- EMSA is ordering large amount of satellite images in Mediterranean
  - Oil spill monitoring requires less resolution (conflict)
JRC in close cooperation with the Icelandic Coast Guard explored how VDS can support aircraft surveillance in the NE Atlantic to

• detect and identify IUU vessels
• detect illegal transshipment or supply activity

Areas with main fishing activity are covered in order to

• Report in near-real-time to surveillance means areas with possible IUU vessels present
• Using post-analysis identify if number of VDS targets corresponds with number of vessels reported with VMS

Southern area covered in order to

• Report in near-real-time areas with vessels possibly involved in transshipment or supply services

20 June 2008
Scenario

Kongsberg Satellite Services (KSAT) was the satellite image service provider. VMS data (without vessel identification) received from NEAFC secretariat (through Iceland). An automatic set-up provided VMS data around the time of image acquisition on a ftp account. JRC correlated VDS and VMS information and reported to ICG. The report was delivered in the form of a Google Earth (.kmz) file.

Ideal near-real-time scenario is

To provide the Icelandic Coast Guard with positions of VDS targets not correlated with VMS (suspect targets) within 30 minutes after image acquisition – 1 hr is more realistic (correlation challenges due to targets close together and VMS data often not polled).
Image acquisitions 2008 (8 images)

- 3 June 08:12 (green)
  - Surveillance
- 6 June 08:24 (light blue)
  - Surveillance not scheduled
- 13 June 08:20 (dark blue)
  - Surveillance
- 20 June 08:16 (yellow)
  - Surveillance
- 27 June 08:12 (green)
  - Surveillance not scheduled
- 30 June 08:24 (light blue)
  - Surveillance not scheduled
- 7 July 08:20 (dark blue)
  - No Surveillance due to SAR operation
- 14 July 08:16 (yellow)
  - No Surveillance due to bad weather
• VDS : 39
  – 28 on the main fishing line
  – 6 in area south of fishing I.
• VMS : 36
  – 30 on the main fishing line
  – 5 in the second area
• VMS correlated: 34
• VMS additional : 2
  – 2 not correlated vessels, 3 hrs before image acquisition
• VDS additional: 5
  – None on the main fishing line, one on the small fishing line
• Lots of false alarms due to weather fronts (removed manually)
• Surveillance
  – ICG identified all VDS. VDS no 96 was cargo vessel Scarlett 3 (Cyprus) that has taken frozen fish from trawlers in the area, VDS174 was a container vessel
## Overall correlation results 2008

<table>
<thead>
<tr>
<th>Date</th>
<th>#VDS</th>
<th>#VMS</th>
<th>#Correlations</th>
<th>#Additional VDS</th>
<th>#Missed targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>2008-June-3</td>
<td>35</td>
<td>34</td>
<td>31</td>
<td>4</td>
<td>3</td>
</tr>
<tr>
<td>2008-June-6</td>
<td>41</td>
<td>37</td>
<td>36</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2008-June-13</td>
<td>40</td>
<td>36</td>
<td>34</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2008-June-20</td>
<td>39</td>
<td>36</td>
<td>34</td>
<td>5</td>
<td>2</td>
</tr>
<tr>
<td>2008-June-27</td>
<td>24</td>
<td>22</td>
<td>22</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>2008-June-30</td>
<td>18</td>
<td>18</td>
<td>16</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>2008-July-7</td>
<td>26</td>
<td>21</td>
<td>20</td>
<td>6</td>
<td>1</td>
</tr>
<tr>
<td>2008-July-14</td>
<td>19</td>
<td>17</td>
<td>16</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>242</strong></td>
<td><strong>221</strong></td>
<td><strong>209</strong></td>
<td><strong>33</strong></td>
<td><strong>12</strong></td>
</tr>
</tbody>
</table>

- Correlation results overall: 95 %
- 6 of the 12 “missed target” may be correlated or are of low quality
## Correlation Results (2007)

<table>
<thead>
<tr>
<th>Date</th>
<th>#VDS</th>
<th>#VMS</th>
<th>#Correlations</th>
<th>#Additional VDS</th>
<th>#Missed targets</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007-May-16 (W)</td>
<td>58</td>
<td>35</td>
<td>35</td>
<td>23</td>
<td>0</td>
</tr>
<tr>
<td>2007-May-19 (Sa)</td>
<td><strong>11</strong></td>
<td>31</td>
<td><strong>11</strong></td>
<td>0</td>
<td><strong>20</strong></td>
</tr>
<tr>
<td>2007-May-26 (Sa)</td>
<td>50</td>
<td>34</td>
<td>31</td>
<td>19</td>
<td>3</td>
</tr>
<tr>
<td>2007-June-2 (Sa)</td>
<td>45</td>
<td>21</td>
<td>20</td>
<td>25</td>
<td>1</td>
</tr>
<tr>
<td>2007-June-9 (Sa)</td>
<td>51</td>
<td>43</td>
<td>40</td>
<td>11</td>
<td>3</td>
</tr>
<tr>
<td>2007-June-12 (Tu)</td>
<td>27</td>
<td>24</td>
<td>20</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td>2007-June-16 (Sa)</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2007-June-19 (Tu)</td>
<td>47</td>
<td>43</td>
<td>41</td>
<td>6</td>
<td>2</td>
</tr>
<tr>
<td>2007-June-26 (Sa)</td>
<td>39</td>
<td>35</td>
<td>34</td>
<td>5</td>
<td>1</td>
</tr>
<tr>
<td>2007-July-3 (Tu)</td>
<td>19</td>
<td>13</td>
<td>12</td>
<td>7</td>
<td>1</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td><strong>348</strong></td>
<td><strong>279</strong></td>
<td><strong>244</strong></td>
<td><strong>104</strong></td>
<td><strong>35</strong></td>
</tr>
</tbody>
</table>

- Correlation results overall: 87%
- Correlation results not including 19th May: 94%

- A lot more additional VDS targets in the beginning (until 2nd June)
Fishing pattern 2003-2006
Fishing pattern 2007
Fishing pattern 2008

- 2008-06-03
- 2008-06-06
- 2008-06-13
- 2008-06-20
- 2008-06-27
- 2008-06-30
- 2008-07-07
- 2008-07-14
2008 Results

• The results were available approx 1 hr after image acquisition (average)
  – Need of manual interpretation slows down the process, but take-off was 3 hr after image acquisition

• 95% of vessels reported with VMS are detected in the image
  – 6 of the 12 non detected VMS positions are of “low quality” for correlation

• In 2008 confirmed again more VDS targets than VMS, but less than previous years
  – 242 VDS and 221 VMS (9% more with regard the VMS)

• Little activity detected in the southern area
VDS benefits and future use

- VDS is a mature pre-operational technology and tested successfully in many campaigns.

- VDS supports surveillance operations in near-real-time (satellite data in combination with patrol aircraft/vessels).

- VDS can provide information when surveillance means not available.

- New EU regulation foresees operational use of satellites where cost/benefit can be proven (e.g. high seas) from 1 January 2009.

- VDS is being expanded to other sectors besides fisheries (e.g. maritime security, illegal immigration etc.).