

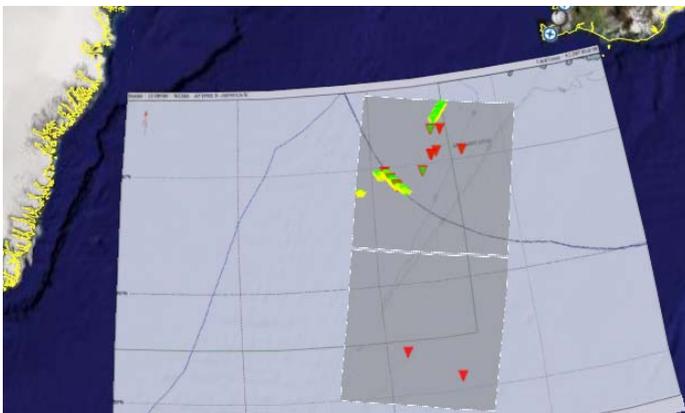
The Vessel Detection System

Satellite Technology for Fisheries Monitoring, Control and Surveillance

Vessel Monitoring System and Vessel Detection System

The Vessel Monitoring System (VMS) was designed for fisheries Monitoring, Control and Surveillance (MCS). Since January 2005 all EU fishing vessels above 15 metres in length are subject to VMS. VMS is also used widely worldwide. The system is based on satellite navigation and communication technologies. A VMS box installed on board transmits the GPS-derived vessel position by satellite to the Fisheries Monitoring Centre (FMC) of the vessel's flag state. The FMC in turn communicates this information to the coastal state or regional fisheries body in whose waters the vessel is present. The period between VMS vessel-to-FMC transmissions varies, but is normally between one and two hours. The vessel can also be "polled" by the FMC to determine its exact position at any given time. This allows FMCs to determine the position of vessels within a certain area and at a given time frame. VMS enables fishermen to demonstrate their compliance with regulations setting days at sea, closed areas or closed seasons.

VMS is a key tool for fisheries enforcement. It requires little effort by both fishermen and authorities. However, VMS cannot be used to monitor vessels whose system is switched off or malfunctioning and cannot identify vessels that do not have VMS. For this reason, **based on a concept developed by the JRC**, the EU Fisheries Council of December 2002 asked Member States to carry out pilot projects **to assess the use of remote sensing as an additional control tool**. Commission Regulation (EC) No 1461/2003 of 18 August 2003 states that the aim of the proposed **Vessel Detection System (VDS)** is to (a) determine the number of fishing vessels and their position in a given area; (b) cross-check the positions of the fishing vessels detected by VDS with position reports from VMS, and (c) signal the possible presence of fishing vessels from which no position reports have been received through VMS. Council Regulation 1966/2006 of 21 December 2006 now foresees operational use of satellite remote-sensing (VDS) in contexts where its cost-effectiveness can be proven, starting in January 2009.



North East Atlantic, monitoring Redfish fisheries, between Icelandic EEZ and North East Atlantic Fisheries Convention (NEAFC) waters. Radarsat-1 ScanSAR Narrow, 5 June 2007.

The red triangles are satellite-detected vessels which were NOT reported using VMS - as they should. The ones south of the controlled area (bottom rectangle) could be fuel supply or support vessels (reefers), potentially aiming at illegal activities. The yellow boats are positions reported with VMS. The green triangles are VDS (satellite) targets that correlate well with VMS.

Synthetic Aperture Radar Imagery

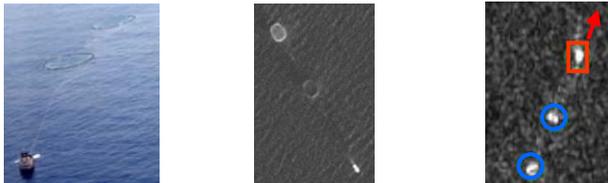
VDS relies on polar orbiting satellites carrying **Synthetic Aperture Radar (SAR)** instruments. These can **detect vessels at sea under most conditions** – day and night and through cloud. At present the main satellites carrying such instruments are – the European Space Agency's Envisat; the Canadian Radarsat-1 and Radarsat-2; the German TerraSAR-X and the Italian COSMO-SkyMed.

Depending on latitude, these SAR satellites are able to provide an image of almost any area on the earth every one to three days – more frequently as we move away from the equator. SAR sensors can operate in a number of modes – from covering wide areas with less detail to smaller areas with more detail.

Typical VDS scenario

There are a number of steps in the process: (1) Satellite image acquisition, (2) SAR processing, (3) Vessel detection, (4) Reception of other positioning data (VMS and AIS*), (5) data fusion - matching VDS positions with VMS and AIS and reporting results to inspectors. The time needed for the whole process varies between 15 and 90 minutes, depending on the context.

*AIS: Automatic Identification System, collision avoidance system, using transponders on-board large vessels.



Mediterranean Sea, Bluefin tuna cages can be automatically identified.

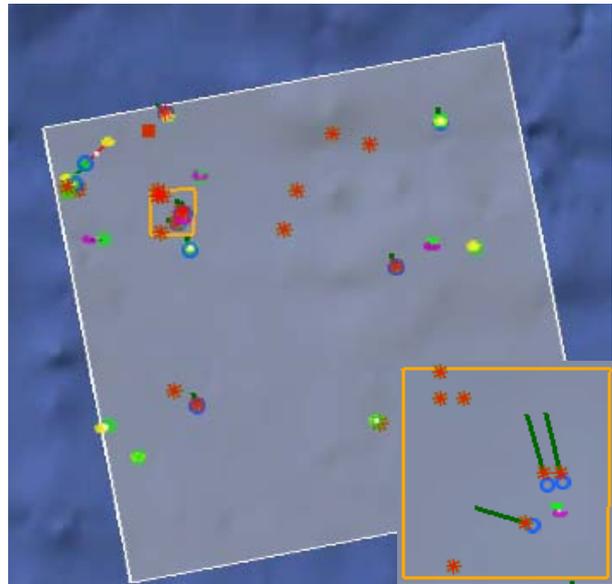
A tug towing two cages shown inside an aerial photograph - courtesy Maltese fisheries authorities (left); in a 2.5m resolution SPOT5 image (center); in a SAR image (right).

Pilot studies and first operational campaigns

Pilot studies of VDS – mostly in real-time – were carried out by JRC, in European and international waters - the Baltic, the Barents Sea, the North Sea, the English Channel, the Bay of Biscay, the Azores, the Mediterranean, the North East and North West Atlantic.

The studies indicated that **the VDS system can detect nearly all vessels subject to VMS under most weather conditions**. Areas as wide as 300 km in the open ocean and 50-100 km in coastal regions were found to offer the best compromise between resolution and area coverage. The system works best if all the VMS-equipped vessels within the image frame are “polled”.

JRC organized a large VDS campaign in the summer of 2008 in the Mediterranean to support **monitoring of Bluefin tuna (BFT) fisheries**. The control campaign was coordinated through the BFT Joint Deployment Plan by the Community Fisheries Control Agency. The main goal of the campaign was to support the inspections during the most intensive BFT fishing period (May-June) by providing information on areas of interest to inspect based on the information found in satellite imagery and reported by JRC after matching these with positions from VMS and AIS.



Mediterranean Sea, monitoring Bluefin tuna fisheries, Radarsat-1 Standard Mode, 22 June 2008, 16:55 UTC.

Yellow boats are fishing vessels reported by VMS; magenta boats are vessels reported by AIS. Asterisks, squares and triangles are all vessels detected in the image; green color is used to indicate that a vessel's VDS position matches with a VMS or AIS position; red is used when this correlation is not possible (usually indicating non-cooperative vessels).

Blue circles show tuna cages towed by vessels. Since the vessels towing cages move very slowly and their heading (the dark green line) can be estimated from the satellite images, it is possible to predict relatively easily their future positions for later inspection.

From pilot to operational systems

VDS technology has reached maturity. Vessel positions in all European waters can be sent to FMCs in useful time. The delivery time depends on several factors like the capacities of the ground stations or vessel traffic intensity. In the majority of cases it is now technically possible to guarantee image delivery time below 60 minutes. However, a minimum of 30 hours advance notice is still required to order an image. The main cost item of the VDS process is the cost of the images. The costs to the authorities amount to € 700-2000 per image.

VDS is not designed to replace inspections but to complement them through better targeting. VDS is also a useful deterrent. Ideally, aircraft and vessel patrols, with their closing-in capabilities, are to be used only when needed to collect evidence of illegal activity.

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