

Satellite Technologies for Fisheries Monitoring, Control and Surveillance (MCS)

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**IPSC - Institute for the Protection and Security of the Citizen
Maritime Affairs Unit**

Motivation

- Common Fisheries Policy (CFP) includes regulations to limit fishing effort and total allowable catches (TACs), avoid overfishing and combat illegal, unregulated and unreported (IUU) fishing
- Risk is fish stocks collapse, fishing industry is ruined
- **Need to enforce the common rules and check for non-compliance**

Monitoring and control tools

- Inspections at sea (vessel/aircraft patrols)
- Control of landings
- Other controls (market, transport etc.)
- Automated systems to detect fishing vessel activity

Designed for fisheries management and control

- Automatic position reports from fishing vessels, sent to Flag State's fisheries inspection authorities (FMC, Fisheries Monitoring Centre)
 - "Blue box", GPS receiver + communications unit
 - Reporting frequency: 1 or 2 hours.
 - Some boxes can be polled, i.e. respond on request
- Flag State forwards to Coastal State or to convention area secretariat (e.g., NEAFC, ICCAT)
- EU fishing vessels with overall length > 15 m
- Global coverage thanks to satellite communications

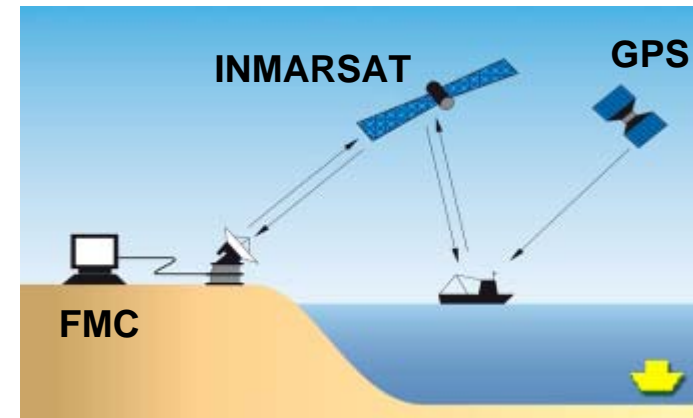
VMS is a powerful tool in fisheries MCS

But has still problems to overcome:

- Some vessels may not have VMS
- System may fail or be switched off
- Vessels might transmit false positions



Based on a concept developed by JRC, EU Fisheries Council of 12/2002 asked MS to carry out **pilot projects to assess the use of satellite remote sensing as an additional control tool**

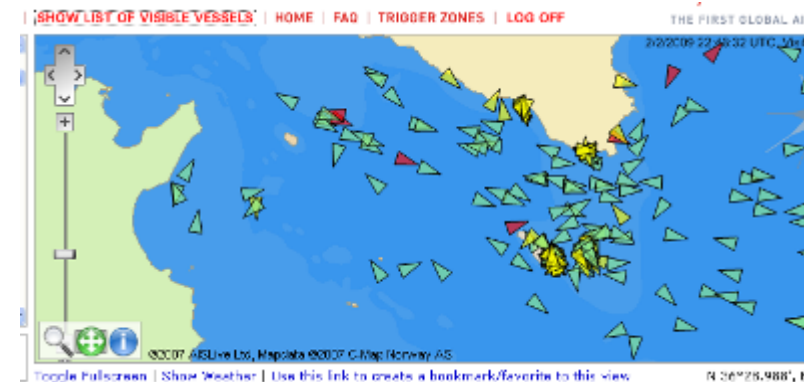


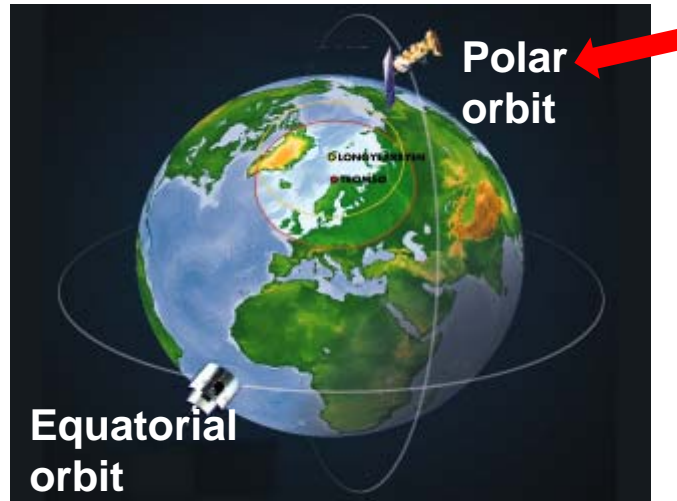
Designed for maritime traffic safety (collision avoidance)

- Introduced by International Maritime Organisation (IMO)
- Each merchant ship carries a transponder that automatically communicates to all neighbouring ships by VHF radio link
 - ID, position, speed, heading; cargo, draught, origin, destination, ...
 - High reporting frequency
- For ships >300 GT, tankers, passenger vessels
- Gradually extended to fishing vessels
- AIS receiver on the coast will give local picture
 - Ashore (range of approx 60 NMiles)
- Many countries are installing coastal AIS network
- Some companies offer AIS access on the web (e.g. AISLive.com, marinetraffic.com)



Picture from Kongsberg Seatex





Synthetic Aperture Radar (SAR) instruments:

Can detect vessels at sea under most conditions

- day & night & through clouds
- Must wait until satellite passes within range
- One image every 1 to 4 days depending on latitude

1) Detect vessels using SAR imagery

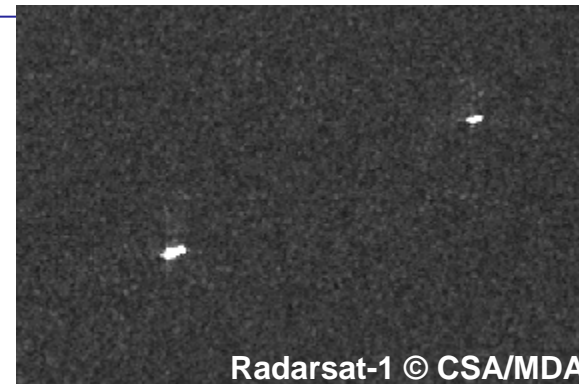
- Automatic vessel detection (SUMO)

2) Cross-check with other positioning data:

- VMS (Vessel Monitoring System)
- AIS (Automatic Identification System)
- Sightings (from inspections)

3) Signal / report mismatching

- Possible presence of *non cooperative vessels* – fishing vessels from which no VMS reports have been received –
- Fishing vessels possibly manipulating their position, in cases where VMS reports do not match with detected targets





Experience on:

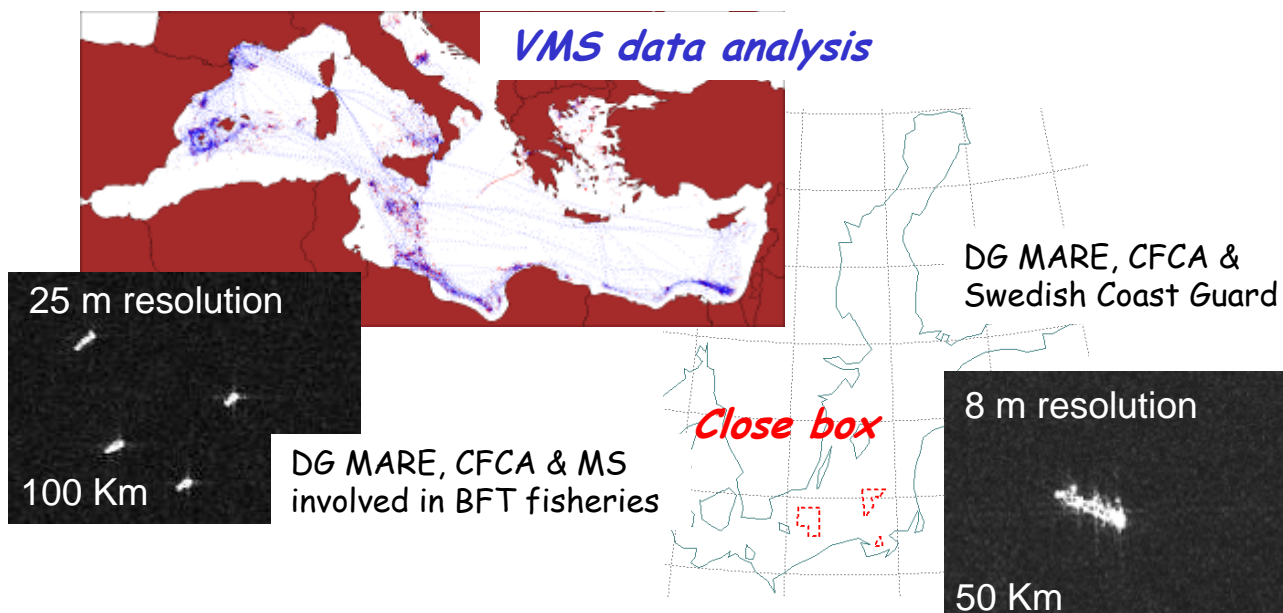
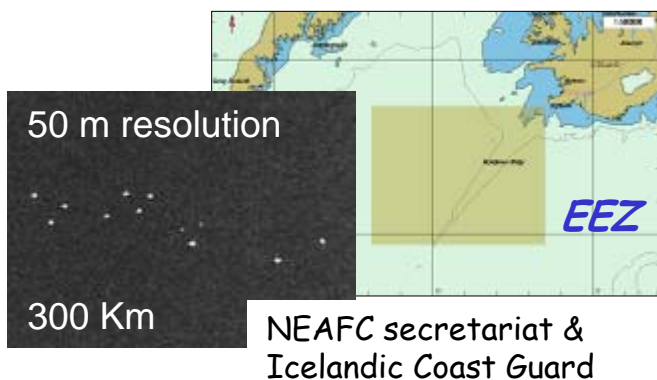
- RADARSAT-1
- ENVISAT ASAR

New sensors to explore:

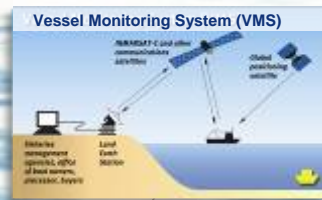
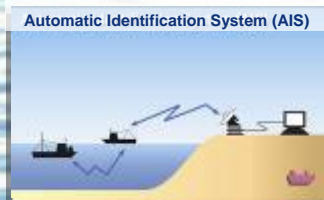
- RADARSAT-2
- TerraSAR-X
- CosmoSKYMed

Defining a campaign: specific fisheries; time & space constraints

Wide coverage, low resolution \leftrightarrow Narrow coverage, high resolution



Typical VDS scenario

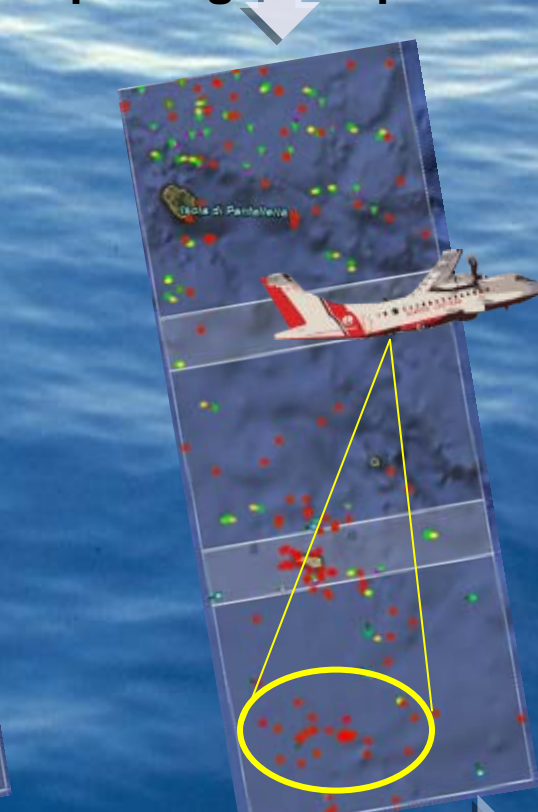
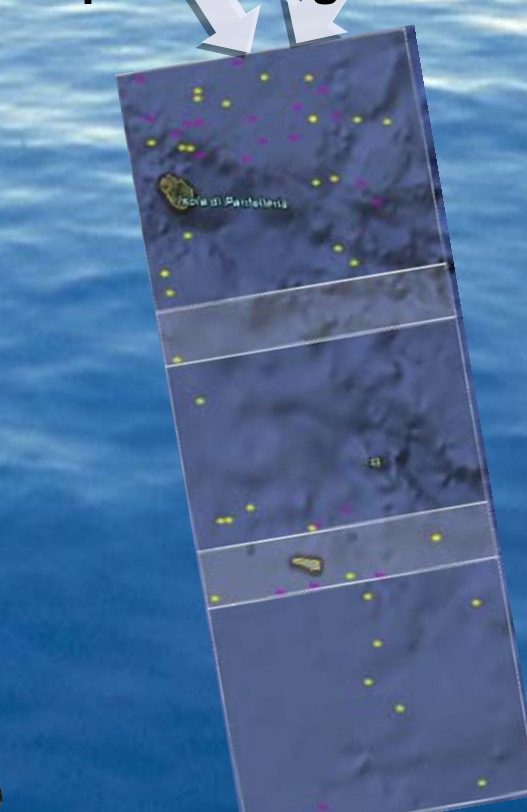
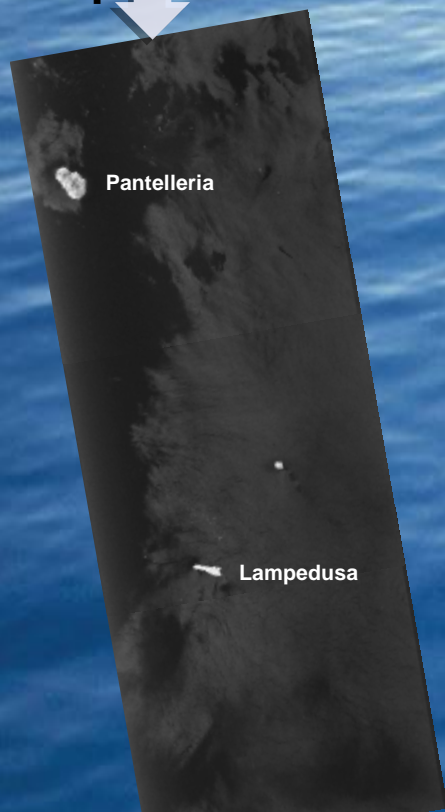


Satellite image acquisition

JRC's vessel detection software

Reception of other positioning data

Data fusion and reporting to inspectors



Total: 15-90 minutes

	min-max	Difficulties
Image Delivery Time - from satellite to GS - processing image - from GS to JRC	5-30 minutes 2-15 min 3-15 min	- transfer of images
Analysis Time - Vessel and cage detections - Supervision of the analysis	5-30 minutes 2 min (automatic)	- false alarms - if many targets
Reception of VMS	very variable	- if not automatic
Correlation Time - Algorithm - Manual intervention	5-30 minutes 2 min (automatic)	- ok for AIS (timely) - if no answer to polling of VMS

15-90 minutes

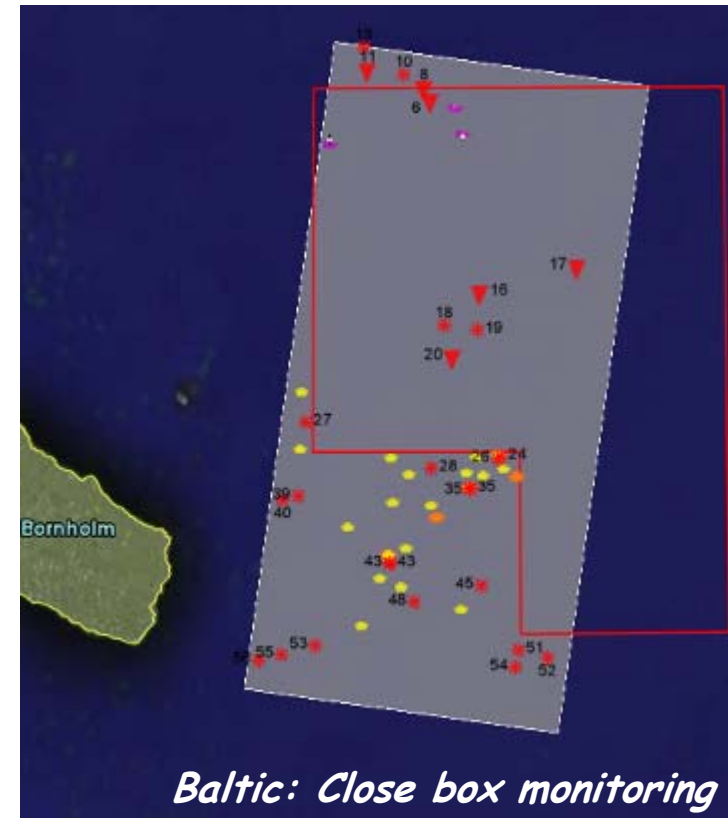
Margin for improvement

Mostly in near-real-time, in European and international waters:

- FP5 project IMPAST (2002-2004)
- The Baltic Sea, North East Atlantic (NEAFC), the North Sea, the Bay of Biscay, Azores, Mediterranean, Barents Sea, Western Waters etc.
- In close cooperation with DG MARE, the national authorities and the Community Fisheries Control Agency (CFCA)

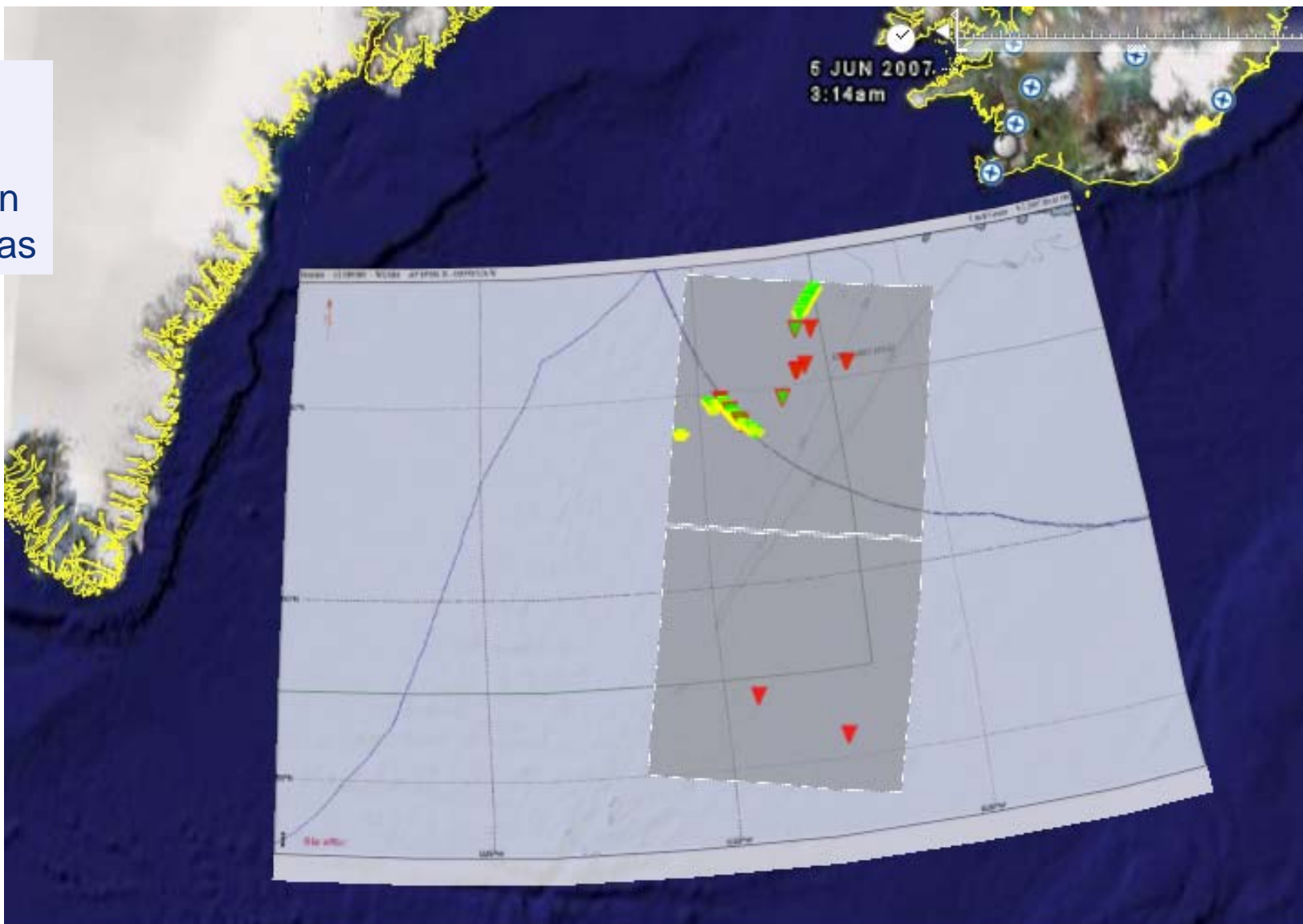


- **The VDS system can detect nearly all vessels subject to VMS under most weather conditions**
- **Demonstrated through several campaigns to improve the monitoring of fisheries activities**



Best added value:

In open ocean and wide areas



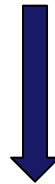


Facts:

- The world's most valuable fish
- Mostly exported to Japan (sushi & sashimi)
- Mainly caught by purse seiners
- Fattened in farms in the Mediterranean

Problems:

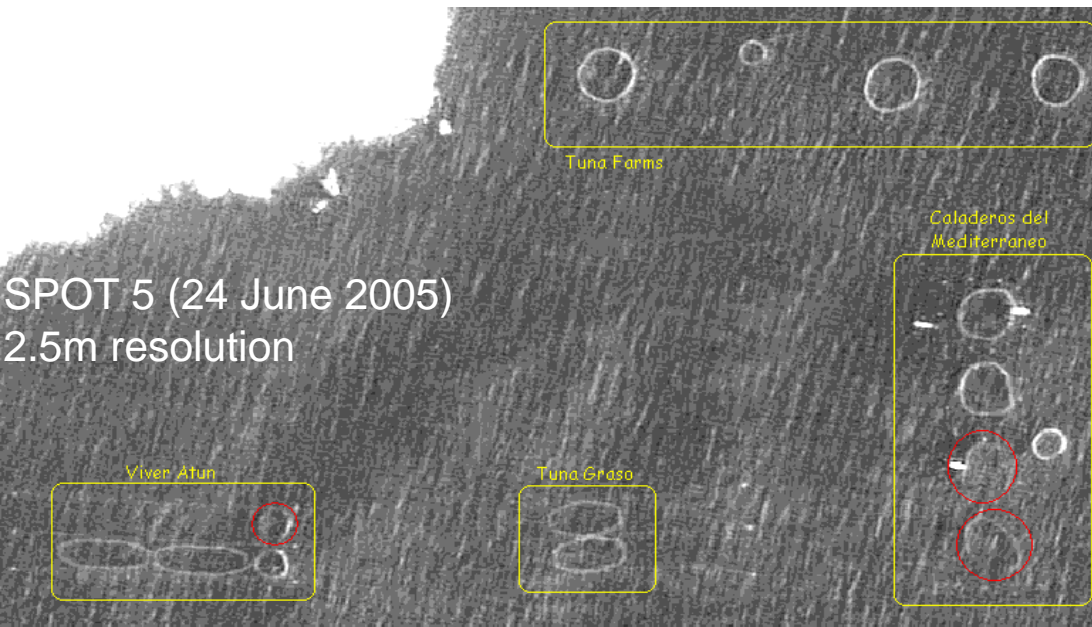
- Massive overfishing, stocks close to collapse
- Illegal fishing and farming
- In the list of endangered fish



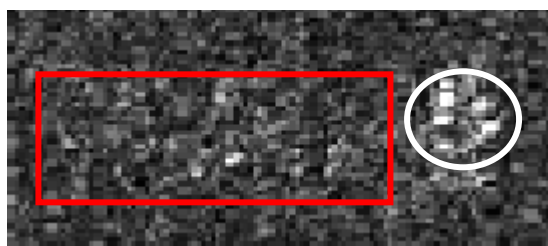
DG-MARE requests in 2006-2008:

monitor BFT fisheries and farming in the Mediterranean

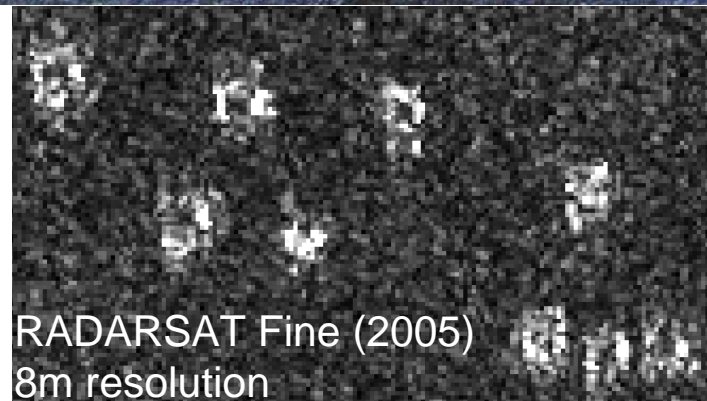




RADARSAT Limitations



Difficulties with submerged types

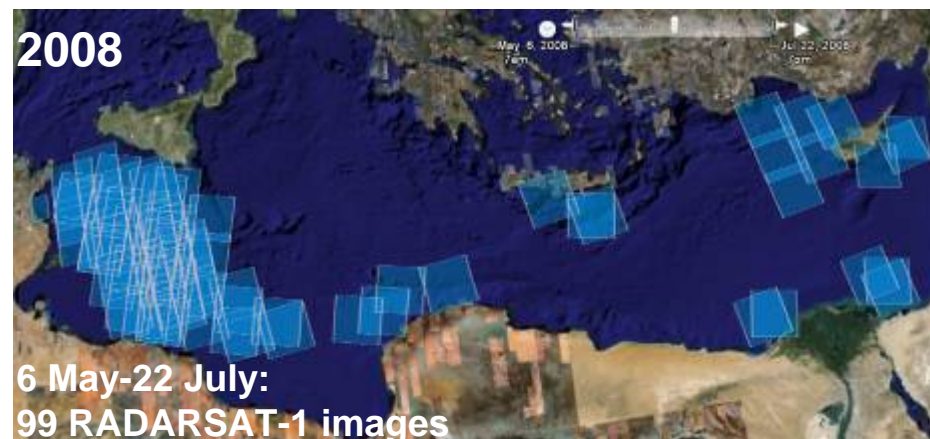
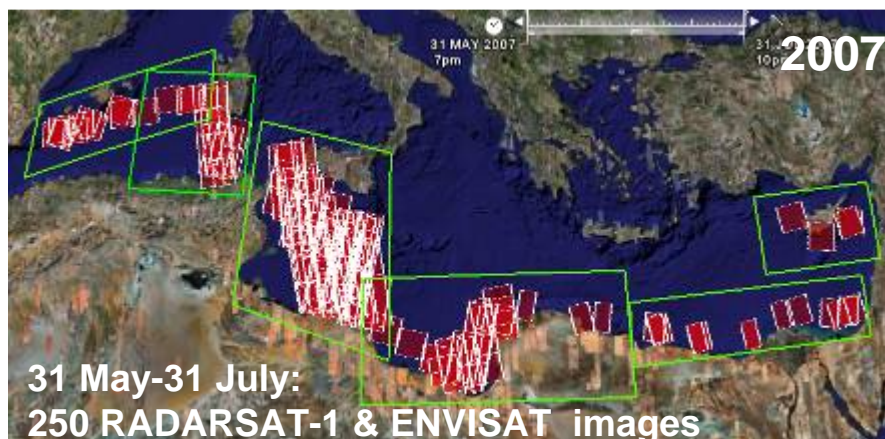


Contribute to monitoring BFT fisheries and identifying IUU (illegal fishing) activity using VDS in 2007 and 2008

- Report to surveillance means interesting activity based on detected targets in satellite images (after correlation with VMS and AIS data):

- Vessels towing tuna cages from fishing grounds towards farms
- Possible transfer of tuna from fishing vessels to cages
- Group of vessels engaged in fishing activity
- Transhipments at sea

- Provide reports in near-real-time (NRT)
- Support BFT Joint Deployment Plans (JDP)
- In coordination with DG MARE, CFCA and MS involved

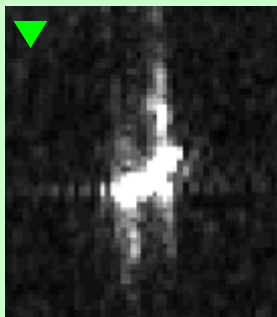


Developments in vessel detection software (SUMO)

- Automatic detection of tuna cages:
(paper to be published in IJRS)
- Vessel size classification (L, M, S)
- Automatic identification of Azimuth ambiguity
- New sensors: Rsat-2, TerraSAR-X
- Dual polarization detector

Target size classification (for Mediterranean)

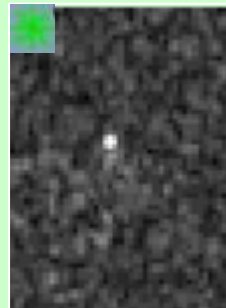
(depends a lot in AOI and type of vessels)



Big signature
big vessel



Medium signature
size uncertainty



Small signature
small vessel

Potential fishing vessels

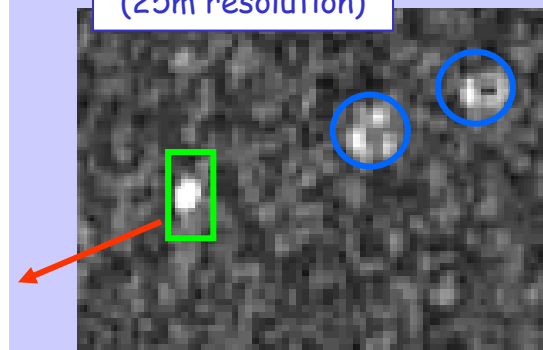
Identification of tuna cages

Optical images
(2.5m resolution)



Aerial photo from
Maltese inspection

SAR images
(25m resolution)





JRC has been running VDS campaigns for several years

- In coordination with FMCs, DG MARE and CFCA
- In 2007 and 2008, very large campaigns were executed in the Mediterranean

VDS technology has reached maturity

- Can be used routinely as an operational service, to support surveillance operations in near-real-time


VDS is not designed to replace inspections but to complement them through better targeting

VDS can provide information when surveillance means not available

New EU regulation foresees operational use of satellites where cost/benefit can be proven from 1 January 2009

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

Thank you for your attention!



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