



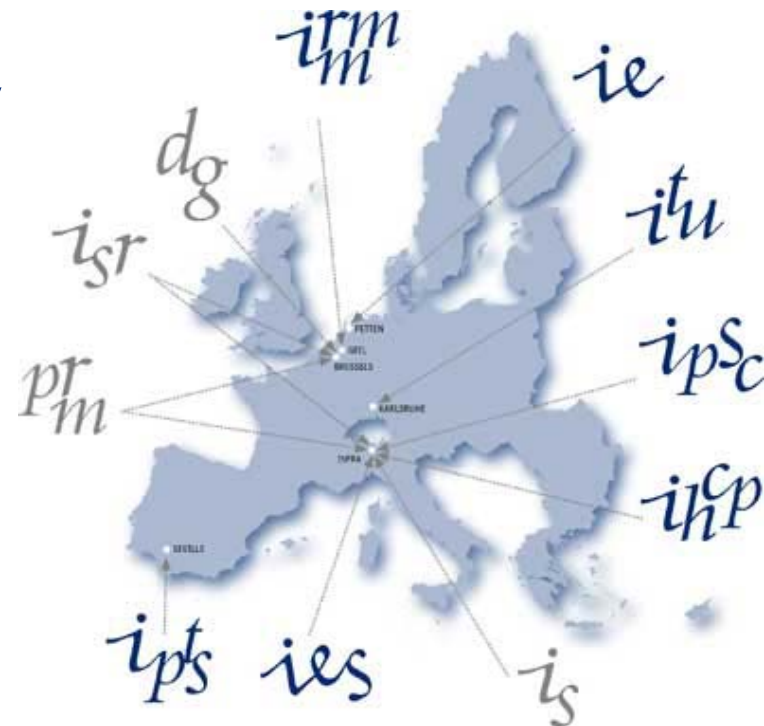
R&D in Support of EU Policies on Maritime Border Surveillance

**H. Greidanus, G. Ferraro, A. Gabban, U. Kroener,
V. Silva, T. Tares, F.X. Thoorens, M. Vespe**

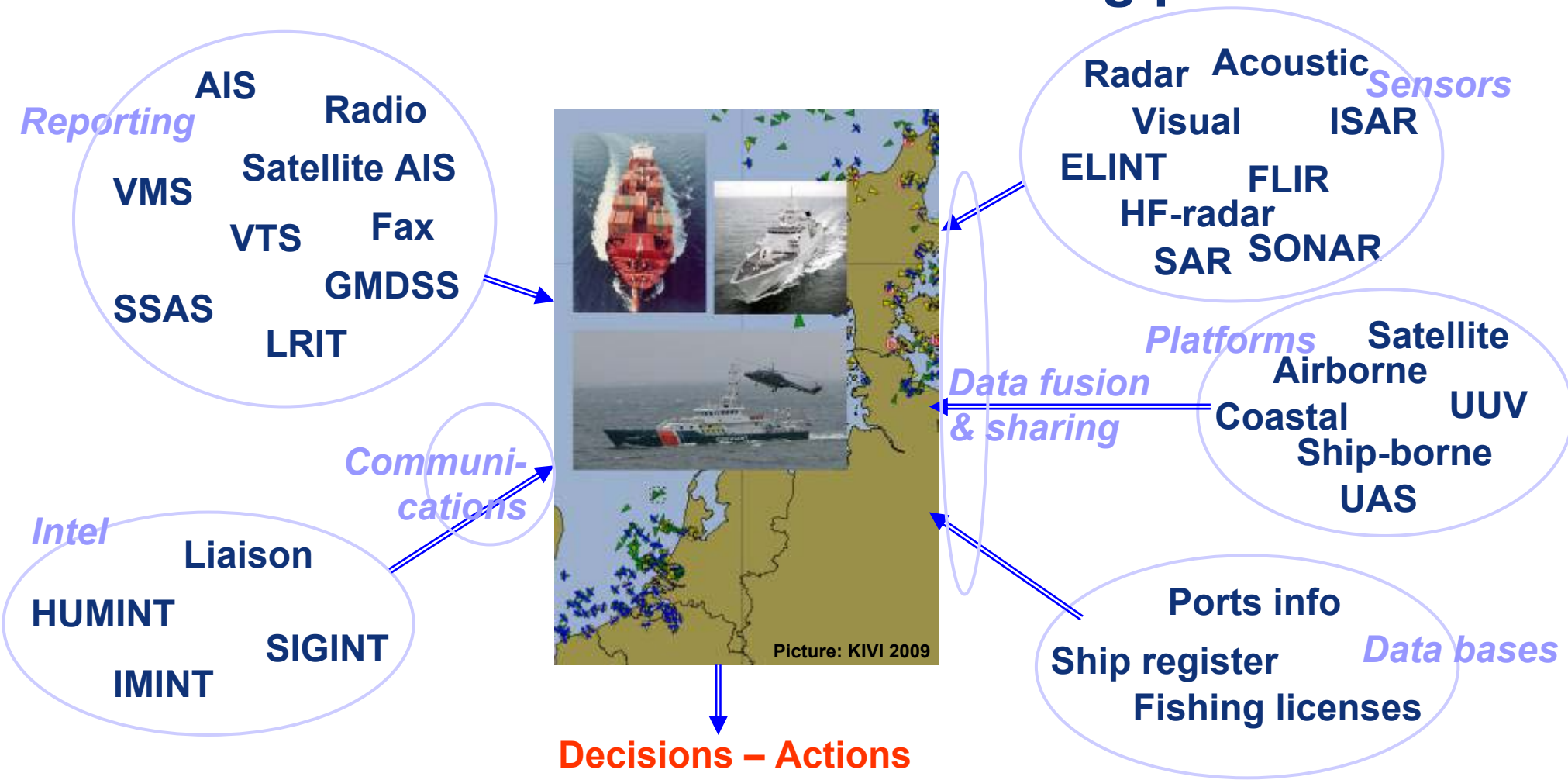
European Commission – Joint Research Centre

Joint Research Centre – Who we are

- Scientific and technical support for European Union policies (conception, development, implementation and monitoring)
- For European Commission, Agencies, Member States
- Part of the European Commission
- Reference centre of science and technology for the EU
- Serves the common interest of the Member States
- Independent of special interests (private or national)
- 7 Institutes, 5 sites



Maritime border surveillance – The big picture



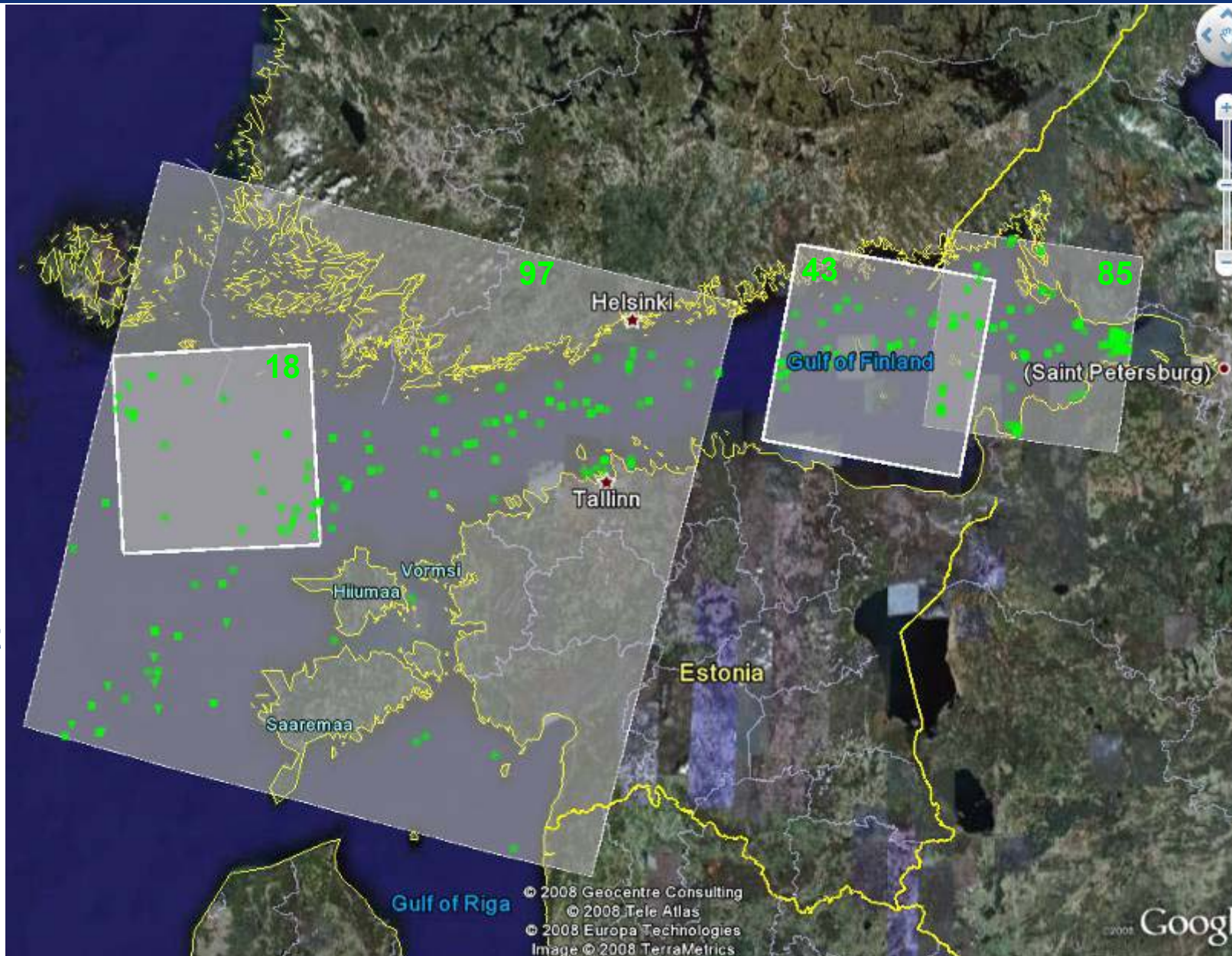
- Reporting systems
 - Satellite-AIS DG MARE-funded pilot
- Sensors
 - Satellite SAR (Synthetic Aperture Radar)
 - Passive AIS
- Platforms
 - Unmanned Airborne Systems (UAS)
- Communications
 - Hardening of GNSS based trackers
- Data fusion & sharing
 - VMS + AIS + ...
 - CISE
 - C-SIGMA
- Maritime surveillance concepts
 - EUROSUR
 - GMES Border Security

Linked to
EDA (European
Defense Agency)

June + Nov 2008

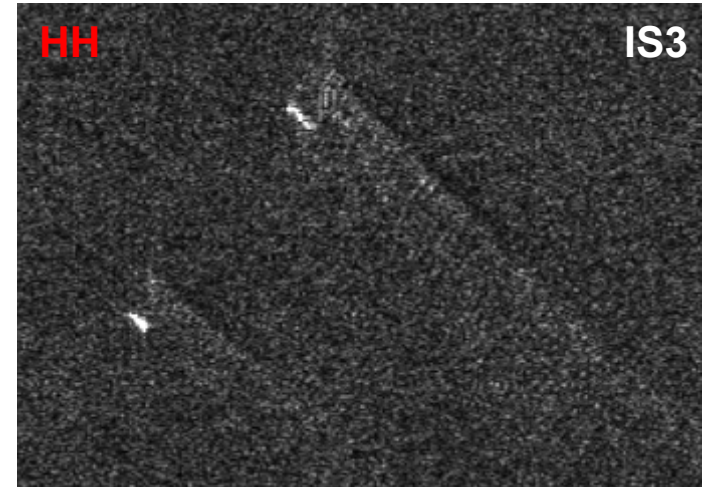
General maritime
awareness

- *Most value:*
away from coast
- *Problems:*
with the many
small islands

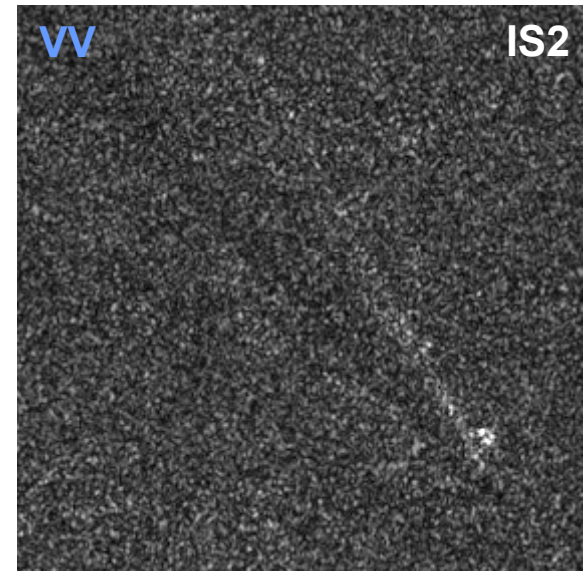


Ships and wakes

ENVISAT Alternating Polarisation
Baltic Sea, 2006

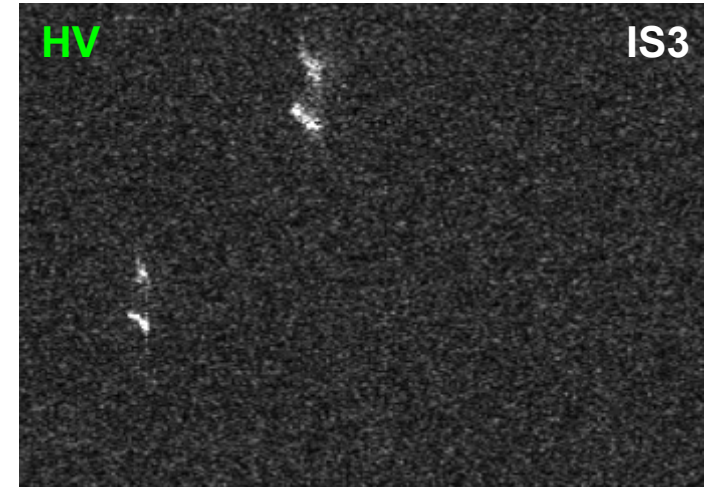
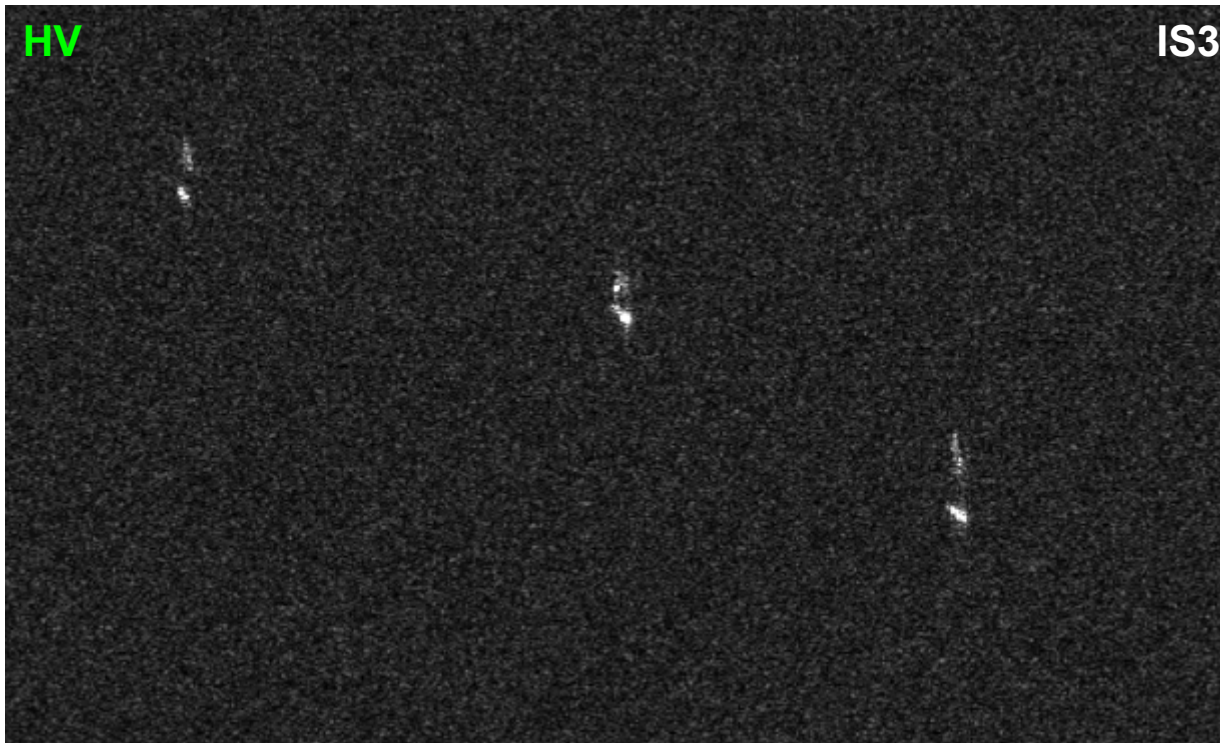


ENVISAT-ASAR © ESA

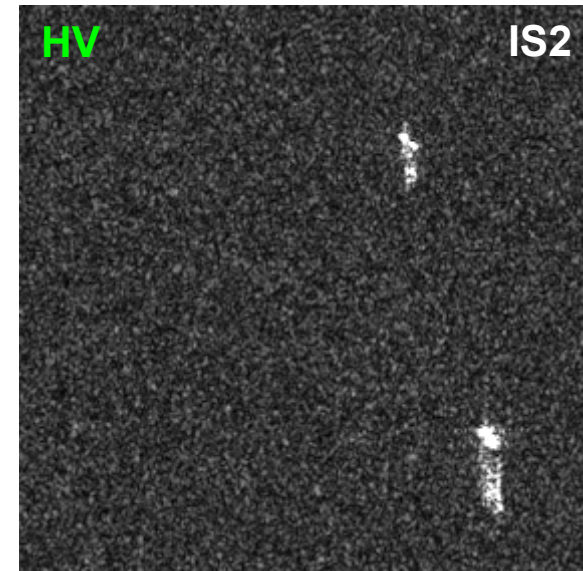


Ships and wakes

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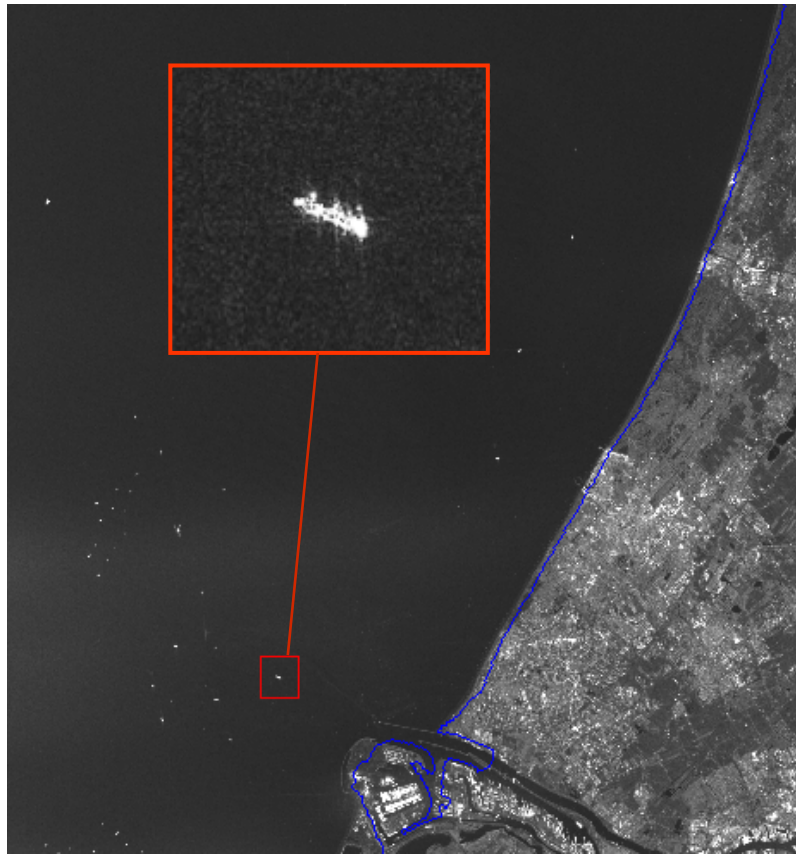


ENVISAT-ASAR © ESA



From...

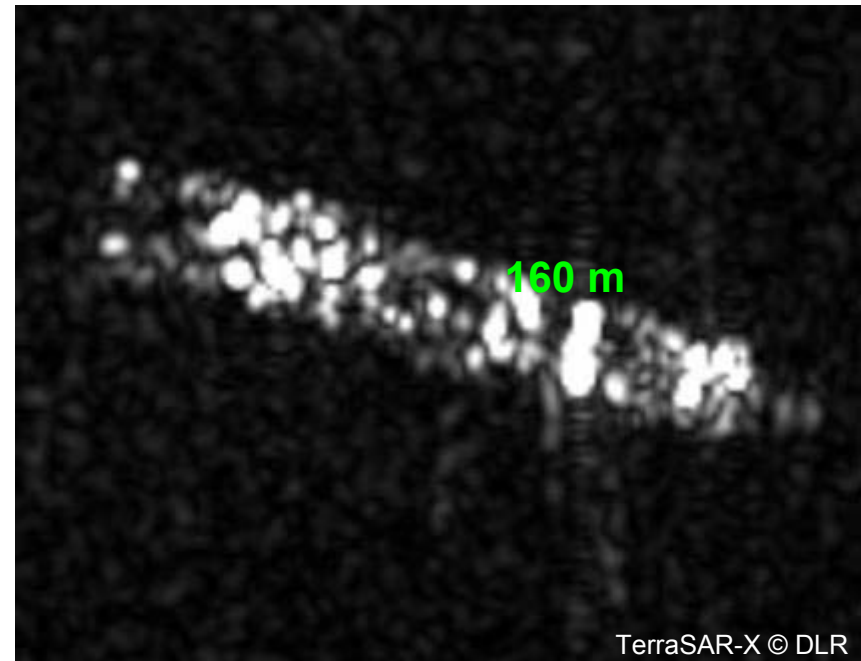
**Radarsat-1 Fine 10 m resolution
(North Sea)**



RADARSAT-1 © CSA/MDA

To...

**TerraSAR-X Stripmap 3 m resolution
(Caribbean, June 2008)**

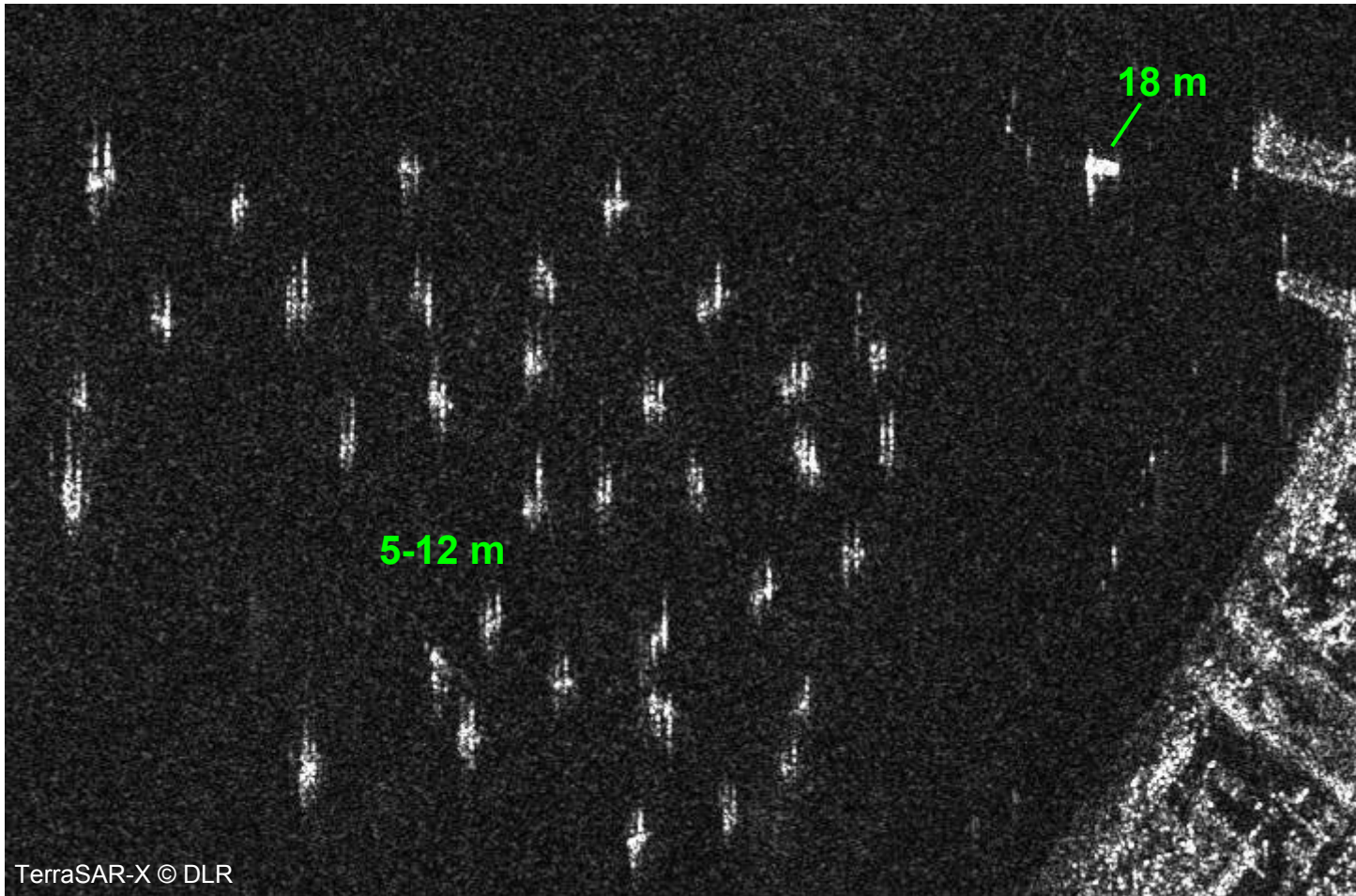


 **LIMES** EADS Astrium, JRC, EUSC, SPOT Image, Nev@ntropic

Merchant Vessel



TerraSAR-X Spotlight 1.5 m resolution Caribbean, June 2008

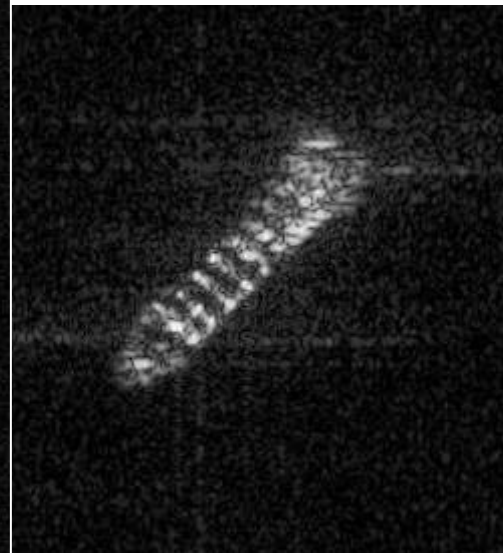


Fishing vessel



Sailing boat





Radarsat-2
North Sea, Jan 2009

RADARSAT-2 © CSA/MDA

UltraFine HH
From SLC

Small boat detection from satellite

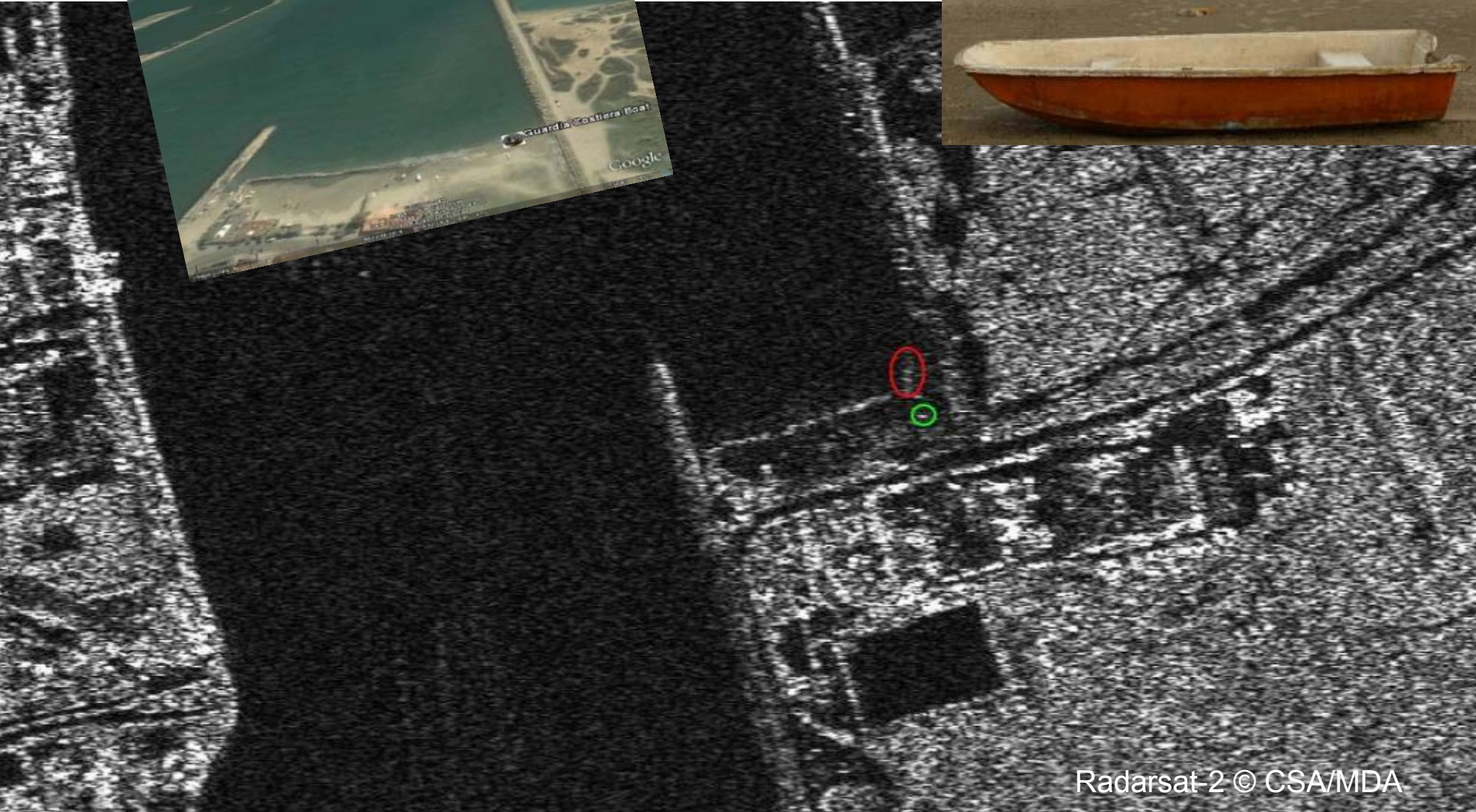
- Illegal immigrants often use small boats (5 – 8 meter)
- The earlier they are found the better
- Even already on the departure shores
- Can SAR (radar) satellite do this?

Trial (2009) with:

- Frontex
- Italian Coast Guard and Guardia di Finanza
- Spanish Navy
- New VHR SAR satellites
 - 1-3 m resolution
 - Radarsat-2, TerraSAR-X, CosmoSkymed



European Maritime Day, Gijon, 21 May 2014

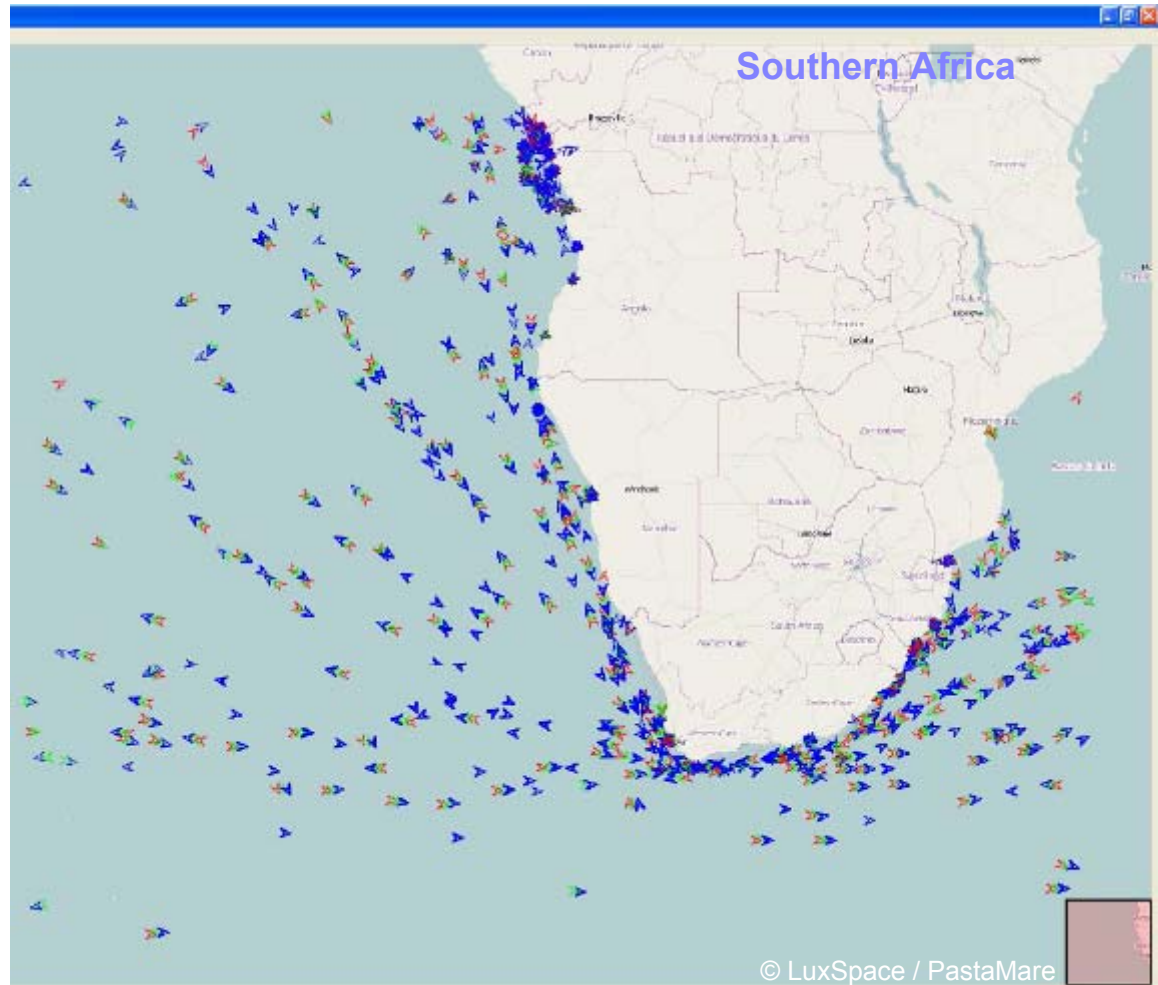


Preliminary validation with terrestrial AIS indicates:

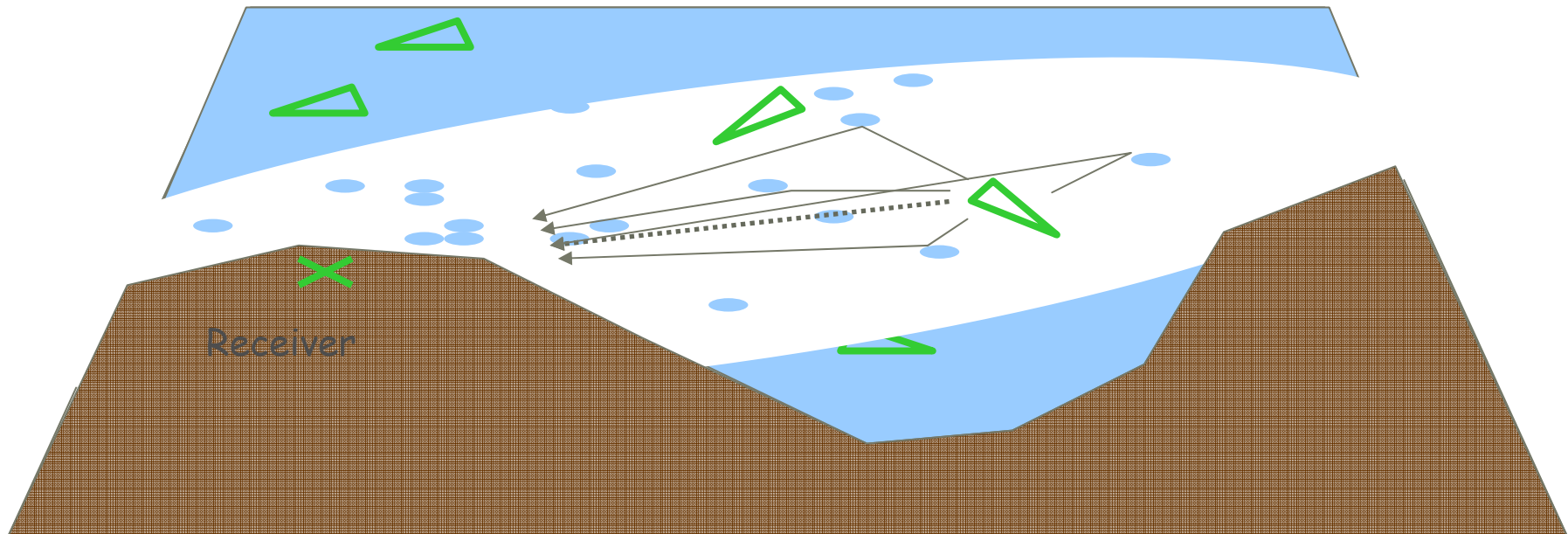
- Detection of S-AIS is 50 % – 65 % (Orbcomm – Pathfinder)
- With experimental systems

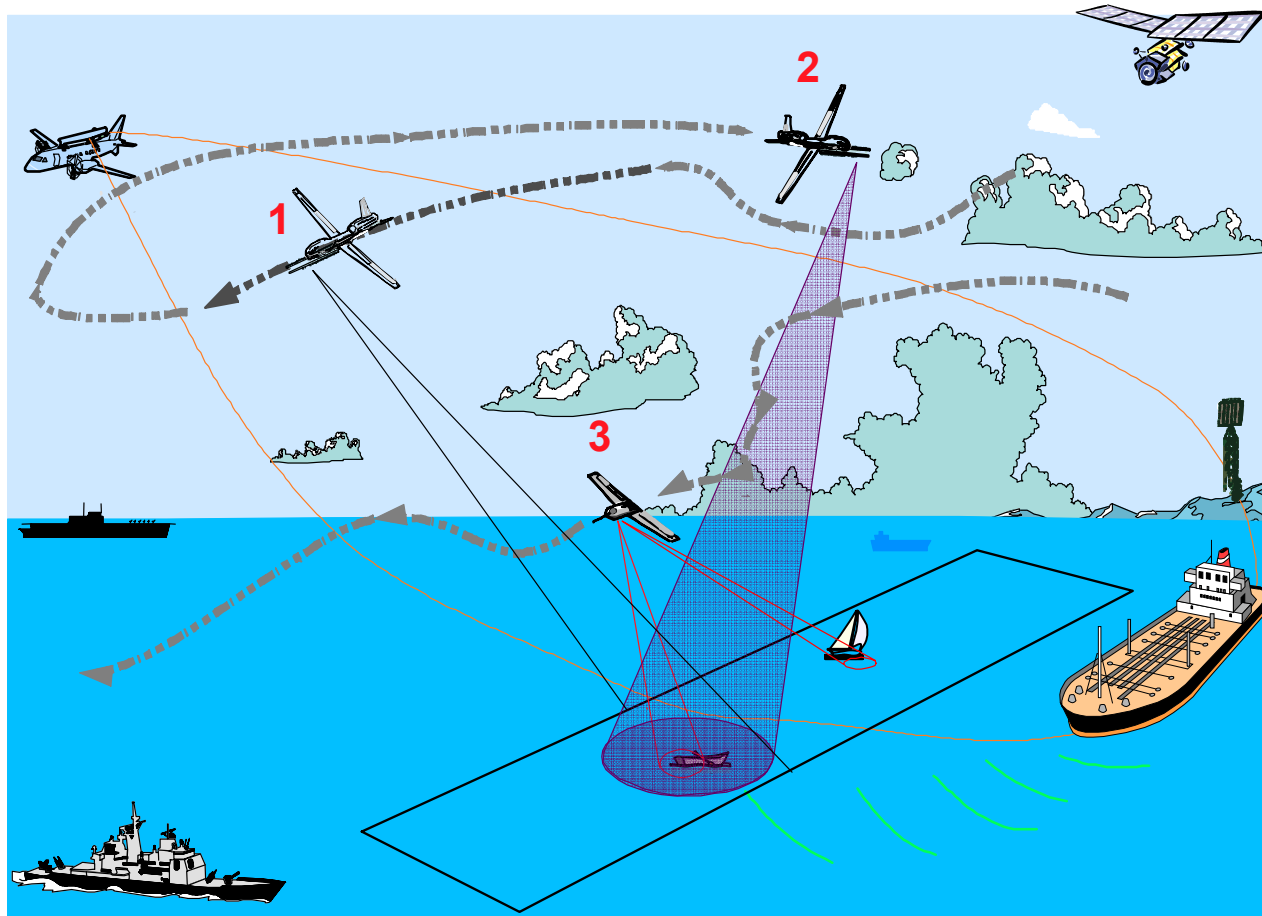


- Orbcomm FM37 ➤
- Orbcomm FM39 ➤
- Pathfinder 2 ➤



- Receive AIS (HF radio) signal that is reflected off other boats
- Disentangling the many reflections is made easier because:
 - AIS transmitter reports its own location
 - Several AIS transmitters, but only one at a time



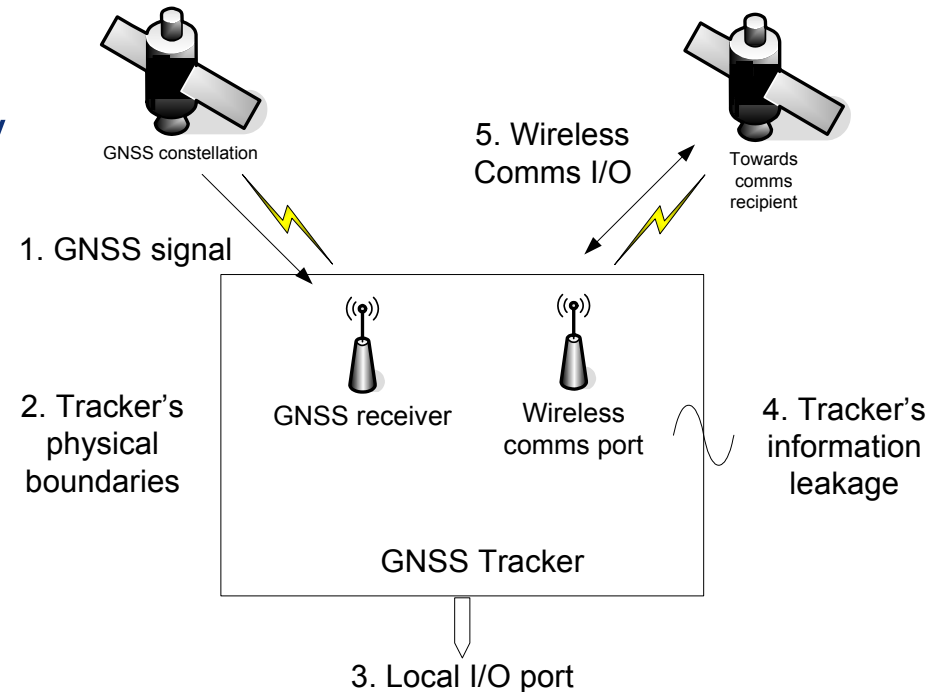


- Wide Maritime Area Airborne Surveillance
- FP7 capability project
- Towards unmanned systems
- Scenarios
- System of systems
- Sensors
- Operations, command & control

- 14 Partners
- Lead: Thales Airborne Systems (TSA)



- Global Navigation Satellite Systems (GNSS): GPS, Galileo, ...
 - Used in VMS, AIS, transport of hazardous goods, ...
- Incentives to induce false reporting
- Vulnerabilities & remedies:
 - Fake GNSS signal (1) → Validation by inertial measurement, internal clock, dual antenna
 - Physical opening (2) → Seals, destruction of h/w or s/w on opening
 - Fake messages (5) → Timestamp, digital signatures, crypto chip
 - More ...
- Good news:
Measures are often economically feasible



- US initiative for global space partnership
- Workshop 27-29 Sept, Washington DC
 - Co-hosted by European Commission



US Coast Guard; and
Office of Global Maritime Situational Awareness

The end



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