North-East Atlantic:
The challenge of surveillance in wide maritime areas

Harm Greidanus

European Commission
Joint Research Centre (JRC)
Institute for the Protection and Security of the Citizen (IPSC)
http://www.jrc.ec.europa.eu
http://ipsc.jrc.ec.europa.eu

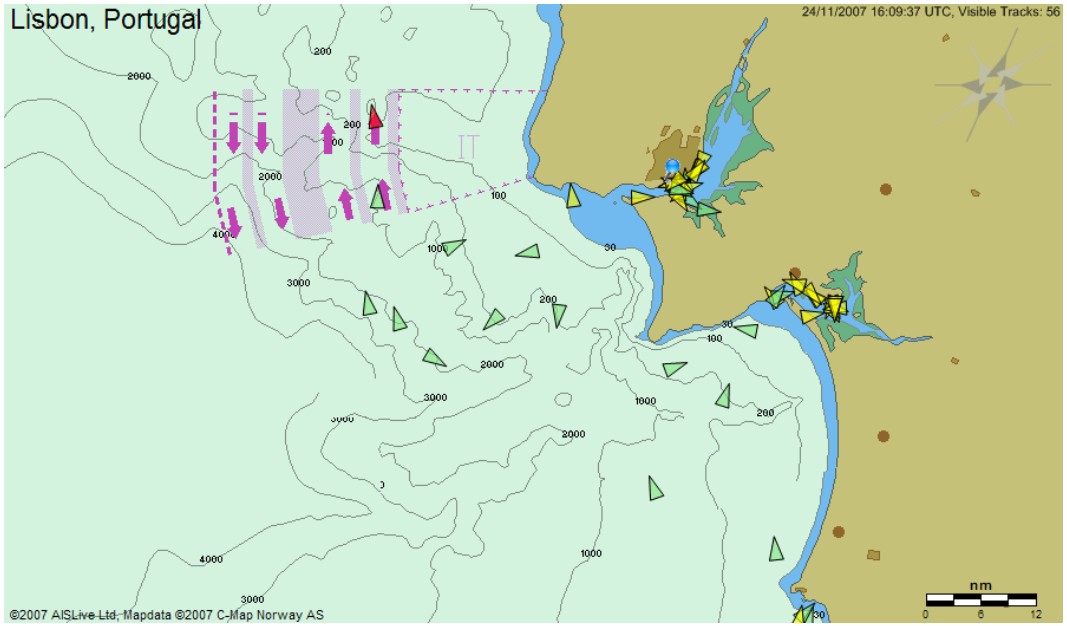
Contents

- Maritime surveillance
- Satellite imaging
- Problems and way ahead

Why maritime surveillance?

General:
- Find illegal activities, infringements
- Find safety and security threats

Applications:
- Fisheries control
- Counter pollution
- Navigation safety
- Border security
- Defence
- …



AISLive.com

Specific seas, specific issues

- Mediterranean — Illegal immigration, fishing, oil pollution
- North Sea — Navigation safety, fishing
- …
- North-East Atlantic — Fishing, oil pollution, smuggling

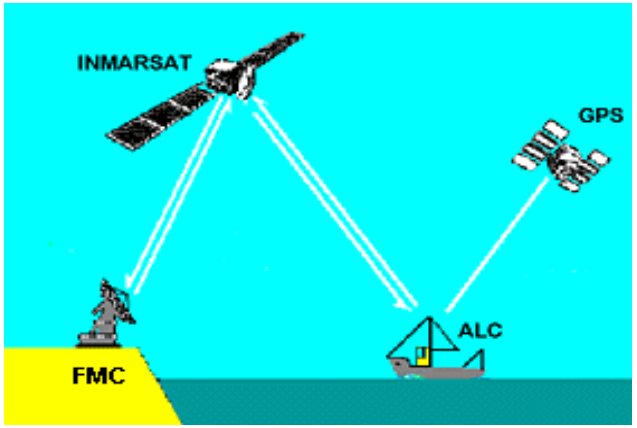
GoogleEarth

Transcends national boundaries
→ European Commission and JRC role

Surveillance tools

Ship reporting systems
- Short messages sent from ship to authorities
- VMS, AIS, LRIT, …
  (Vessel Monitoring System, Automatic Identification System, Long Range Identification and Tracking)

→ The 'known and trusted' ships



Observation systems
- Radars, cameras, infrared, ….
- From the coast, patrol ships, maritime patrol aircraft, …

→ All ships

- Combine the two to pinpoint unknown ships that might be a threat or infringement

Wide area maritime surveillance

- Out of reach from the coast
  (coastal range 5…20…40… nm depending on ship size)

- Have to use
  - Patrol ship
  - Patrol aircraft
    - Satellite
      - Unmanned Aerial Vehicle (UAV)
        - Surveillance buoys, …?

now → future

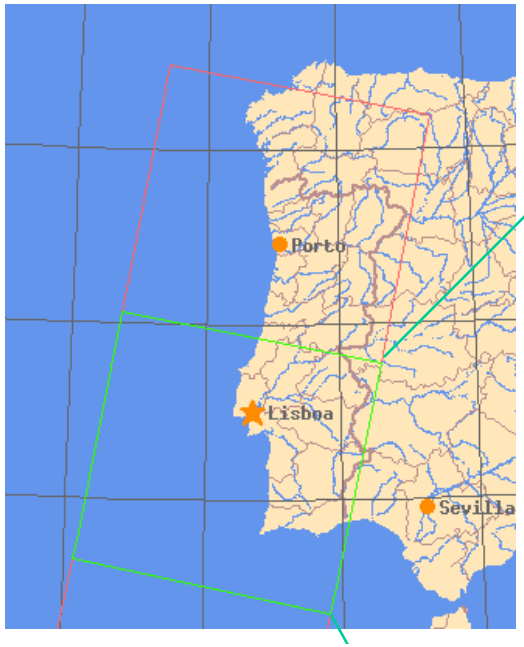
Portuguese project partners:

inov inesc + inovação

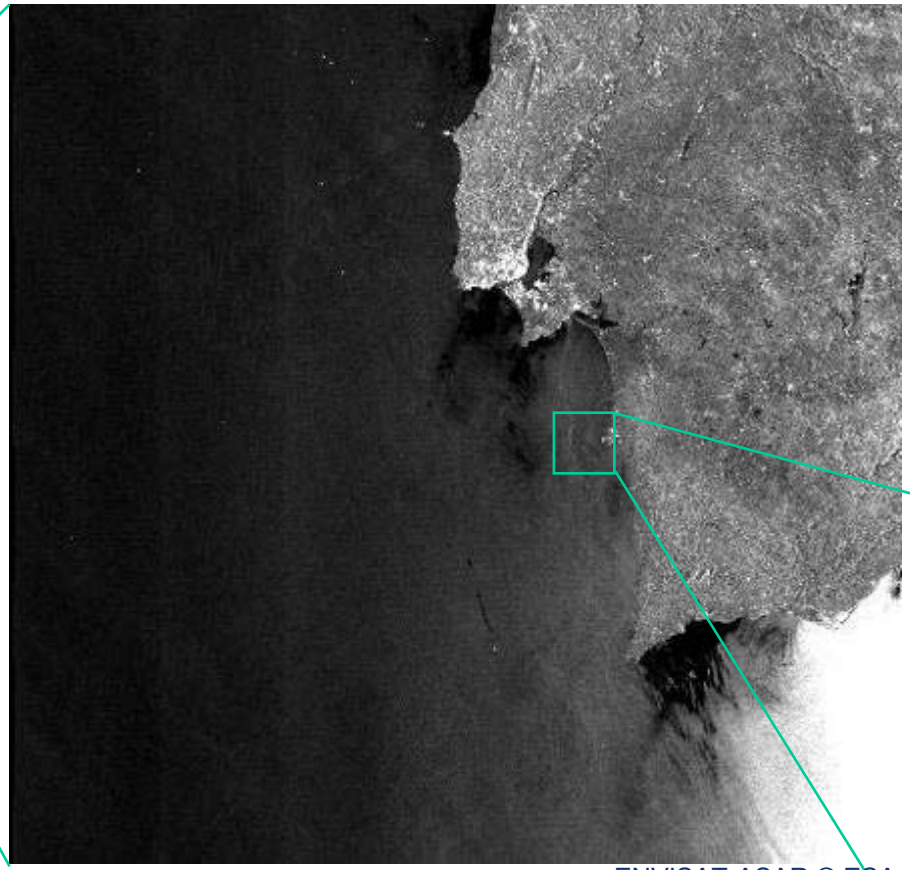
EDISOFT

SKYSOFT PORTUGAL

Satellite radar image – Wide

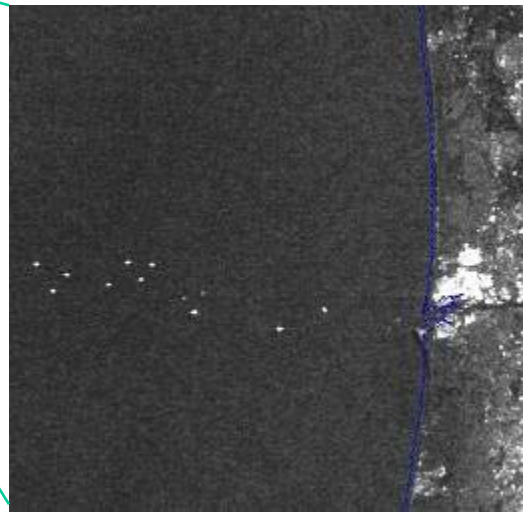


300-400 km swath



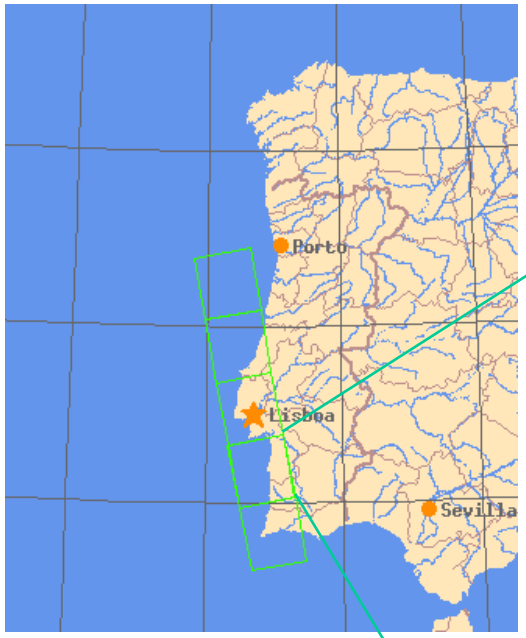
ENVISAT-ASAR © ESA

50-150 m resolution

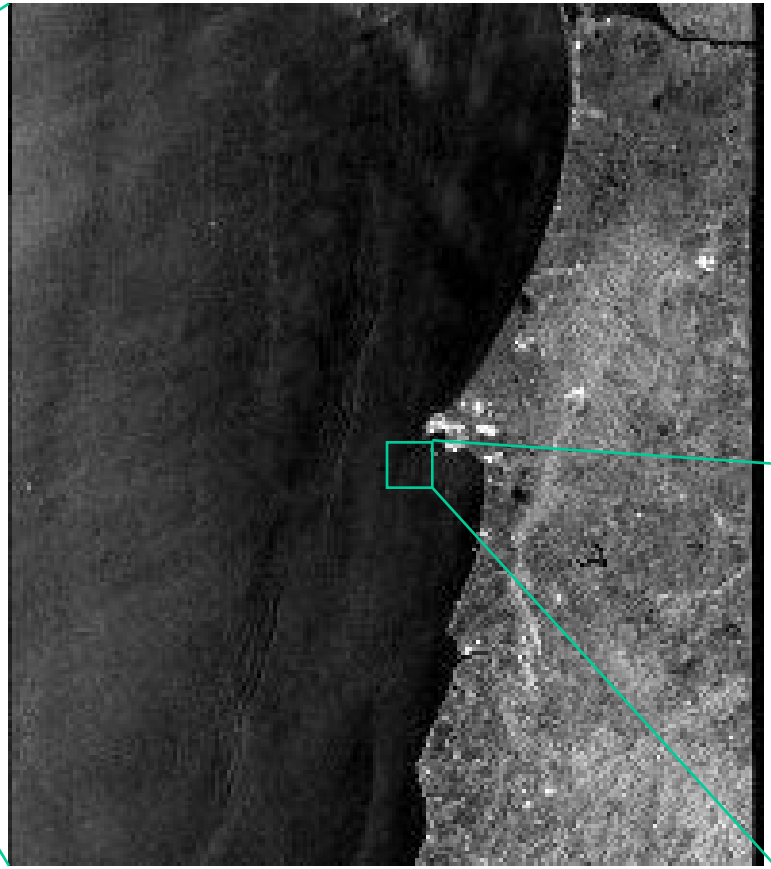


only to show relative size, not actual zoom→

Satellite radar image – Standard

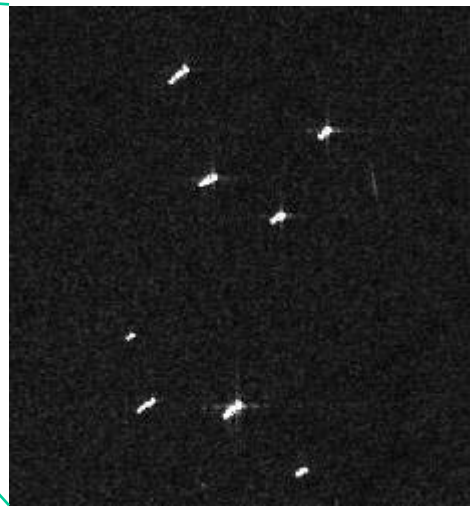


100 km swath



ENVISAT-ASAR © ESA

25 m resolution



RADARSAT © CSA/MDA

Satellite optical image

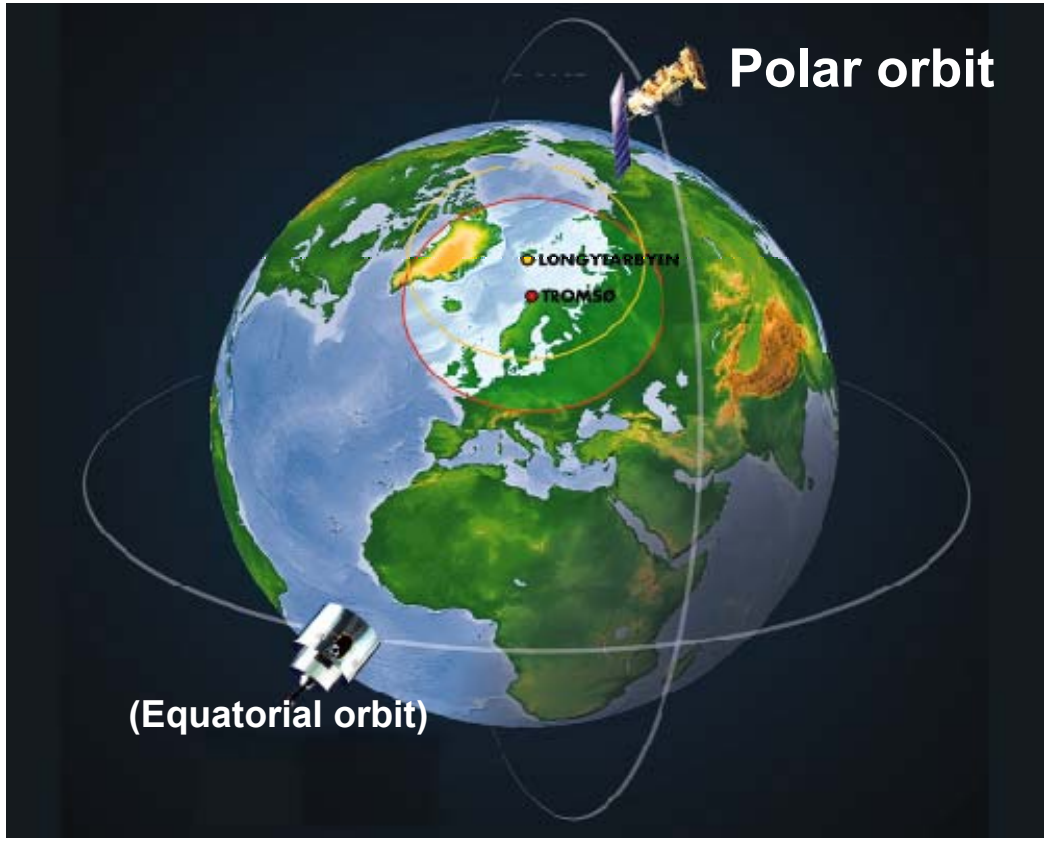
10-15 km swath

QUICKBIRD © DigitalGlobe

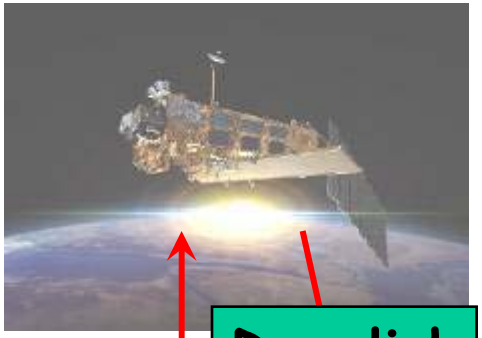
<1 m resolution

Images from satellite

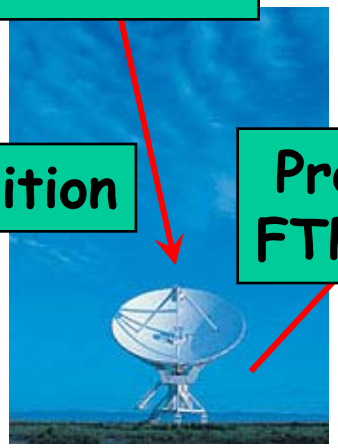
- Altitude ≈700 km
- Polar orbiting
- Make snapshot of area
- Always at same time of day
- Must wait until satellite passes within range
- One image every 1 to 4 days, depending on latitude
- Wide area, low resolution
  or
  Small area, high resolution



Vessel Detection System (VDS)

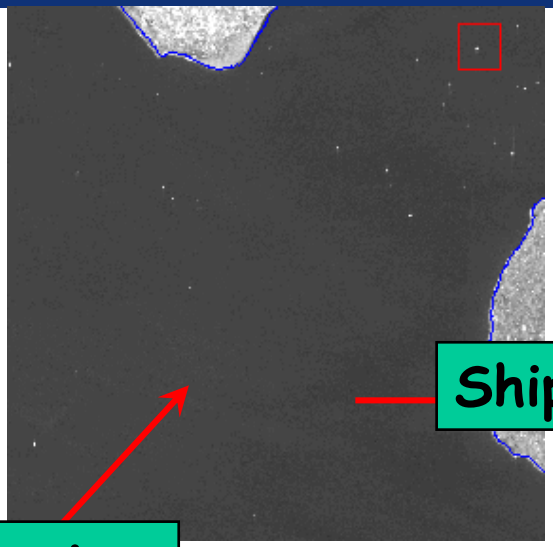


Downlink

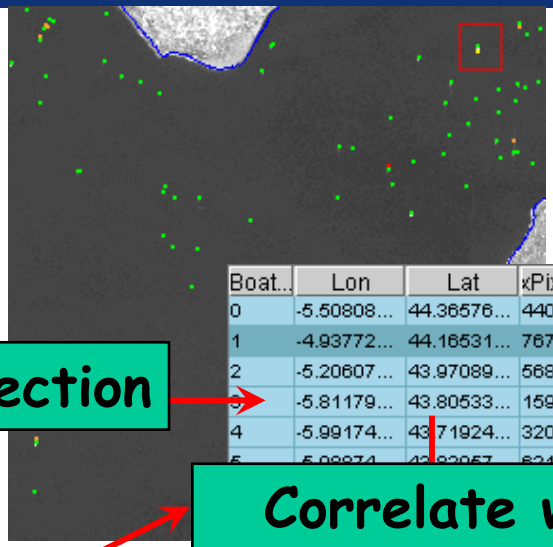


Acquisition

Processing FTP to JRC

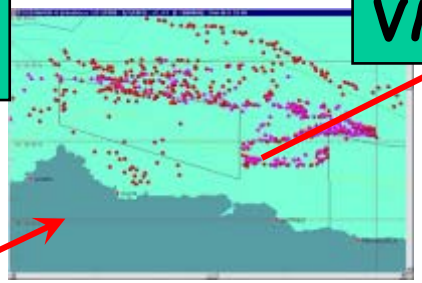


Ship detection

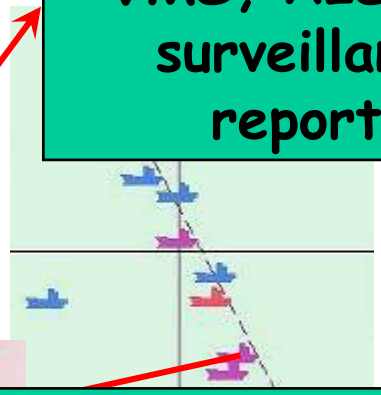


Boat...	Lon	Lat	xPixel...	yPixe...	MaxVa...
0	-5.50808...	44.36576...	4401	722	11583
1	-4.93772...	44.16531...	7678	3103	11996
2	-5.20607...	43.97089...	5689	4516	10596
3	-5.81179...	43.80533...	1599	5283	11655
4	-5.99174...	43.71924...	320	5827	37631

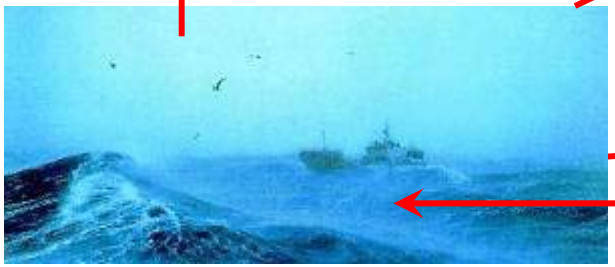
Correlate with VMS, AIS and surveillance reports



VMS



AIS

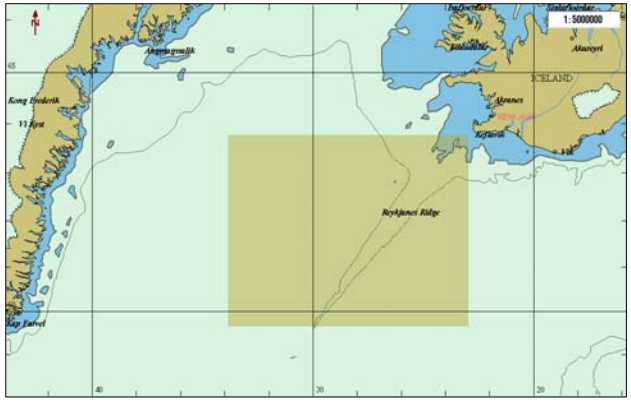


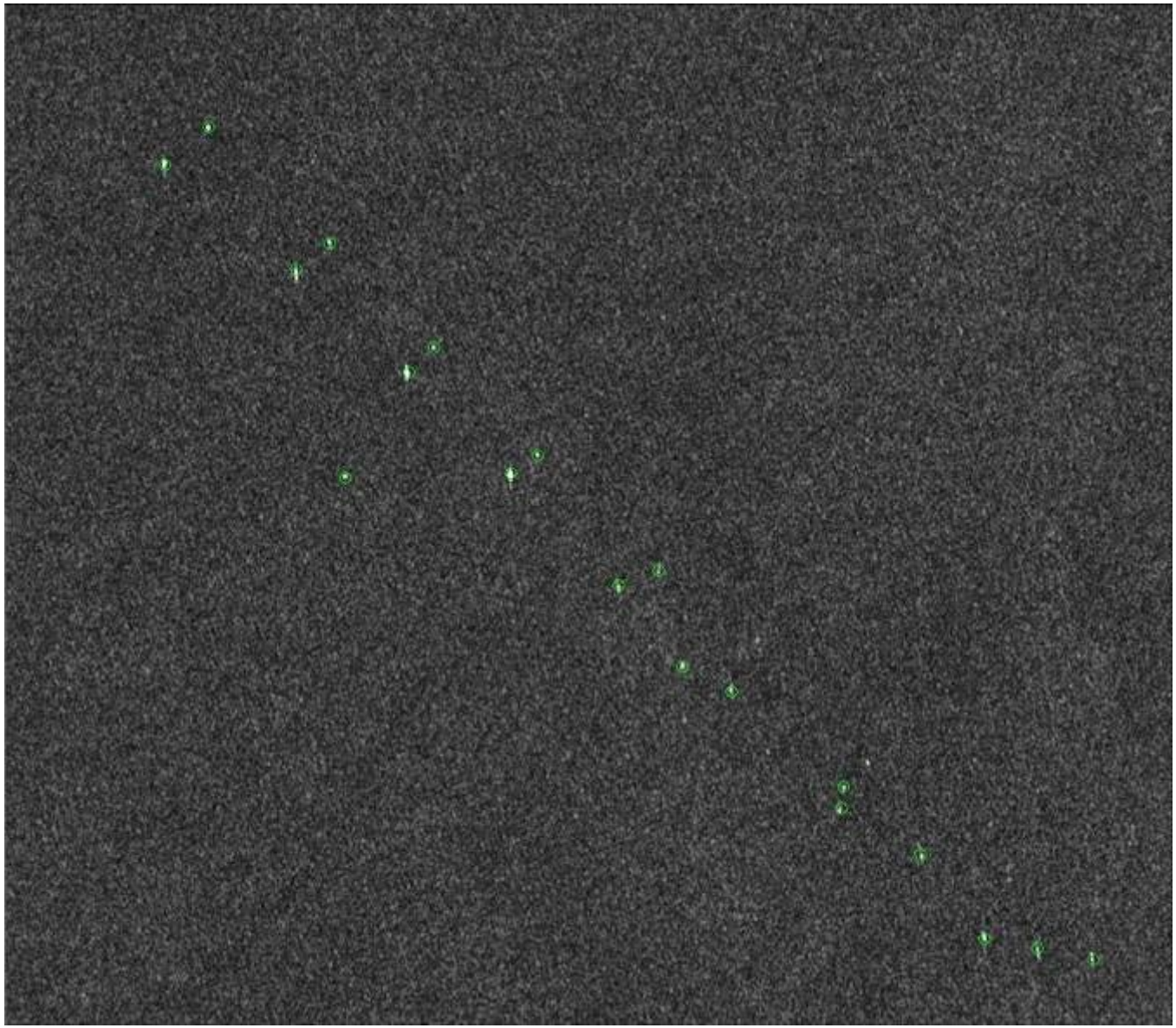
Suspect positions to authorities

Total: 30 min

Example: NEAFC

- Fisheries control
- North-East Atlantic Fisheries Convention

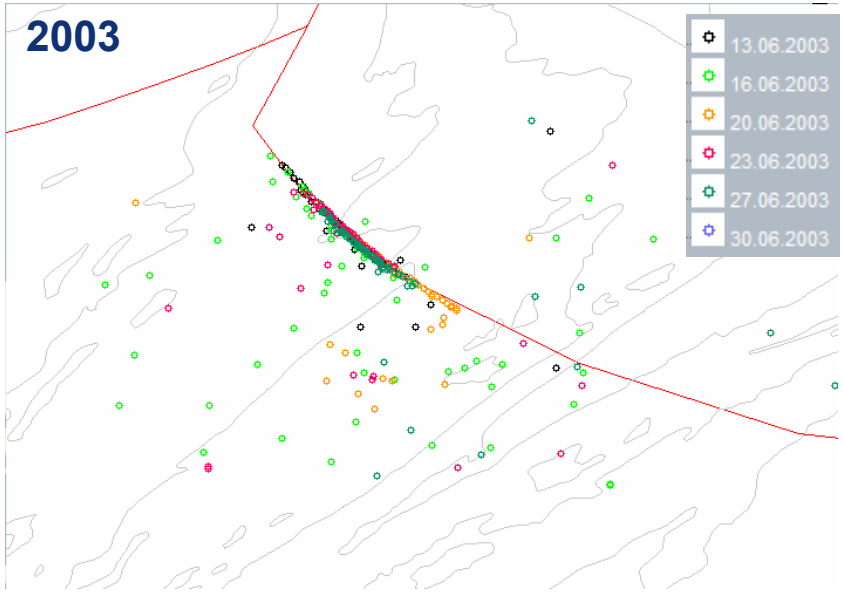


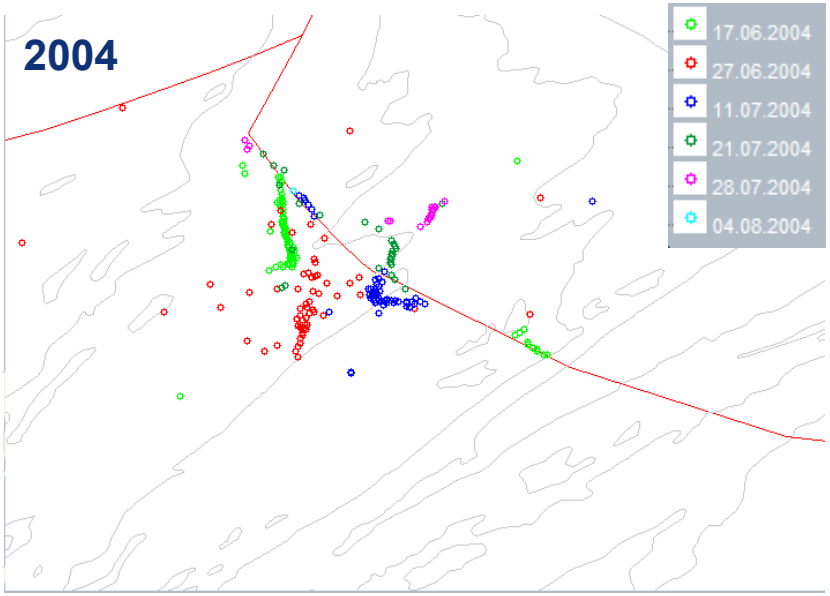


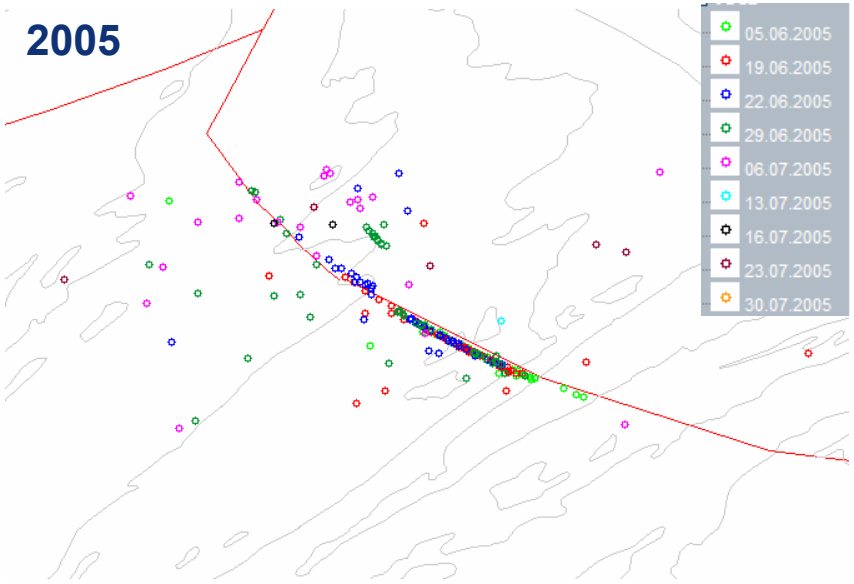
RADARSAT © CSA/MDA

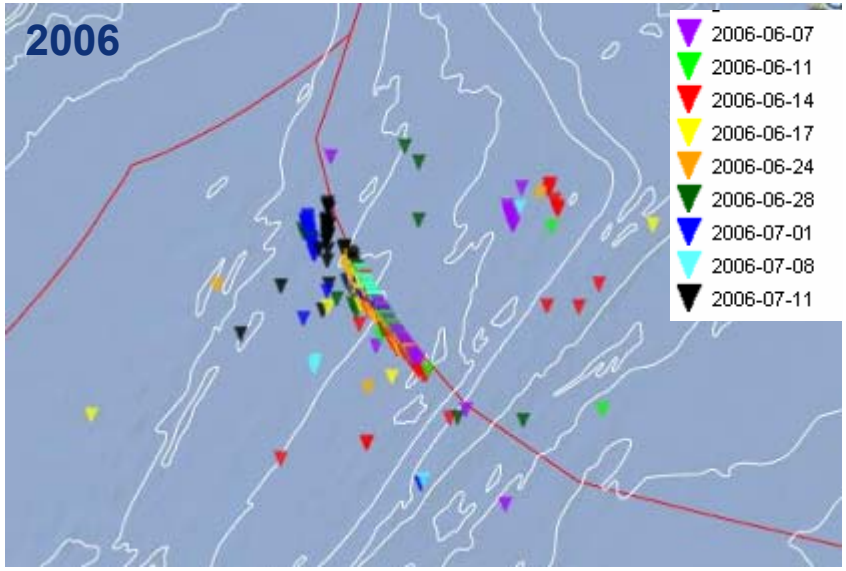
Correlate VDS - VMS

Multi-year survey









Capabilities of imaging satellite

Satellite can be used for wide area maritime surveillance:

- Medium-large ships
- Regular checks, overviews
- Statistics, patterns
- Support airborne patrol

√ Ocean fisheries control
√ Illegal immigration and smuggling (not using small boats)
√ Security related to merchant shipping

Shortfalls of imaging satellite

- Problem to search for small targets in wide areas
- Not capabable of continuous / frequent monitoring

X Drug smuggling across Atlantic
X Illegal immigration on small boats
X Fisheries control closer to the coast

Future of maritime surveillance

- More and better satellites
  - TerraSAR-X, CosmoSkymed, Radarsat-2 (now)
  - Sentinel-1, … (2012)
- Further integration of surveillance systems
  - New EU maritime policy (http://ec.europa.eu/maritimeaffairs/subpage_en.html)
- New concepts
  - Reception of ship's AIS messages by satellite (coastal → global)
  - Unmanned Aerial Vehicles (UAV)
  - Buoys, Unmanned Surface Vehicles, others…
  - Improved automatic processing of sensor data
- R&D under FP7 and by JRC

The end

Harm.Greidanus @ jrc.it
EC Joint Research Centre
TP 051
21027 Ispra (VA), Italy
T +39-0332-78 9739