ESA's Contribution to Space Technology for Maritime Surveillance

Future Trend of Integrated Space Applications (IAP) And Services

Maritime Surveillance Conference: Cooperation in the Practice

May 7th 2015, EMSA, Lisbon

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European Space Agency

Table of content

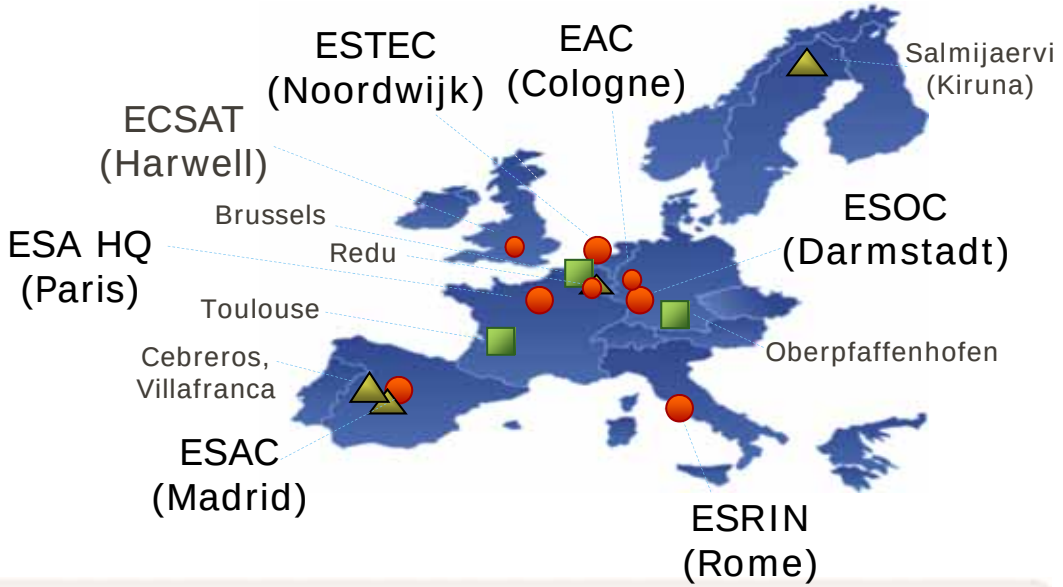
ARTES= Advanced Research on TElecommunication Satellite Systems
IAP= Integrated Applications Promotion programme

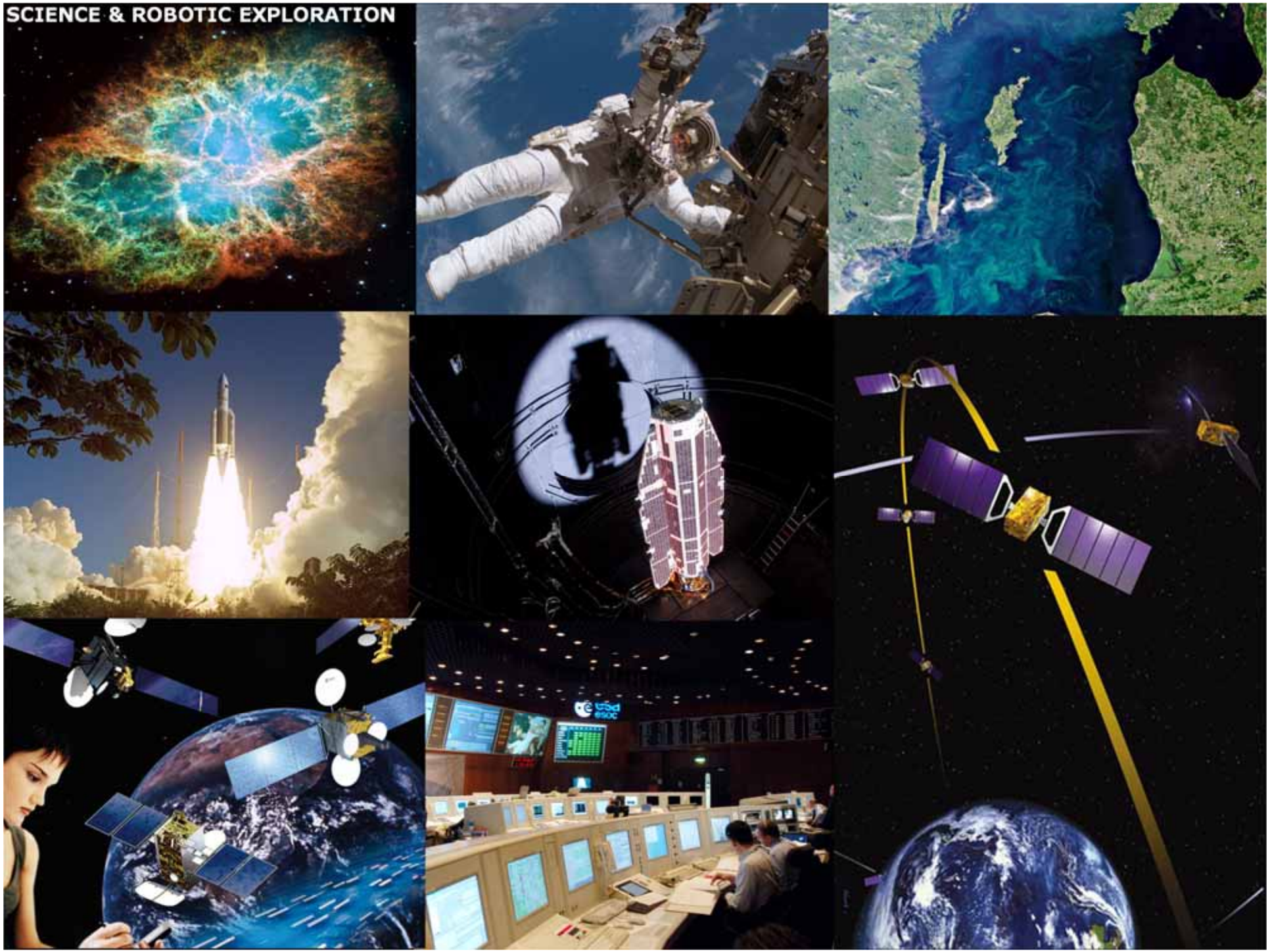
ESA'S LOCATIONS

ESA sites/facilities

Offices

ESA ground stations




SCIENCE & ROBOTIC EXPLORATION

The Sentinel Family

The world's most comprehensive suite of EO missions

- S1: Radar Mission
- S2: High Resolution Optical Mission
- S3: Medium Resolution Imaging and Altimetry Mission
- S4: GEO Atmospheric Chemistry Mission
- S5P/S5: LEO Atmospheric Chemistry Missions
- S6/Jason-CS: Altimetry Mission

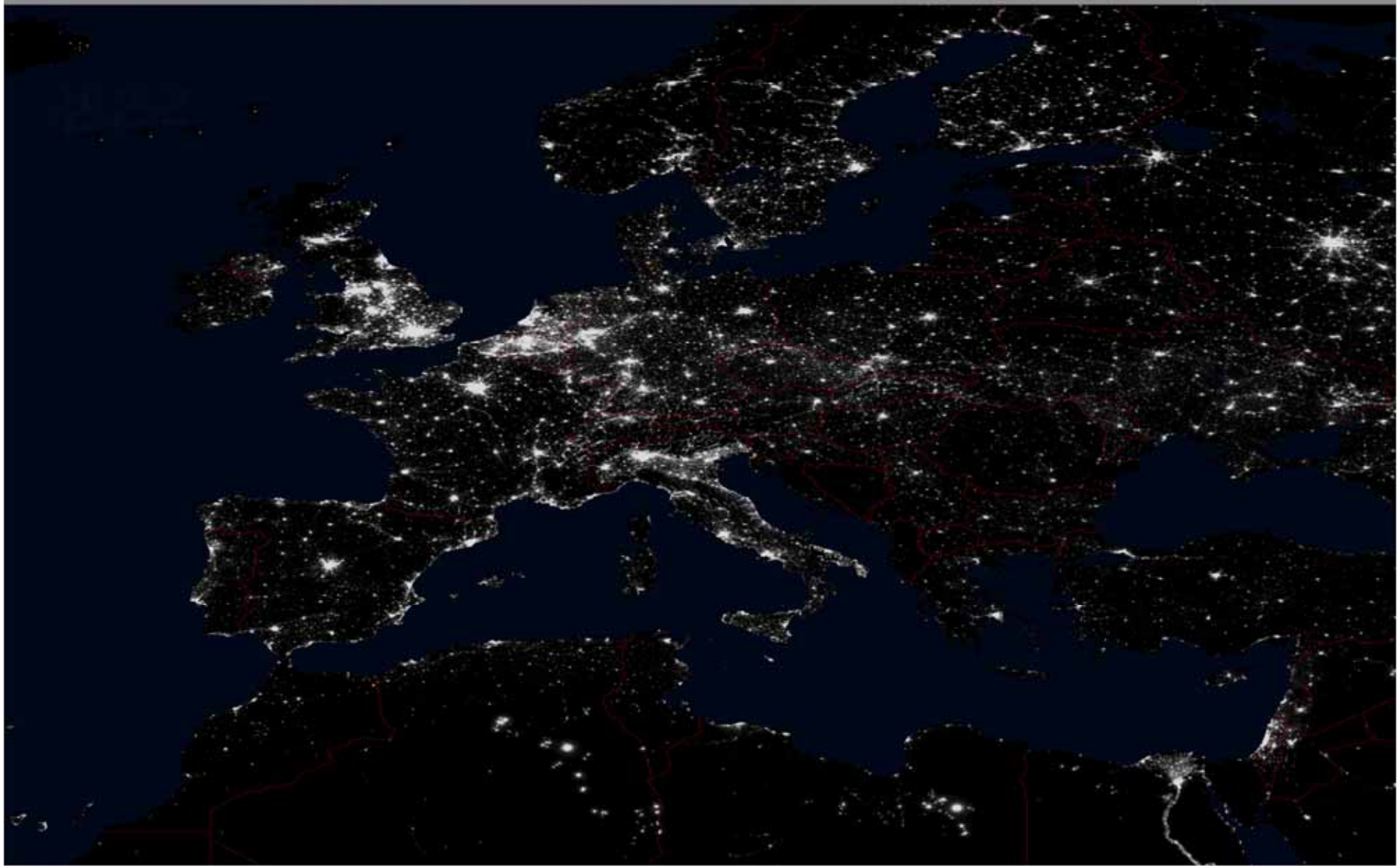
NEW TELECOM PROGRAMMES AND INTEGRATED APPLICATIONS

EDRS (2013/15) the European Data Relay Satellite system. An independent European system to reduce time delays in transmission of large data quantities, making on-demand data available at the right place, at the right time.

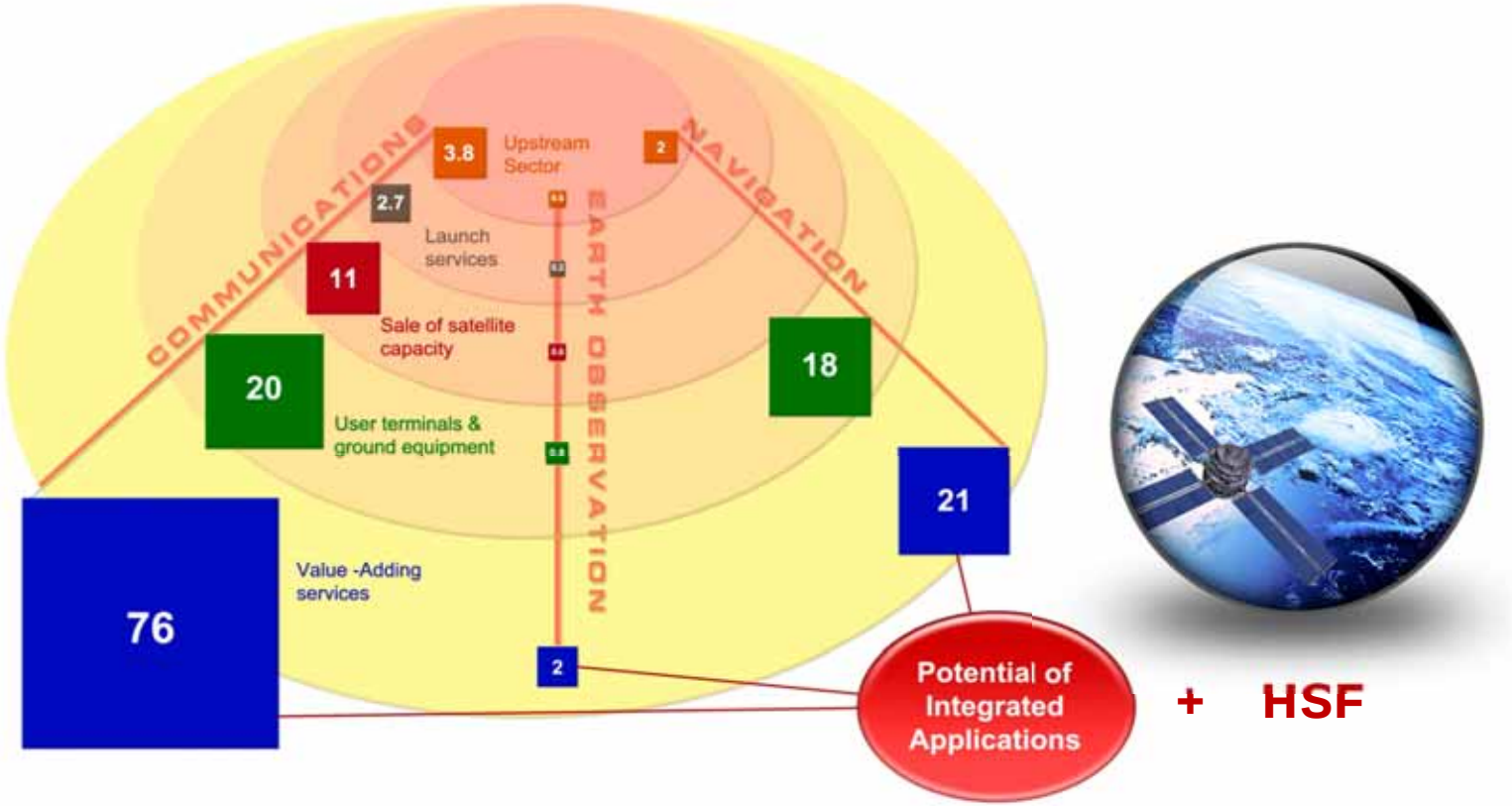
Integrated Applications Promotion (IAP)

SAT-AIS Microsatellites EMSA/ESA initiative: in partnership with LuxSpace & exactEarth

ESA HELPS TO MAKE SPACE PART OF DAILY LIFE FOR EUROPEAN CITIZENS



The Three Value Chains in Commercial Satellite Applications Global Space Market Revenue in US$Bn



1. **Sat communications are dominant with >75% of the downstream services revenue**
2. **Navigation is emerging 21%**
3. **EO is currently 2%**

Source: Euroconsult & GSA, 2009/10

Integrated Applications Promotion (IAP)

Programme Objective

- Existing space infrastructure
- Partnerships
- Customers
- Sustainable services
- Attract Investors attention

Incubator of Services

IAP is ESA's user driven strategy to leverage on space investments and develop sustainable services and new Missions

➔ Developin communities

User Demand

Operational Service

Institutional Cooperation
Strategic Partnerships

EMSA

Maritime Activities

EUROPEAN DEFENCE AGENCY

EUROCONTROL

EMSA

RPAS Activities

LUX DEV

eHealth for Sub-Saharan Africa

European Railway Agency

Space for Rail

European Investment Bank

"SMAP Fund"

Space for Mediterranean Acceleration Programme

Providing a Steady Stream of Opportunities

Thematic Areas

ARTES 20 =IAP

ARTES 3-4
Satcom Applications

Development

Water

European Investment Bank

Energy

Transport

Agriculture & Forestry

Tourism

Health

Maritime

Security

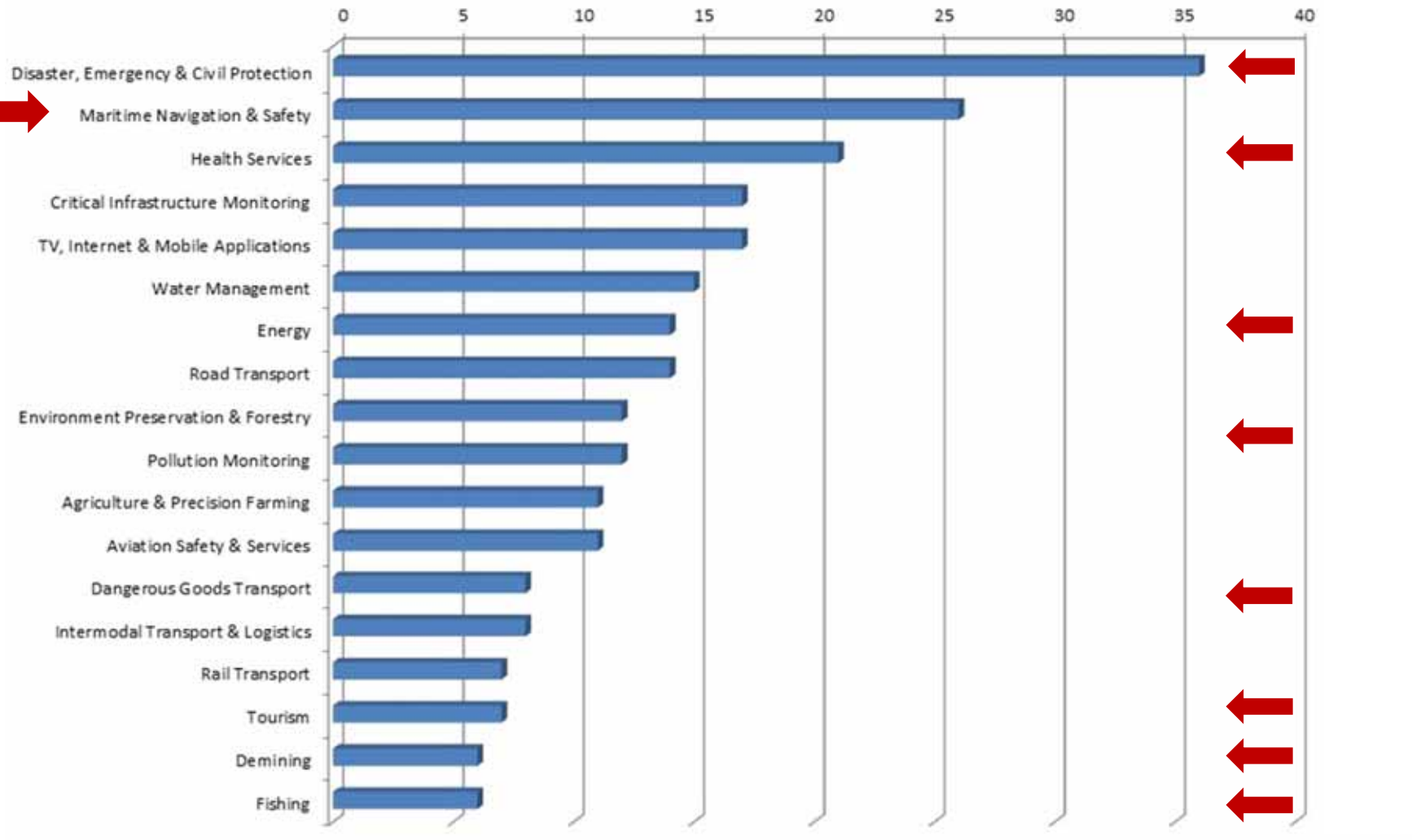
Media & Broadcasting

ARTES Missions:
(e.g. SAT-AIS, Alphasat, Hylas)

3rd Party Funding
(e.g EIB/EC/EDA/ EMSA/Partners)

IAP addresses almost every market sector

(Number of discrete planned activities excluding CCNs)

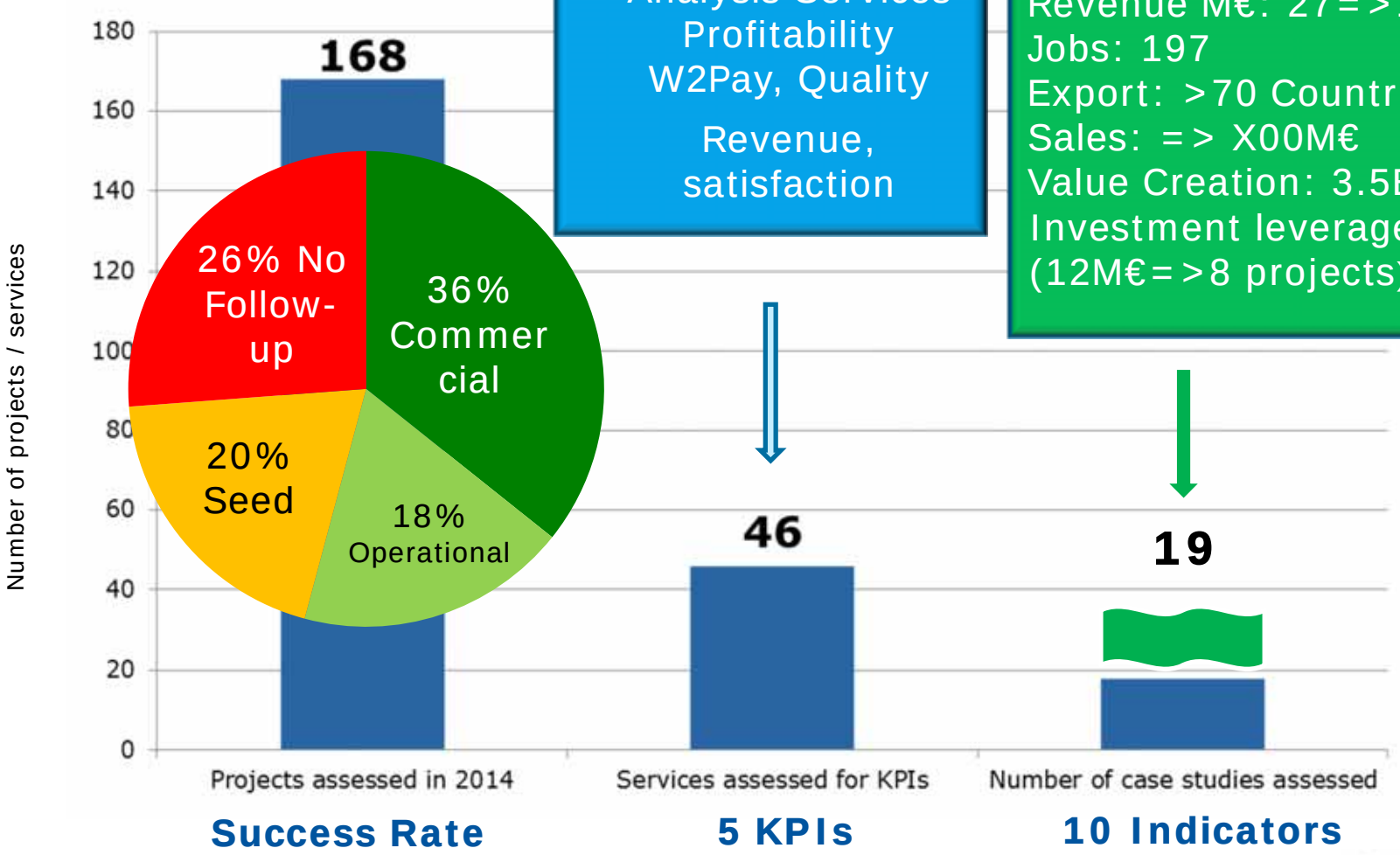


Evaluation of projects with sufficient maturity and available data

Analysis Services
Profitability
W2Pay, Quality

Revenue,
satisfaction

Revenue M€: 27=>107;553
Jobs: 197
Export: >70 Countries
Sales: => X00M€
Value Creation: 3.5B€
Investment leverage:
(12M€=>8 projects)



Success Rate **5 KPIs** **10 Indicators**

Birds and Flight Safety

GAF (1997-2004): 360 collisions strikes/year
FAF (1998-2005): 320 collisions strikes/year
RAF(<2004): 110 documented serious accidents

Estimated conservative cost due to damage and delays of commercial aircraft worldwide
1.2 billion USD per year

ARMÉE DE L'AIR

DEFENCE
PEACE OUR PRIORITY

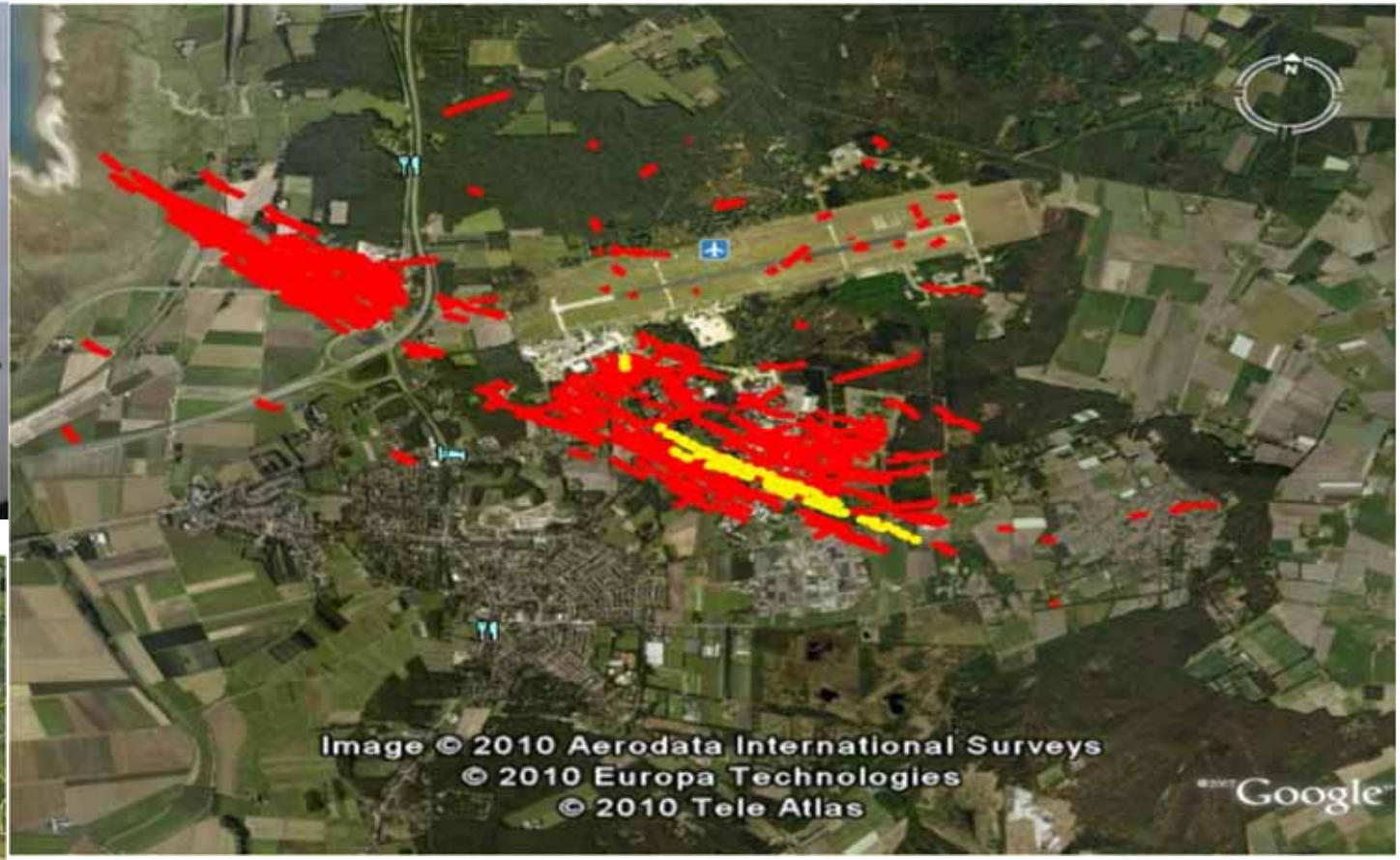
Birds and Flight Safety

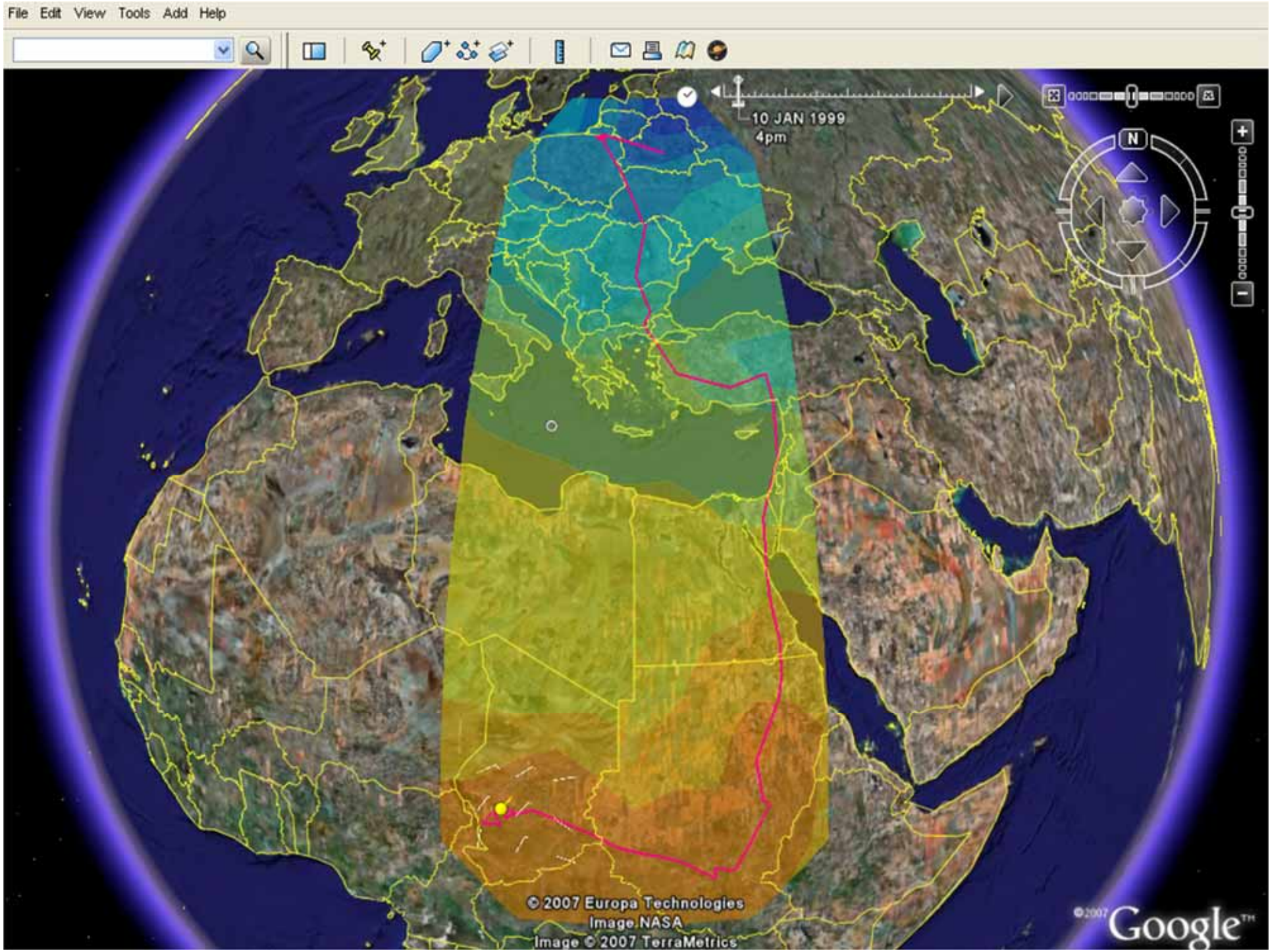
July 15 1996 a Belgian C-130 crashed at Eindhoven Air Base due to a bird strike. 34 people were killed and 7 people were seriously injured.

FlySafe project activities

Trial of on-airfield avian radar (ROBIN Lite)

- prevention of local bird strikes
- 2 D radar on 1 airbase

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© 2007 Europa Technologies
Image NASA
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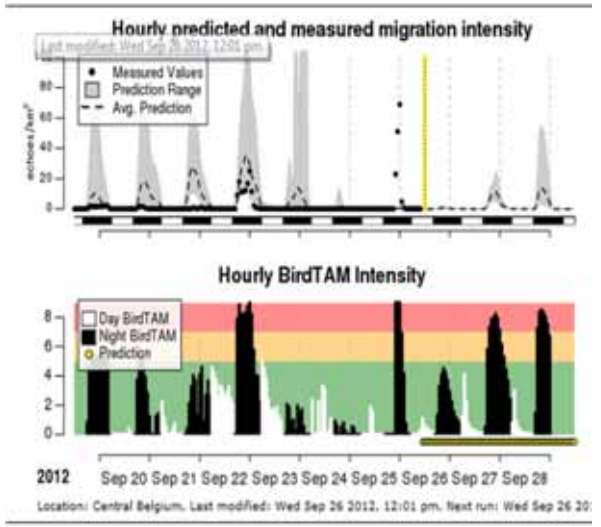
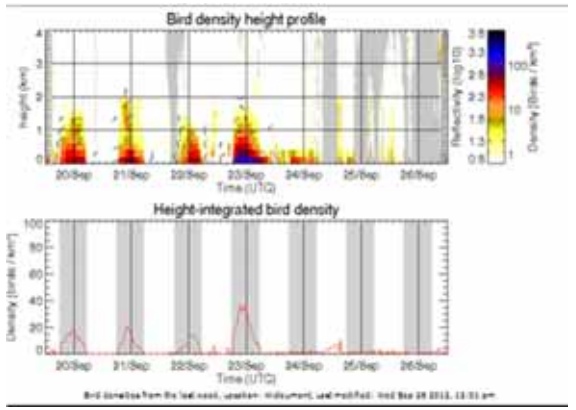
FlySafe web service



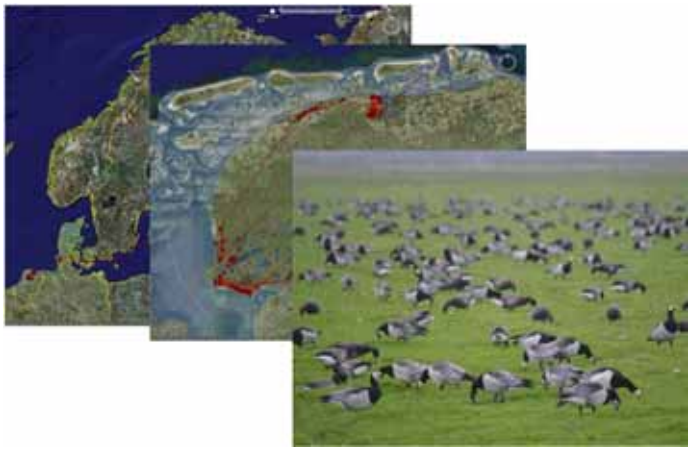


http://www.flysafe-birdtam.eu/

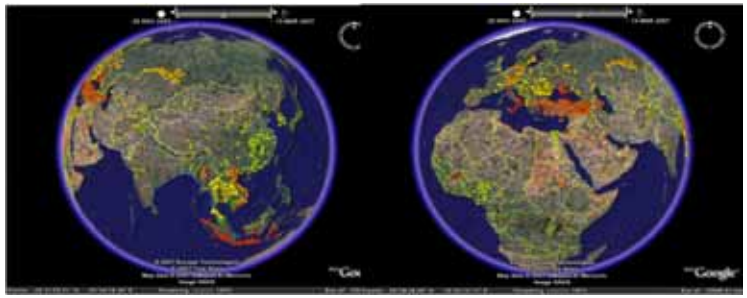
FlySafe, Spin-off Applications

Birds & Energy

Birds and Agriculture



Birds and Health



Avian Influenza H5N1 outbreaks

Source: Declan Butler http://declanbutler.info/blog/?p=58

Space for Mediterranean Countries & SMAP

S4Med has been initiated to Promote economic growth in Southern and Eastern Mediterranean countries

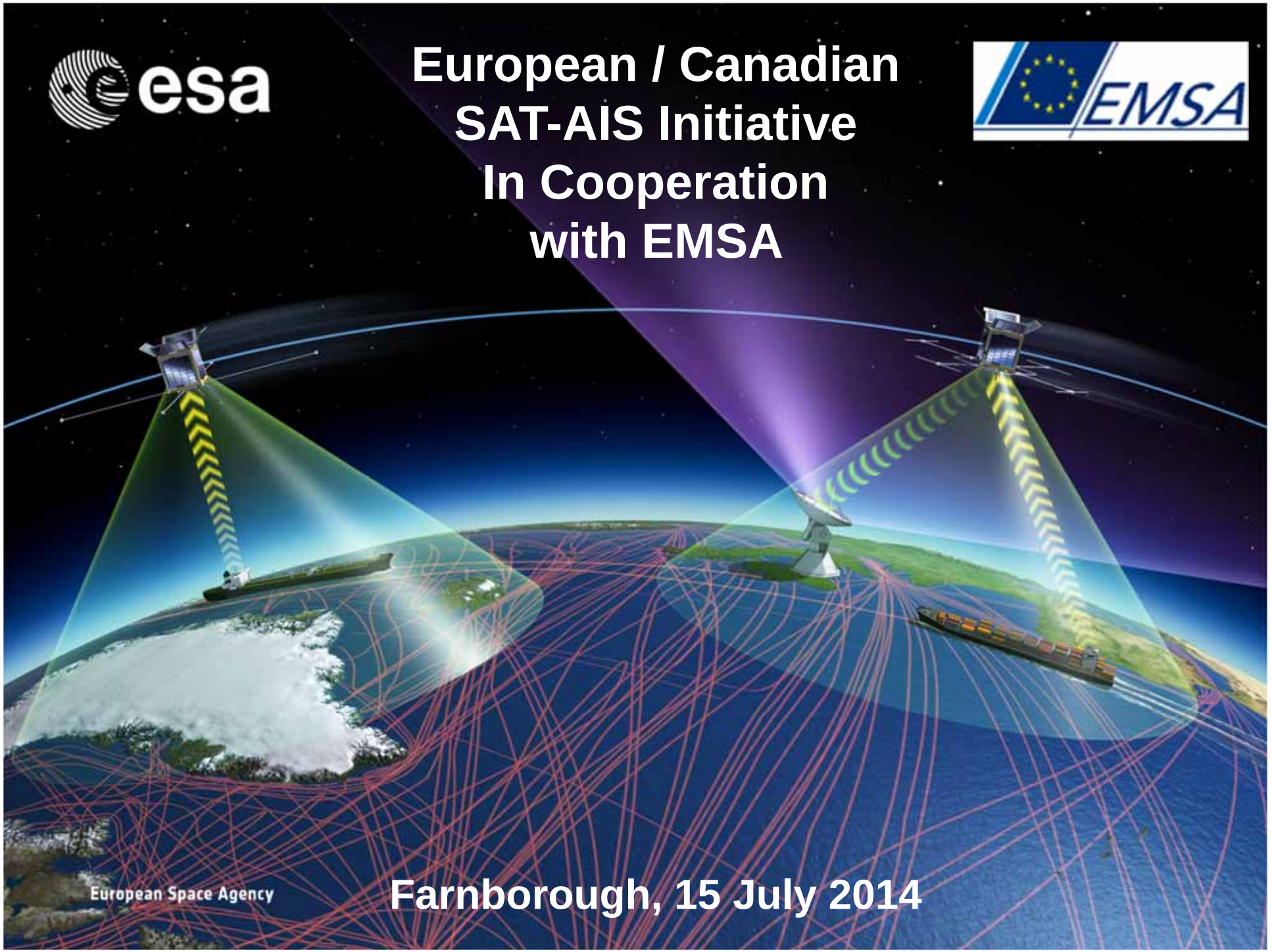
SMAP=Space 4 Med Accelerator Programme

MENA region represents a 350 mln people new market opportunity for NL companies with mature applications and services in ARTES Applications program

The SMAP TA in Jordan and the associated 6 mln JOD (~7.4 mln €) fund will foster collaboration between European companies and local entrepreneurs.

European Satellite AIS Mission
Users Driven in partnership with EMSA

European / Canadian SAT-AIS Initiative In Cooperation with EMSA



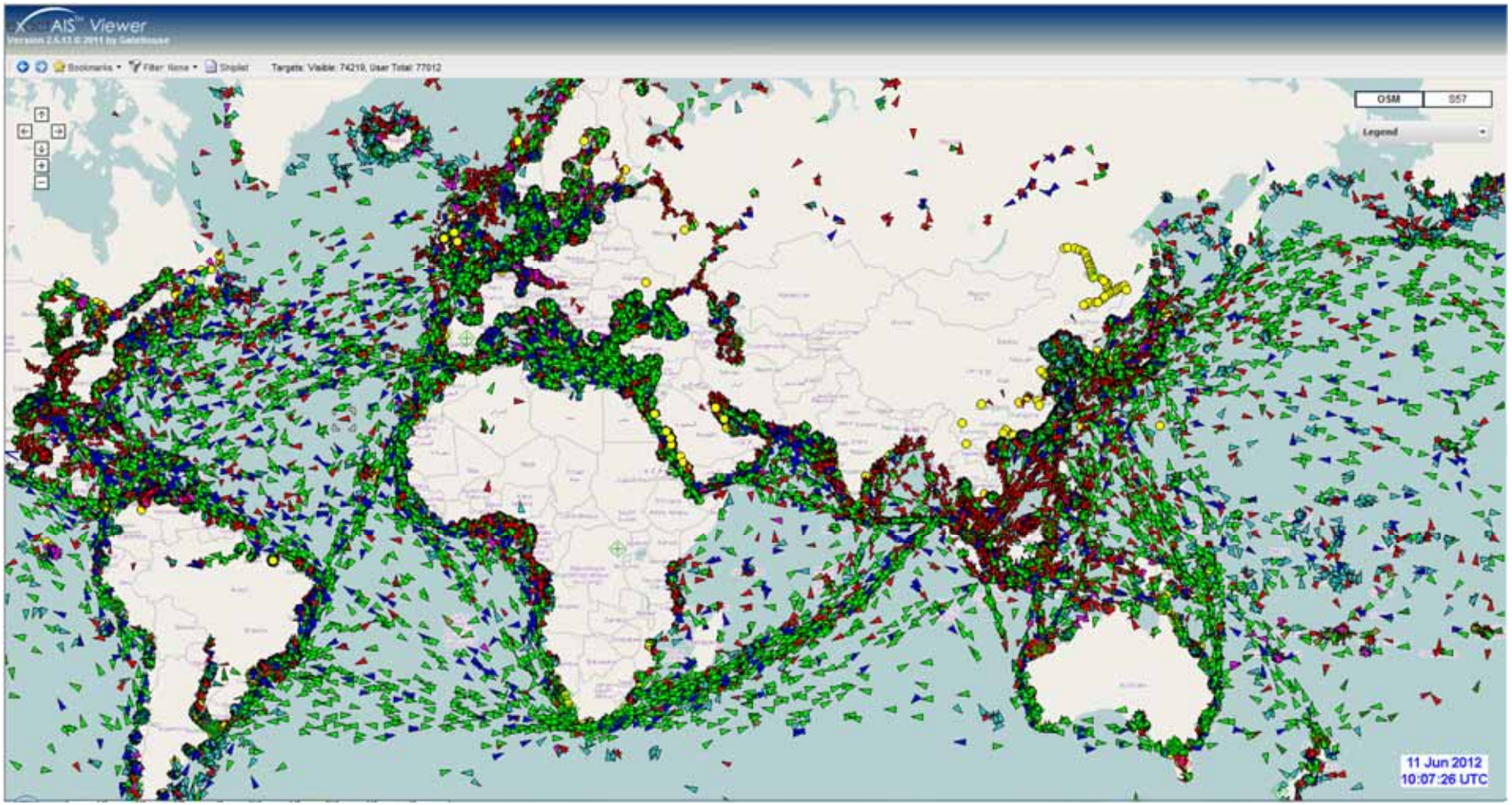
Farnborough, 15 July 2014

AIS Introduction

What is the Automatic Identification System ?

- Merchant shipping is the lifeblood of the world economy, carrying 90% of international trade

What difference does Space make?

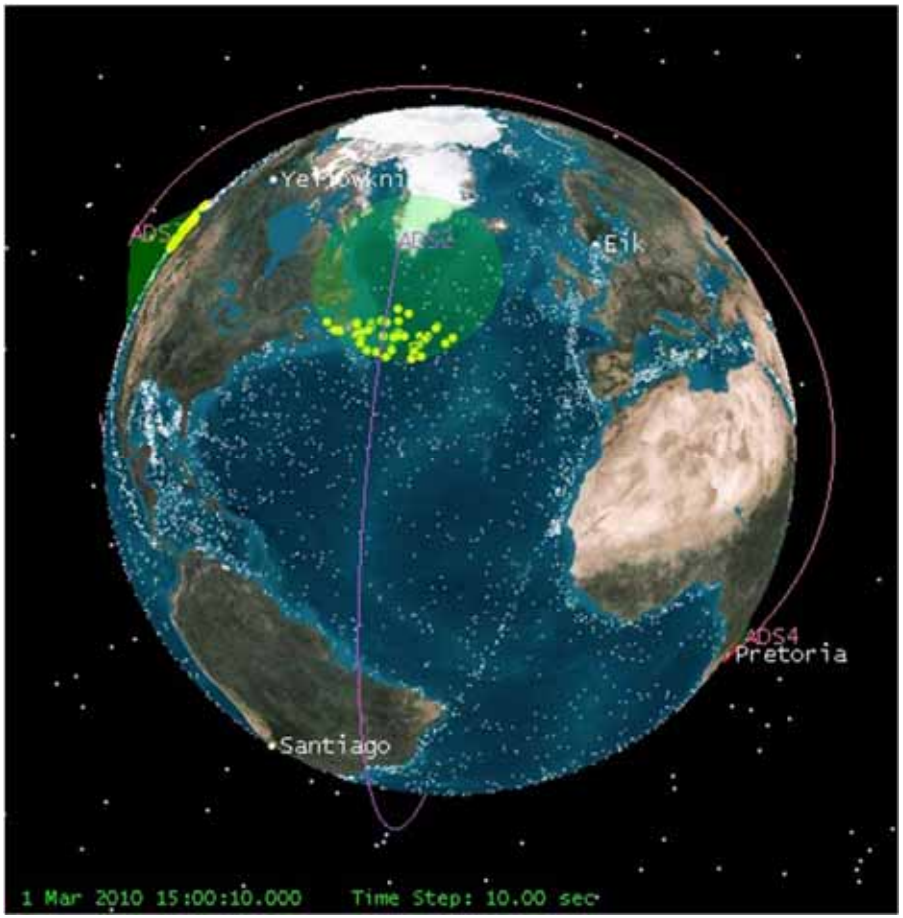


exactEarth

European Space Agency

Applications & Services

- **Maritime Security** : support of security operation,…
- **Law enforcement services**: anti-piracy, illegal fishing, …
- **Search and Rescue** (SAR)
- **Maritime surveillance services**: monitoring of vessel in sensitive areas
- **Environmental services**: pollution response…
- **Maritime Safety services**: vessel traffic management,…
- **Fleet management services** for commercial users: for shipping companies…

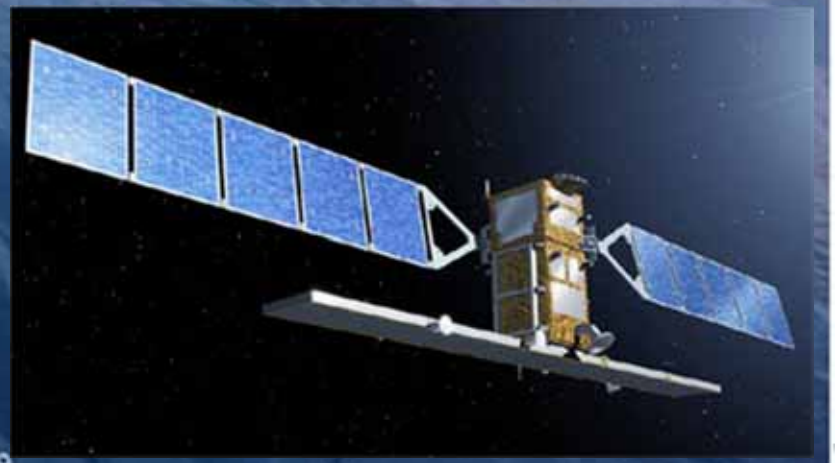


AIS Introduction

Oil Pollution: EO-SAR & AIS data for ship identification

- How to detect oil pollution on the open ocean ?

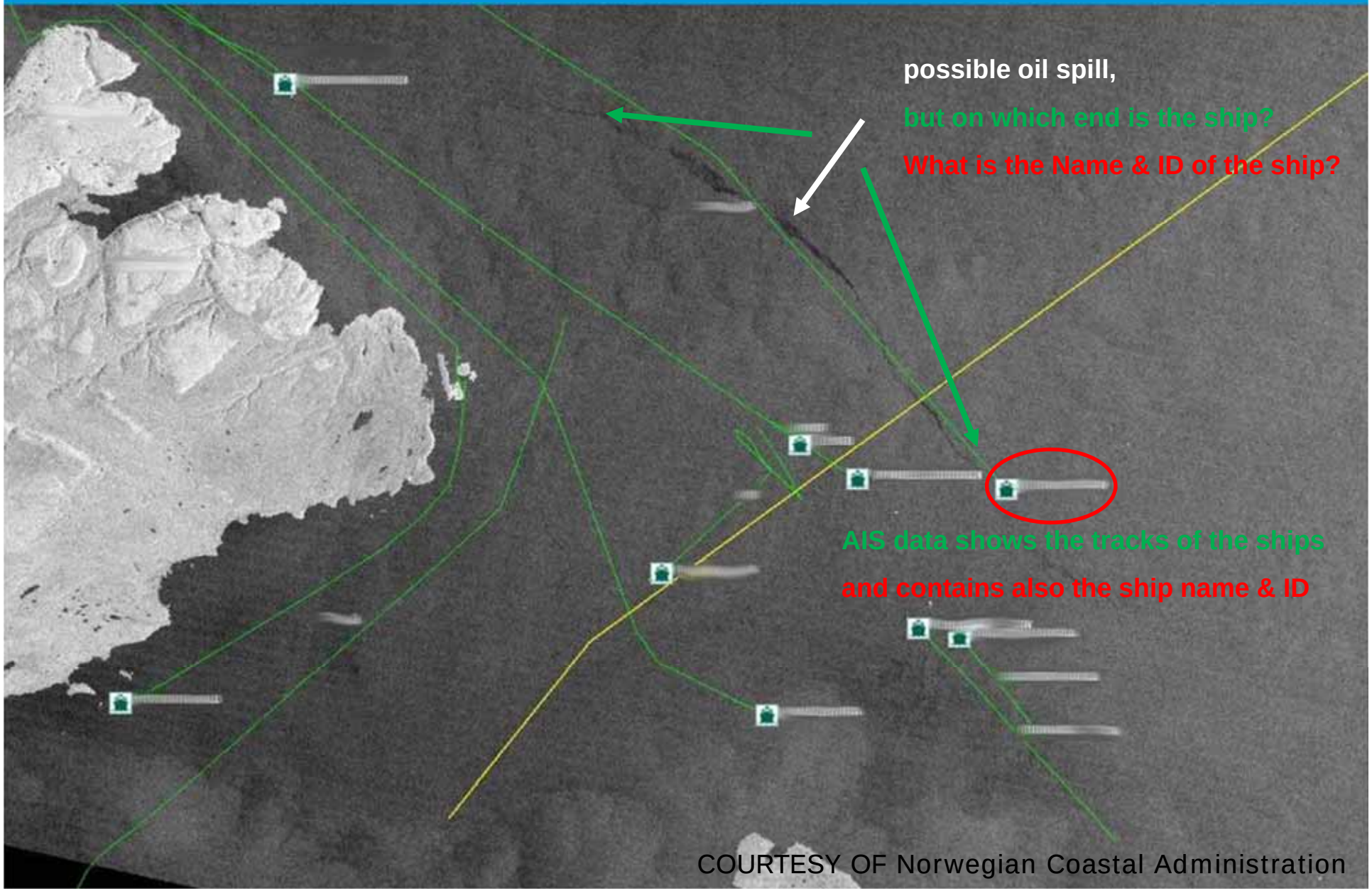
- Earth Observation Radar satellites can distinguish oil from water surface !



Satellite image: © ESA (European Space Agency) / EMSA 2009
Photo: © Irish Coast Guard - MCA

AIS Introduction

Oil Pollution: EO-SAR & AIS data for ship identification



SAT-AIS Micro-Satellites & Applications

ESA improves the identification and tracking of seafaring vessels anywhere on Earth with new AIS satellite technology for the next generation micro-satellite constellation.
In cooperation with the European Maritime Safety Agency ESA is promoting new applications and services for governmental agencies such as coastal administrations.

Innovative Technologies & Microsatellites

E-SAIL
SAT-AIS Micro-Satellites

NAIS
Novel SAT-AIS Receiver

Innovative Services & Applications

PLASMA+
Platform for
Advanced SAT-AIS
Maritime Applications

European Space Agency

SAT-AIS Initiative
Motivation

- Users **request AIS data out of sight of coastlines**, e.g. for Maritime Safety, Search and Rescue support, Security, etc.
- Currently first commercial and national systems provide SAT-AIS data.
- ESA & EMSA analysed institutional user needs, resulting in a need for **reliable and high quality data sources** overcoming current limitations:
  - Limited availability in high traffic zones (Europe, Asia, Gulf of Mexico) due to interference of too many messages received simultaneous
  - Data Age (timeliness) is not comparable with terrestrial services (6 minutes)
- Therefore we are working on next generation solutions to enable higher performance small satellites under cost effectiveness constraints
- ESA's Advanced Research in Telecommunications Systems programme (ARTES – Element 21) and the IAP (ARTES 20) supports the
  - development of **new technologies** (e.g. new generation of receivers), and **micro-satellites**, as well as
  - development of **innovative applications and the roll-out of integrated services** together with service partners

SAT-AIS Initiative
ESA – EMSA Cooperation

ESA's Integrated Applications Promotion, IAP (ARTES 20)
Applications & Services – Technologies & Systems

Cooperation with the European Maritime Safety Agency

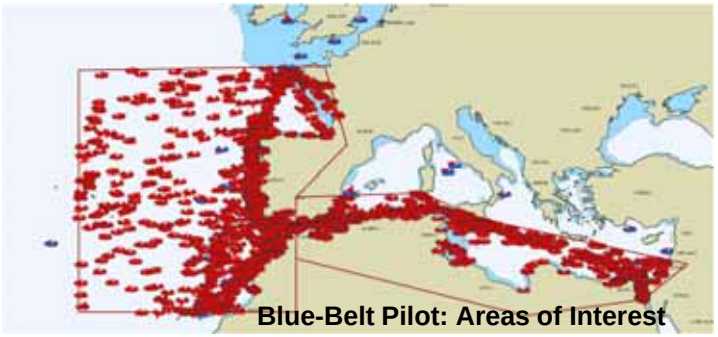
- **EMSA / ESA collaboration agreement** for the use of space-based systems and data in support of Maritime activities was reached **in 2007 and renewed in 2010**

Cooperation on projects:

- Common user survey & requirements analysis
- Common development of a Data Processing Centre as part of EMSA's Integrated Maritime Data Environment
- Pilot projects and service demonstrations, e.g.
  - Blue-Belt: Terrestrial and satellite ship voyage information will be provided to customs before the ship arrival at the port
- ESA supports EMSA for the SAT-AIS service roll-out, e.g.
  - PLASMA ('Platform for Advanced SAT-AIS Maritime Applications') providing novel SAT-AIS information services to international maritime end users

Signature ESA-EMSA Agreement

EMSA MS shore station costal coverage



Blue-Belt Pilot: Areas of Interest

SAT-AIS Programme Roadmap

1. **The jointly developed Data Processing Centre (DPC)**
   - The DPC consists of
     - ESA's Block-2 for SAT-AIS value adding services &
     - EMSA's Block-3/IMDatE for data fusion with other maritime data & services
   - Block2 is currently integrated in EMSA's Integrated Maritime Data Environment

2. **On-going EMSA/ESA Demo Services**
   - ESA supported EMSA's Pilot project for customs service demonstration ("Blue-Belt")
   - EMSA as user is participating in ESA's PLASMA ('Platform for Advanced SAT-AIS Maritime Applications').
     This demonstration service will be extended till 1st September 2016

3. **Future implementation of digital maritime satellite services**
   - Sentinel-1C/D SAT-AIS Block-1: Infrastructure and operations for EMSA's operational needs to receive high quality and near-real-time SAT-AIS information (EDRS model – SLA for additional service provision) overcoming current limitations:
     - Limited availability in high traffic zones (Europe, Asia, Gulf of Mexico) due to interference of too many messages received simultaneous
     - Data Age (timeliness) is not comparable with terrestrial services (about 10-15 minutes)
   - Start of first activities are scheduled for end 2015

SAT-AIS Data Processing Centre

Objectives

To collect SAT-AIS messages, ancillary and auxiliary information for generating and distributing enhanced data services to the maritime community.

Features

- The SAT-AIS Data Processing Centre (DPC) Demonstrator is a development co-funded by EMSA (European Maritime Safety Agency) and ESA.
- The DPC will collect SAT-AIS messages, ancillary and auxiliary information for generating and distributing enhanced data services to the maritime community.
- The ESA component of the DPC (called DPC Block 2) will receive SAT-AIS and ancillary data from satellite providers, process and correlate them with Earth Observation data, then store and distribute the enhanced data to EMSA component of the DPC.
- The EMSA DPC component forms part of the Integrated Maritime Data Environment (IMDatE) that ingests AIS data received from terrestrial and satellite sources with other data sources (e.g. LRIT) in order to distribute the enhanced data to the maritime community.

Prime: : Collecte Localisation Satellites (FR)

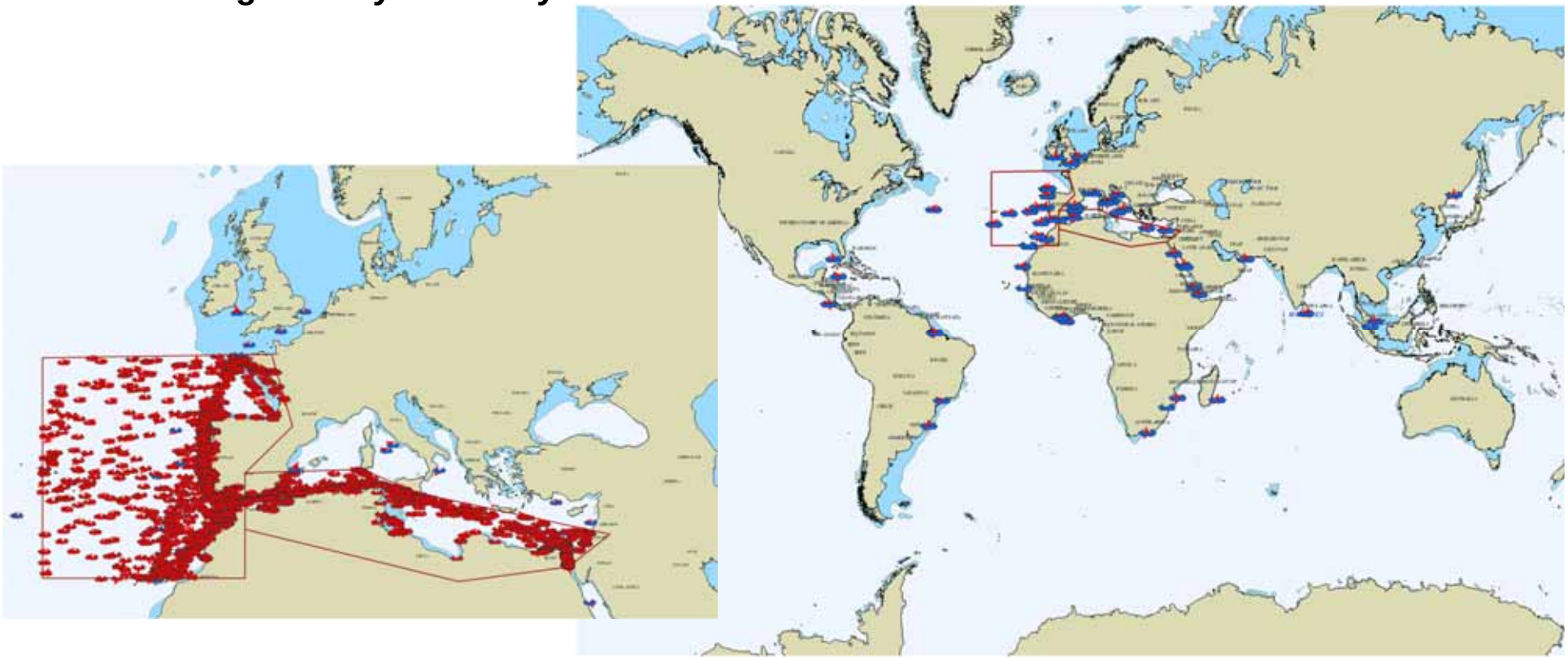
Sub-contractor (s): SpaceBel (BE), Thales Alenia Space (FR), DEIMOS Engenharia (PT), exactEarth Europe (UK), Kongsberg Satellite Services (NO), Norwegian Defence Research Establishment (NO)

User(s): EMSA (and its member states)

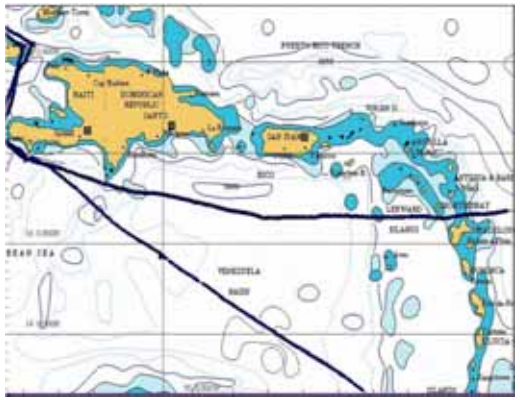
Areas of Interest, Blue and non-Blue ships (for 24h period)

2 services: provision of satellite-AIS data from:

- **251 “Blue ships” which undergo the demonstration, and which are sailing to and from Europe (worldwide coverage)**
- **all ships i.e. “blue ships” and non-“blue ships” operating in southern coast of the Mediterranean Sea (North Africa) and southern Atlantic approach to Europe including the Bay of Biscay**

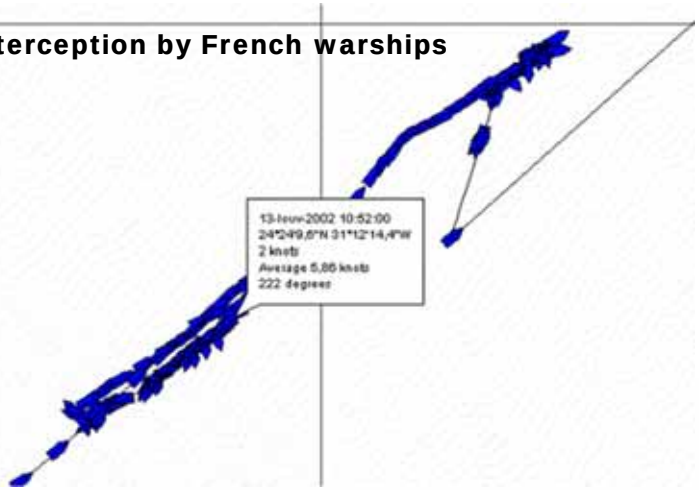


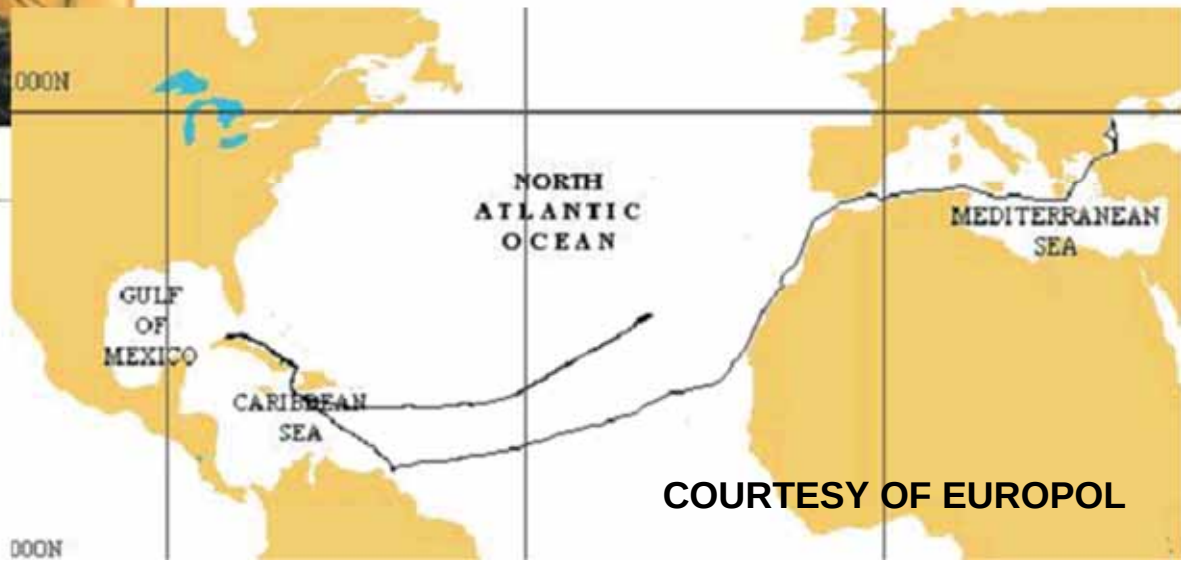
Cocaine Trafficking – M/V Winner, Bolivian flag



Loading point

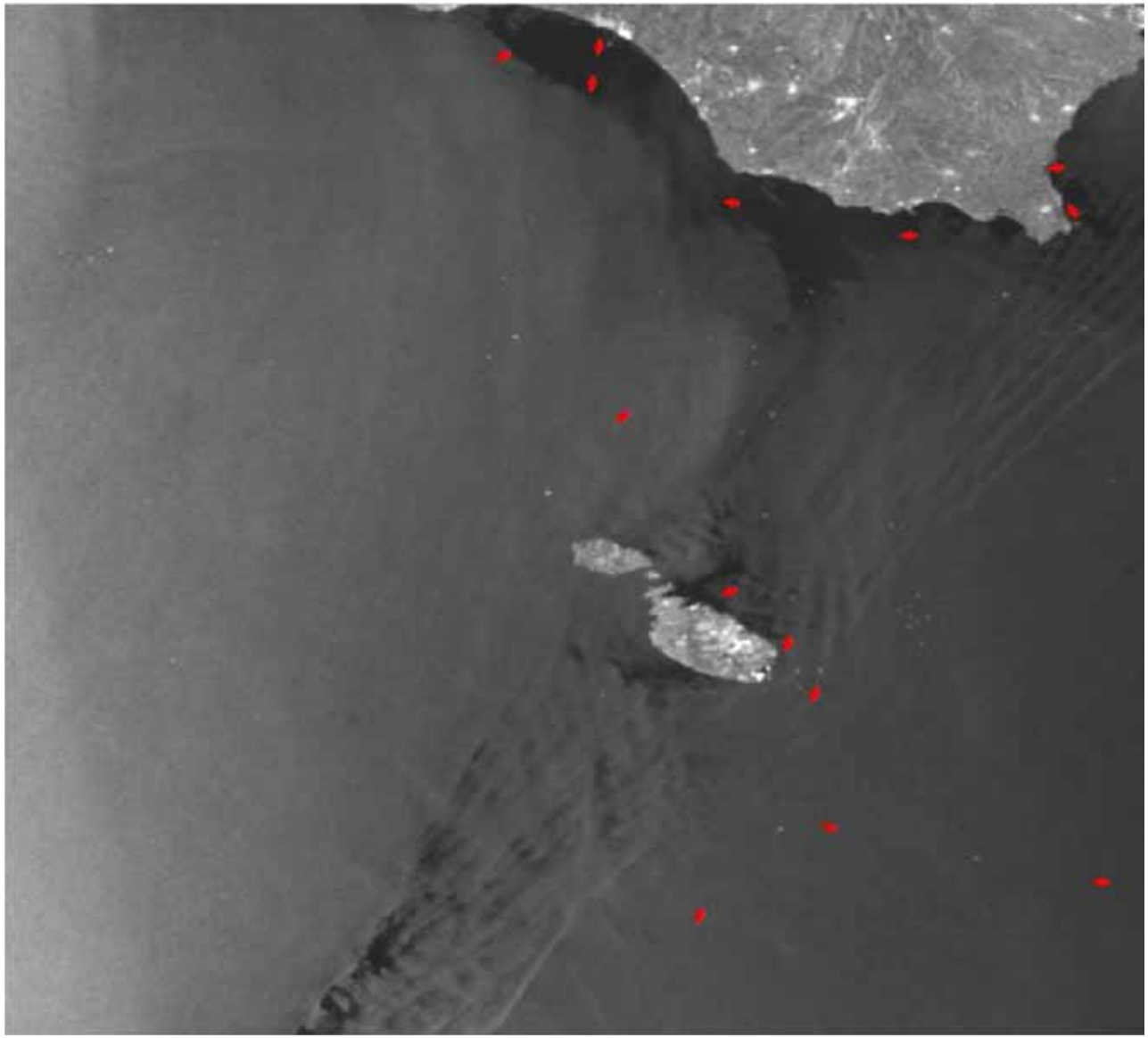
Interception by French warships





COURTESY OF EUROPOL

Integrated Application
Satcom, Nav, EO & RPAS (UAV)



AIS tracks from ships

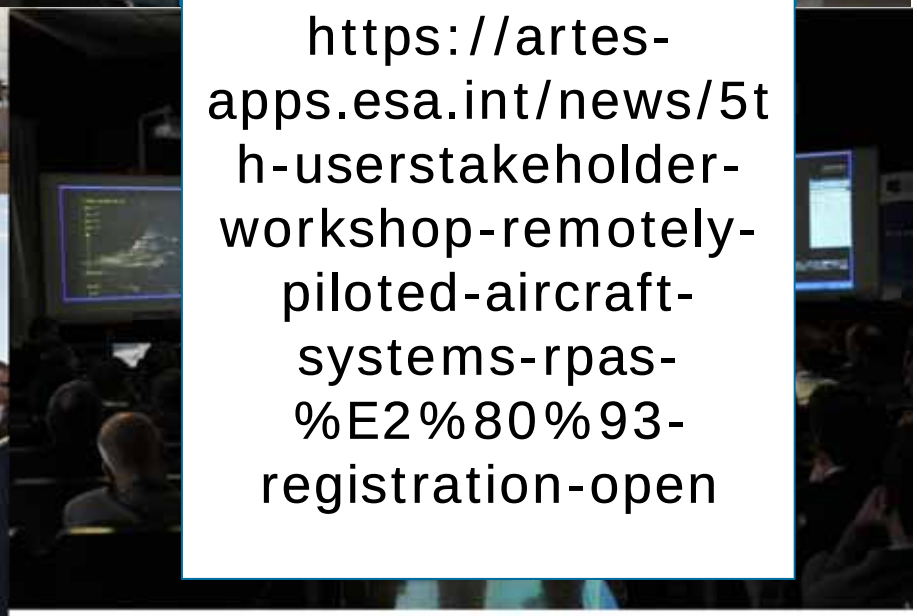
SAR detected ships

Correlation SAR & AIS

Remaining uncorrelated ships & UAV for identification

➔ Mission Video

RPAS (UAV) Demo Day 24.4.14 in Murcia”



5th User/Stakeholder Workshop on Remotely Piloted Aircraft Systems (RPAS), May 21st 2015, ESTEC

https://artes-apps.esa.int/news/5th-userstakeholder-workshop-remotely-piloted-aircraft-systems-rpas-%E2%80%93-registration-open

DeSIRE 2 detailed objectives

Air Traffic Insertion requirements:

- **Accurate and comprehensive measurements** of **BRLOS satcom** links, also in degraded conditions, for multiple frequency bands (**FSS Ka and AMS(R)S L band**)
- Consolidation of **safety requirements** for Satcom C2 data link and verification of BRLOS link performances wrt. them
- **Switch over** between 2 satcom systems to be verified
- Enhanced **emergency procedures** to be implemented and verified.
- **D&A data transmission** for situational awareness improvement

Mission requirements:

- Several civilian applications to be demonstrated: **Maritime S&R, Law enforcement and Fisheries control, Forest fire prevention and monitoring**
- **Participating Users** : Italian Coast Guards, Guardia di Finanza (IT), European Fisheries Control Agency (EFCA), Italian Civil Protection, CEREN (Centre d'Essais et de Recherche Entente pour La Foret Méditerranéenne)

DeSIRE 2 (2nd element of the ESA-EDA RPAS demonstration roadmap)

Main Goals: To develop and demonstrate services based on a RPA flying Beyond Radio Line of Sight (BRLOS) using space assets (SatCom, SatNav) for:

1. **Further supporting the regulatory process within the European context:** focus on **BRLOS operations under Instrument Flight Rules** using **satellite communications**
2. **providing new applications to relevant user communities**

- Consortium: Telespazio, SELEX, Paggio Aero Industries, e-GEOS (IT), VIASAT , Skyguide, Aedel aerospace (CH), Viasat UK (UK)
- Overall project costs: circa. 2,600,000 EUR, co-funded by ESA ARTES 20, EDA and Industry.
- Project kicked off in April 2015, for a 18 month duration
- Use of an European platform : Piaggio P1HH Demo RPAS

CYRIS
InteragenCY RPAS Integrated Services

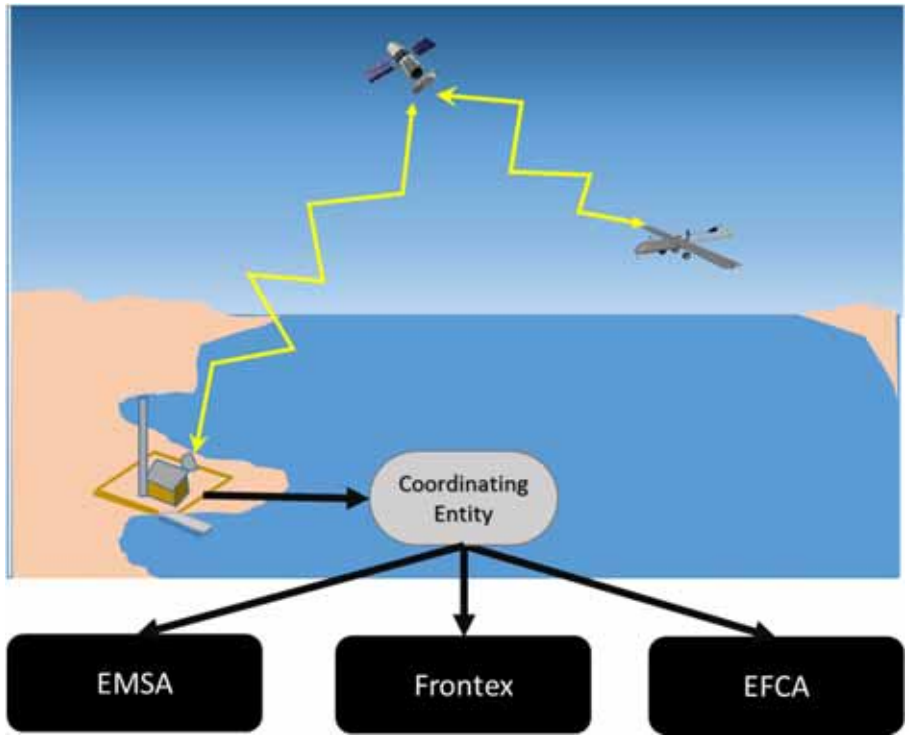
Objectives

To assess and demonstrate the added value and cost effectiveness of the **joint use of a multi-purpose RPAS platform** for enhancing maritime situational awareness of EMSA, EFCA and possibly Frontex for their respective operations in the domains of **maritime surveillance, oil spill detection**, **fisheries monitoring and maritime border surveillance operation.**

User(s): EMSA, EFCA and possibly Frontex as well as EU Member States institutions and authorities in charge of maritime (border)surveillance, oil spill detection, and fisheries monitoring

Price to ESA: 1,500,000 € (firm fixed price), representing 50 % of the total cost of 3,000,000 €

- Status: under preparation (open competition)




esa
VHF Data Exchange System
VDES
European Space Agency

VHF Data Exchange System

Automatic Identification System (AIS) for navigation safety

Monitoring AIS from space => SAT-AIS

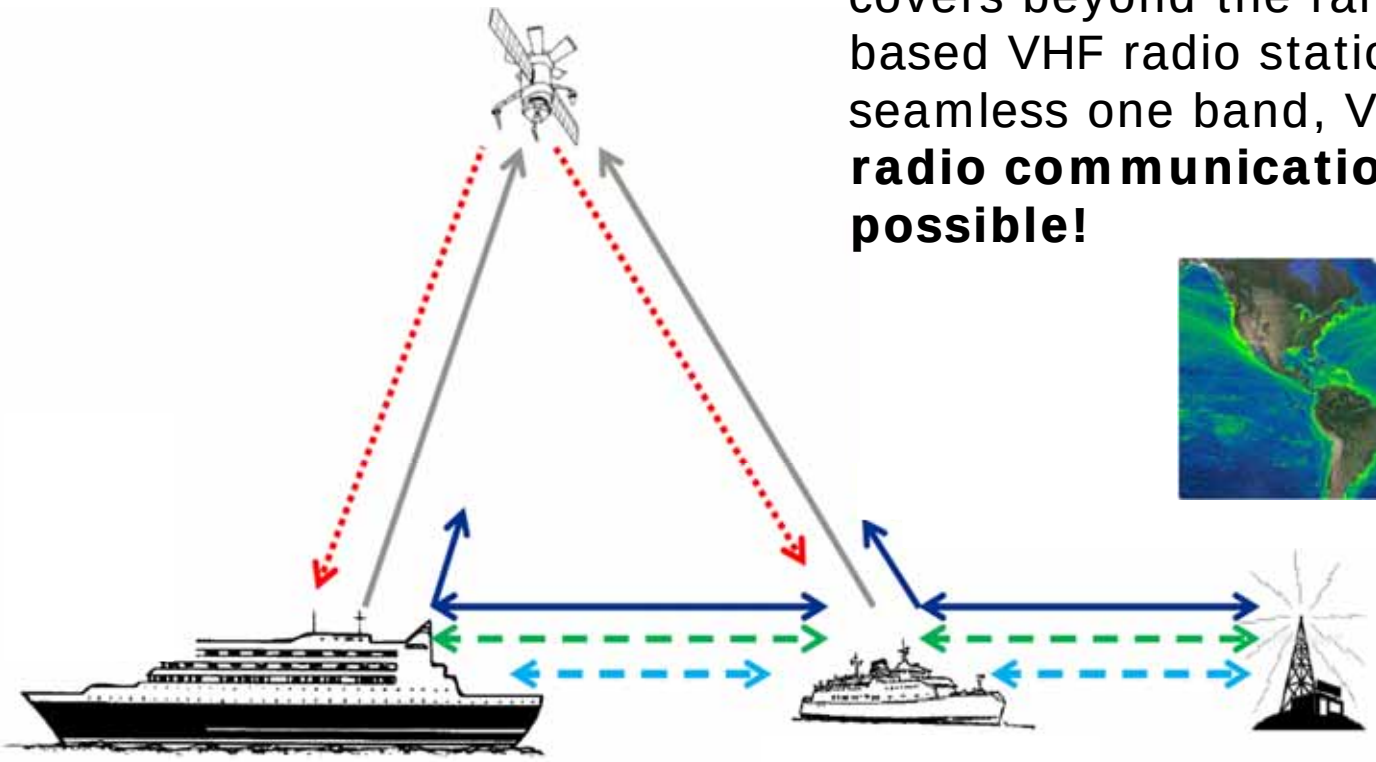
AIS usage has caused increase VHF Data Link loading

new VHF Data Exchange System (VDES)

Maritime community is proposing additional VHF channels for “application specific messages over AIS” and a new digital data link for ship2ship and ship2shore data exchange as part of an agenda item of ITU WRC-15 Agenda Item 1.16.

Satellite is proposed as a part of the VDES, with dedicated VHF channels for broadcasting towards vessels.

Satellite capability



Satellite communication capability covers beyond the range of shore based VHF radio station hence seamless one band, VHF, **worldwide radio communication becomes possible!**

VDES Satellite Component System Study

Objectives of the on going activity

- Exploring **user needs** and required services that could potentially be provided by VDES;
- Investigating applicable technical solutions and performing trade-off analyses;
- Identifying the benefits, constraints, and complementary aspects of VDE-SAT system with respect to a network that could be supported by existing satellite space assets ;
- Defining any roadmap for preparing the ARTES participating states industry in supporting the development of any such service / system;
- **Oct 29th 1st EMSA / ESA User requirements meeting in Lisbon**


esa
“Space is the Limit”
Thank You!
European Space Agency