Information and Communication Technology Services for Environment, Safety and Security in the Baltic Sea

Helsinki, Finland

User driven space applications for the Baltic area region - Relevant examples

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European Space Agency

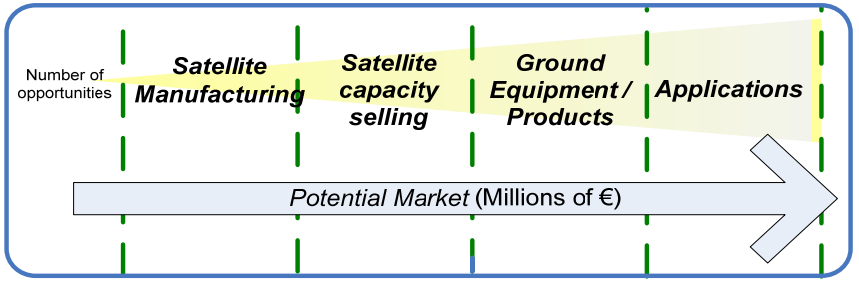
12/4/2010

Outline of the Presentation

- The Integrated Applications Promotion (IAP) programme.
- Background on the Baltic Region.
- Some planned or ongoing IAP Feasibility Studies of relevance to the Baltic Region:
  - FishSAT, Sustainable Fishing.
  - Integrated Satellite-based IAEA Safeguard Services.
  - GRESIMET, Wind Energy Production Assessment.
  - SSMART, Hazardous Materials transport.
  - UAS supported by Integrated Space Systems.
- CleanSeaNet.
- Ideas for future IAP activities ?

IAP Rationale

- Meet:
  - Increasing demand for **sustainable end-to-end services** using **integrated space & non-space** technologies / systems.
  - Space Council Resolution May 2007 (**Political will**).
- Overcome:
  - Cultural gap and lack of dialogue between potential users and the space sector (**Awareness**).
  - Compartmentalisation of space technology (**Synergy**).
- Using:
  - Partnership of users and players from across the value chain (**Partnership**).



"Incubator for Services"

IAP Strategy

- European Dimension Approach
  - ESA expertise and experience, variety of space tools, promotion platform.
  - Contributions from space and non-space players in Europe.
  - Federation of users, ESA needed as “honest broker”.
  - Flexible and accelerated implementation process (“Open door” principle).
  - Inter-disciplinary aspects: Climate/Health, Climate/Energy, etc.
  - Early demonstrations via selected pilot projects.
- Addressing Global Challenges
  - Space for Health, Development …
  - Space for Safety, Knowledge …
  - Space for Energy, Economy …
  - Space for Mobility, Innovation …
- On Regional, National, European and Global scales

IAP Objective

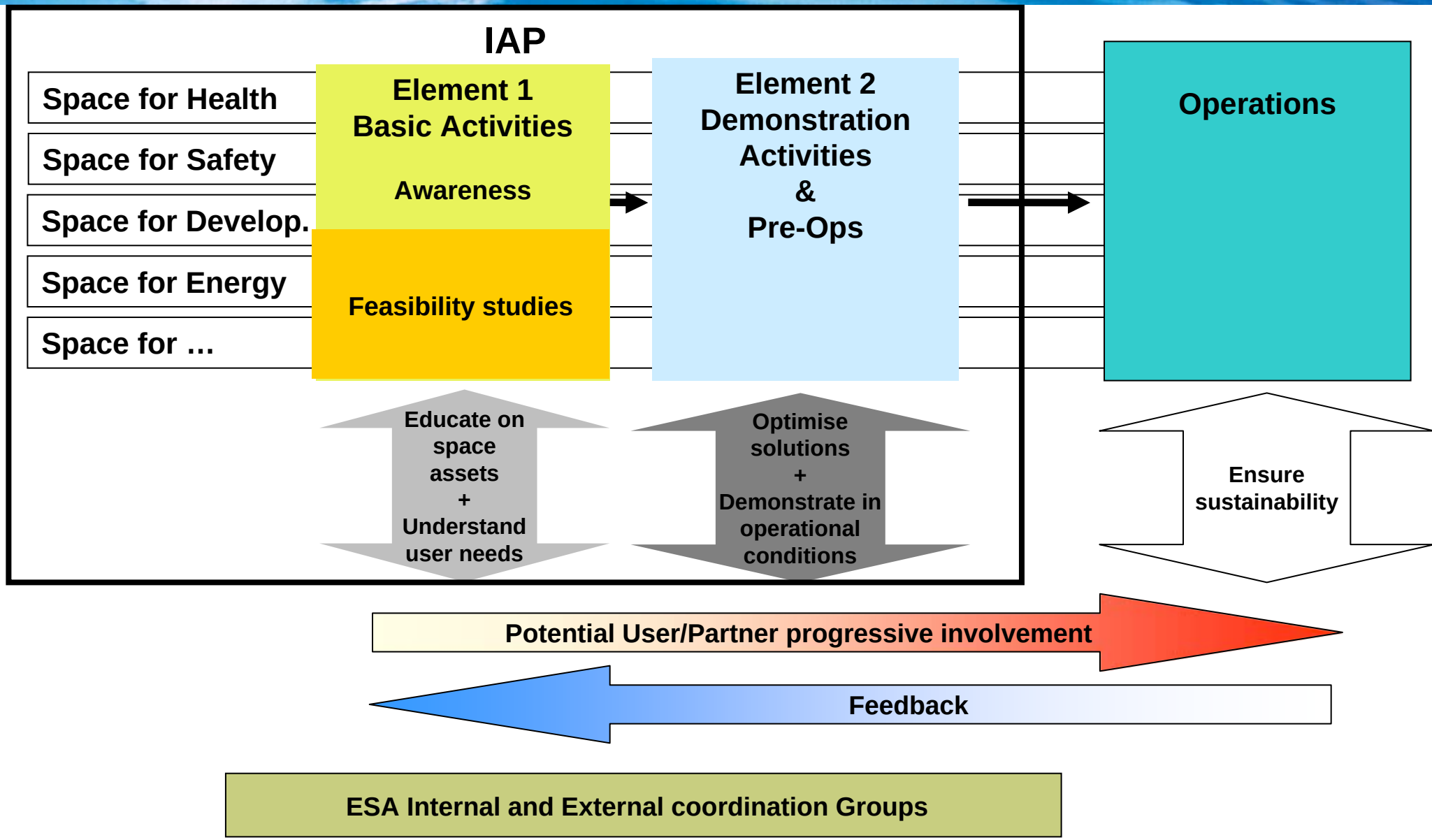
- The objective of the Integrated Applications Promotion programme (IAP) is:

"*The development of Operational services for a wide range of users through the combination of different systems*"

- How will IAP's goals be achieved ?
  - **Promotion** of space applications to a **wider range of users.**
  - Development of **new operational and sustainable** services.
  - Utilisation of **at least two existing different space assets** from different space domains.
  - **Better exploitation** of existing space capacity and know-how, and a better understanding of how they should evolve to meet user requirements.
  - **Cross-fertilisation** across disciplines.

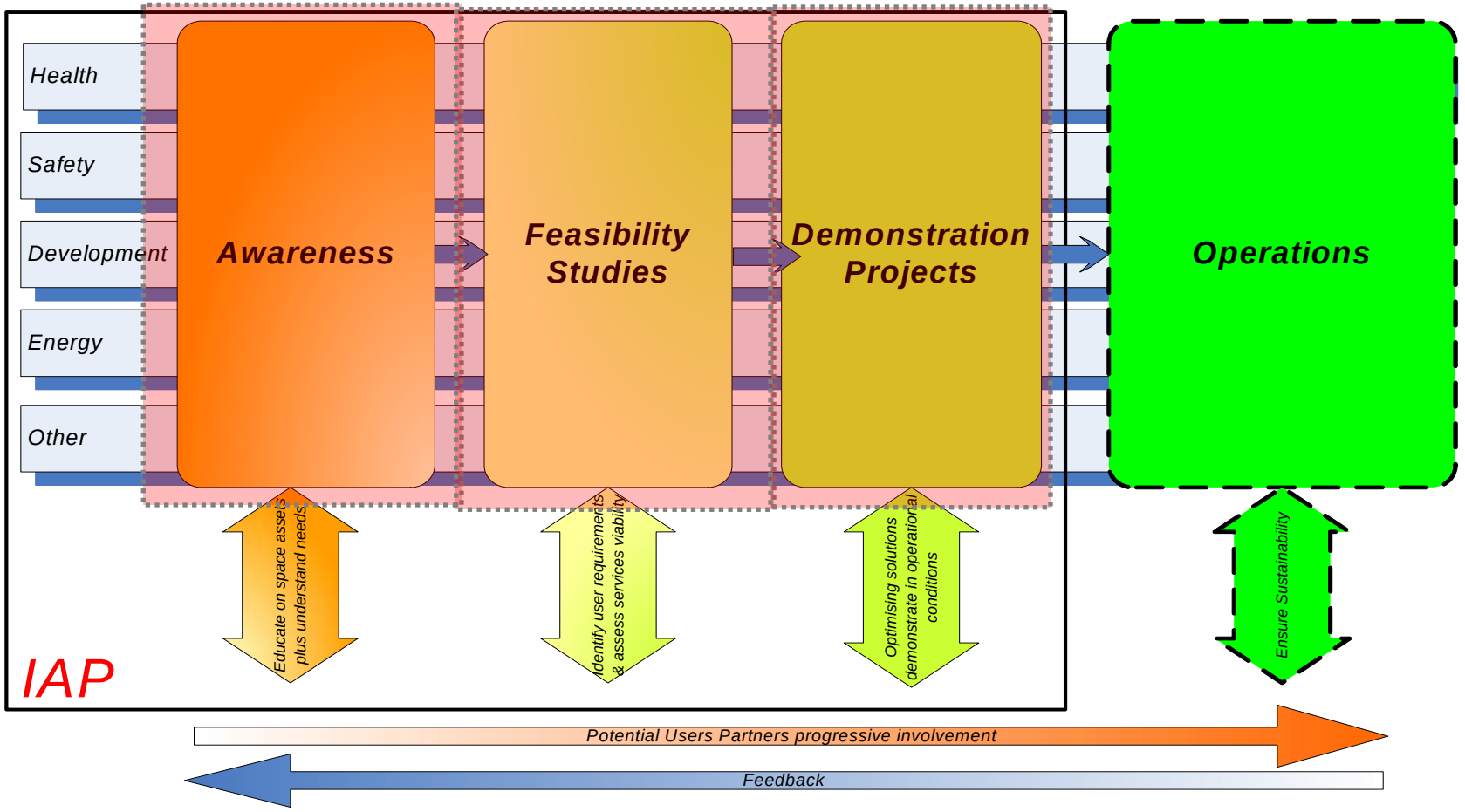
- ARTES 20 includes two types of activities:
  - Feasibility Studies and Demonstration Projects.

IAP Programme Structure



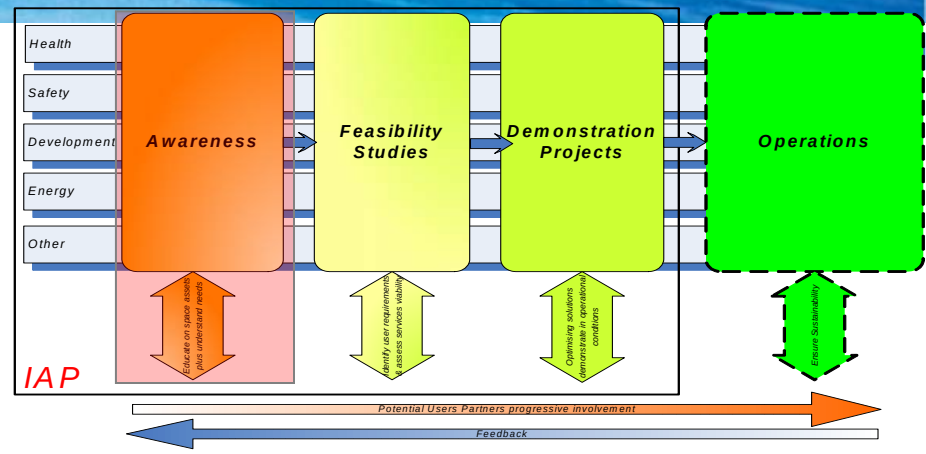
IAP Programme Structure

- **Awareness Activities**, reaching out to stakeholders in order to understand, foster and organise their demands.
- **Feasibility Studies**, to assess the technical and economical viability of services responding to users' requirements.
- **Demonstration Projects:** to implement pre-operational services on the basis of partnership with users/stakeholders.



IAP Awareness

- Goals:
  - Identifying User Communities and their Needs.
  - Identifying Space Capabilities.
  - Informing and Educating Potential Users.
  - Influencing Decision Makers and Facilitating Cooperation.
  - Fostering and Organising User Demand.
  - Paving the way for partnership agreements.
  - Promotion through Interface with External Relations Directorate (ESA).



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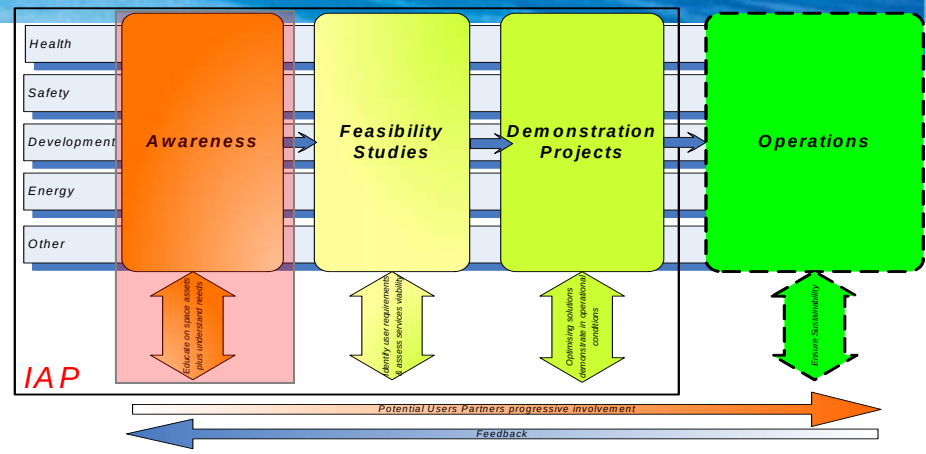

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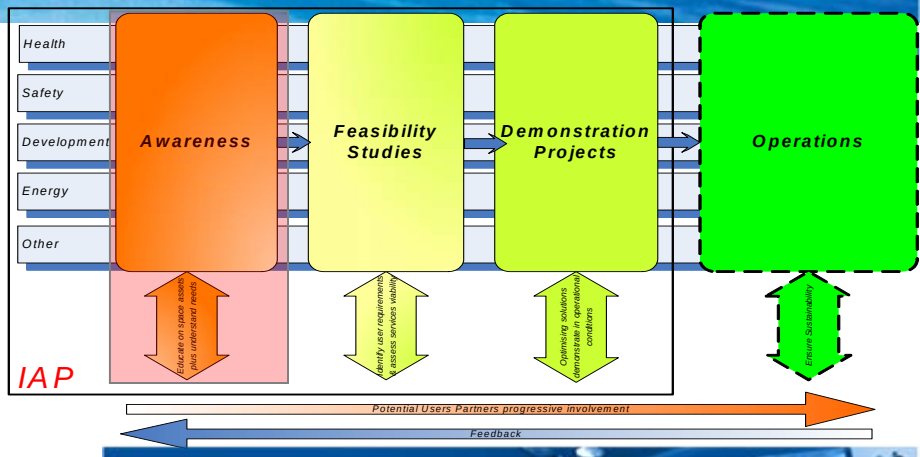

Register at http://iap.esa.int/ to find out more

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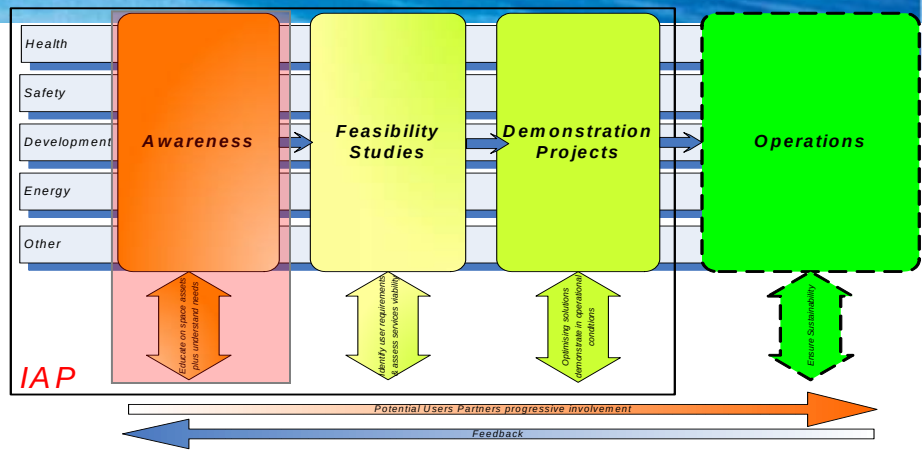

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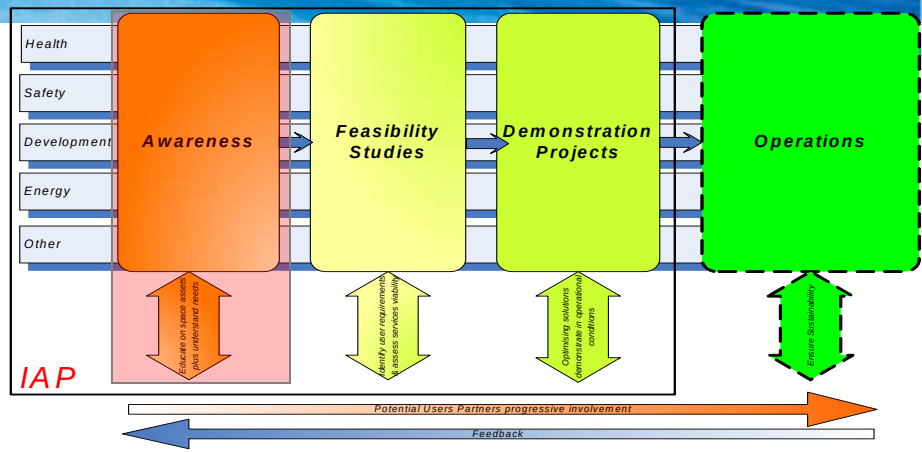
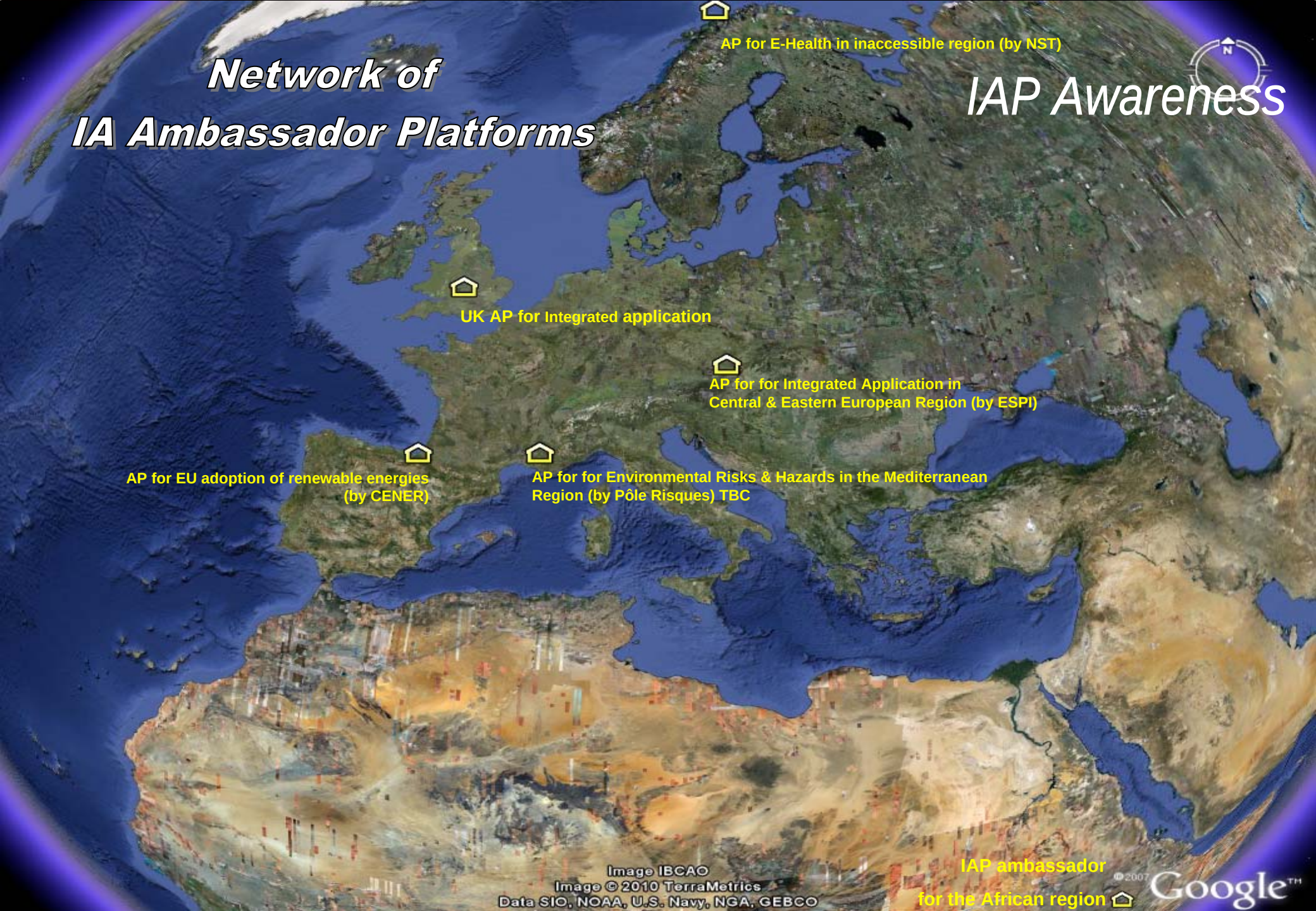


- **Goals of the Ambassador Platform**
  - Spread and increase awareness of IAP.
  - Federate user demand to justify space-based applications resulting in sustainable services.
  - Motivate/stimulate the relevant stakeholders and users to propose new ideas, and/or to propose partnerships with ESA.


Network of
IA Ambassador Platforms
IAP Awareness
AP for E-Health in inaccessible region (by NST)
UK AP for Integrated application
AP for for Integrated Application in
Central & Eastern European Region (by ESPI)
AP for EU adoption of renewable energies
(by CENER)
AP for for Environmental Risks & Hazards in the Mediterranean
Region (by Pôle Risques) TBC
IAP ambassador
for the African region
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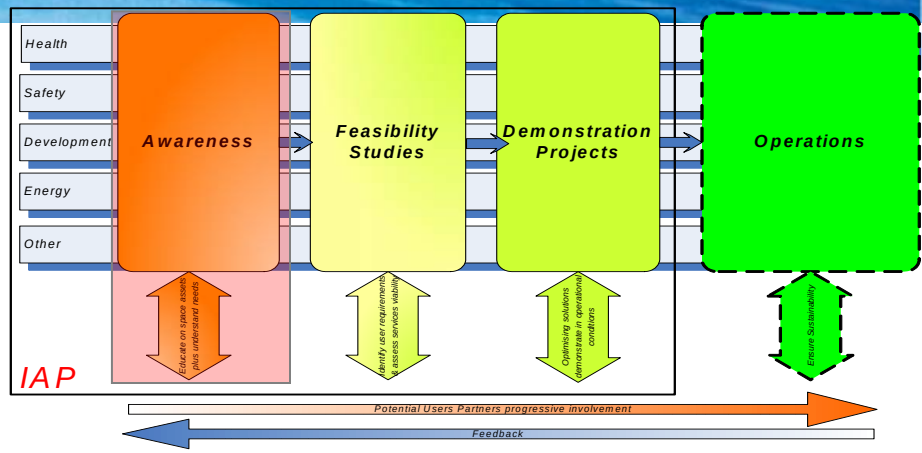
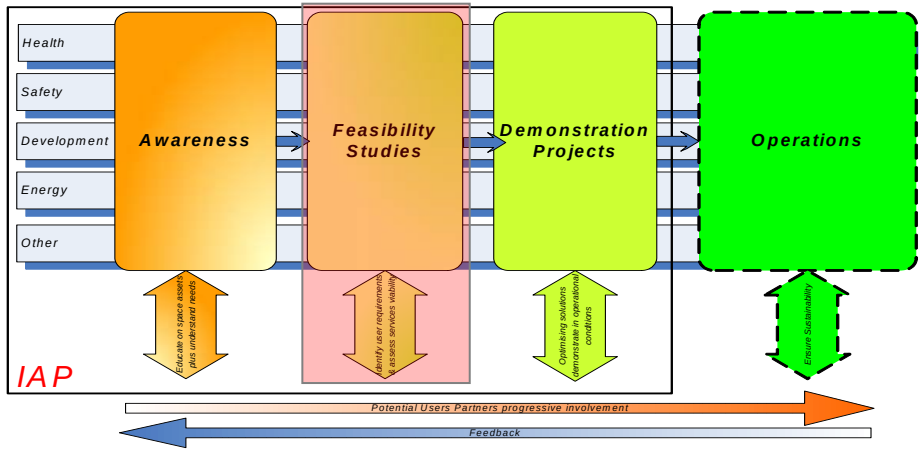
  - A network of IAP Ambassador Platforms across Europe.
  - An Integrated Application Advisory Committee (IAPAC).



- **IAPAC goals:**
  - To provide independent cross-disciplinary expert opinions and recommendations on future IAP activities.
  - To assess which areas of interest have the greatest potential for the development of IAP.
  - To provide overall direction for the IAP programme, and the resulting thematic roadmap.

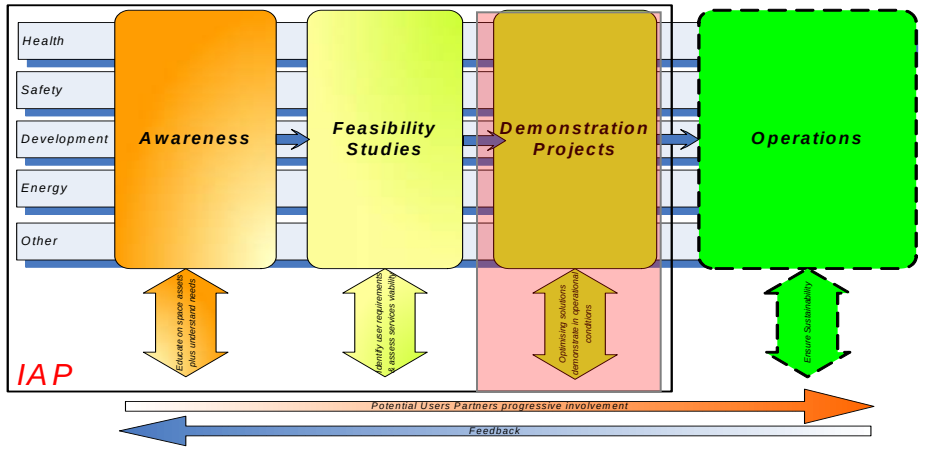
IAP Feasibility Studies

- Feasibility Studies: to assess technical and economical viability of services responding to identified users' requirements.
- Feasibility study objectives:
  - Acquisition and consolidation of user needs and requirements.
  - Translation of user needs into system and space component requirements (state-of-the-art analysis, system/service design).
  - Analysis of the space assets.
  - Definition of the application architecture (Proof of Concept).
  - Analysis of the sustainability of the proposed service (Market Analysis and Business Plan).
  - Preparation of possible Demo project.



IAP Demonstration Projects

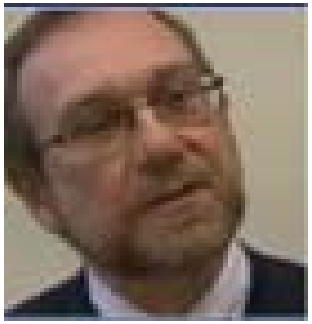
- Demonstration Projects: to implement pre-operational services on the basis of partnership with users and relevant stakeholders.
- Demo Project objectives:
  - Consolidation of feasibility study results (technical and economical).
  - Detail system/service design.
  - System/service implementation and deployment.
  - Service demonstration and validation campaigns.
  - Pre-operations: transfer solutions to service provider.



The Baltic Region today

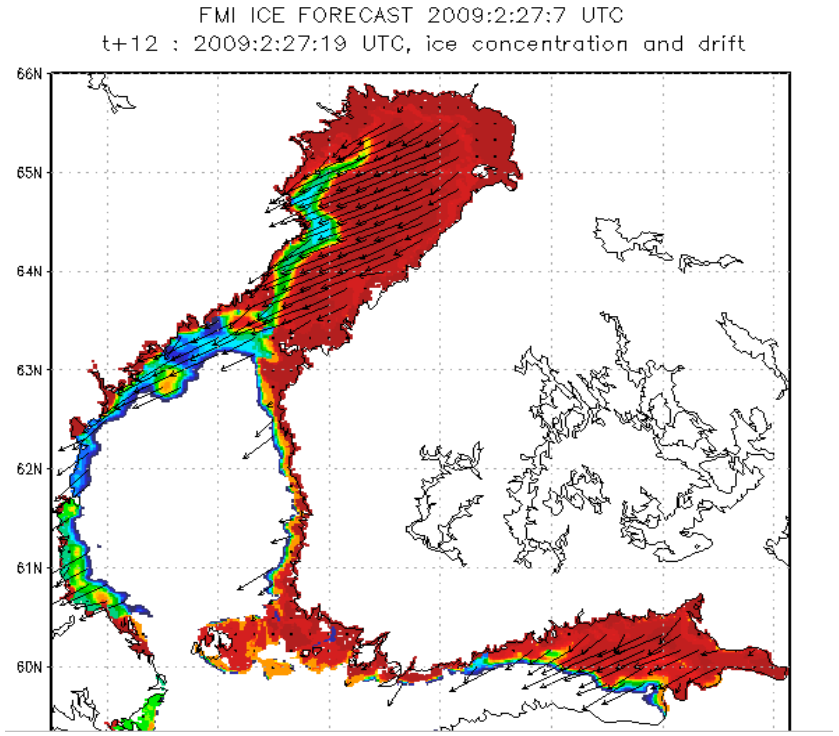
- Environment, economic and policy context:
  - Security of transport, energy, and easier access to strategic zones.
  - Sustainable Fishing: fisheries control and monitoring.
  - Maritime Control: Search & Rescue, pollution monitoring.
  - Climate change: global warming and its effects on infrastructure, transport, access to energy, biodiversity.
  - Energy: Oil and Gas exploration, Arctic transport via new routes.
  - Policy & strategic elements: policy of neighbouring countries, territorial requests for Arctic region.
  - New commercial opportunities.

Maritime Security: Ice-charting for Navigation

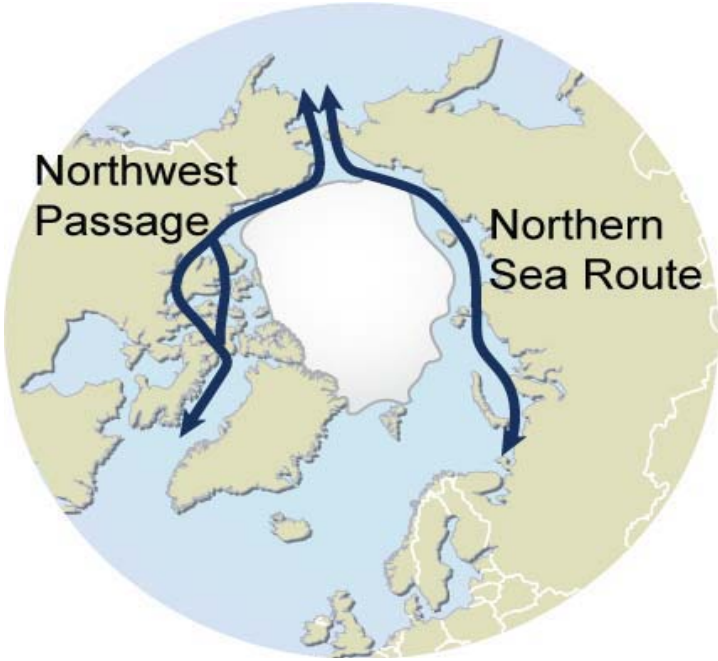


Ulf Gullne
Swedish Icebreaking Services
Swedish Maritime Administration

"The use of Earth Observation satellite images has decreased our fuel consumption by 50%"



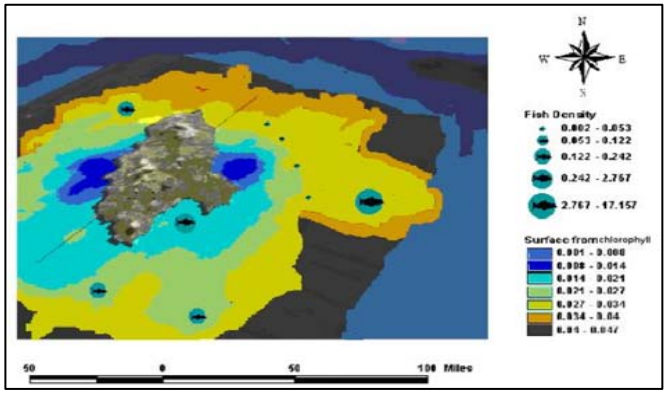
Arctic shipping routes



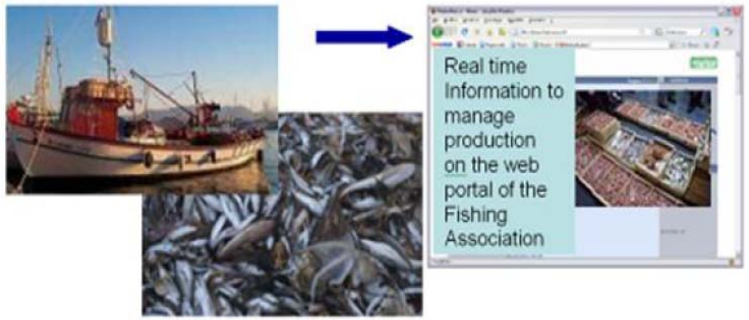
On 21st August 2009, it was announced that two German commercial ships unaccompanied by icebreakers had traversed the Northern Sea Route from Vladivostok to The Netherlands.

FishSAT (1/2)
Sustainable Fishing
Theme: Fisheries (planned)

- Background:
  - Increasing concerns about the ecological impact of industrial fisheries have led to European laws regulating fishing sustainability (Total Allowable Catch - TAC).
  - Prevention and control of unfair competition (boats fishing in prohibited areas, adopting illegal methods) is another concern for fishery organisations.
  - Therefore, fisheries are interested in:
    - Weather information.
    - Operational fishing support (productive sea-spot forecast, real-time geo-fencing alerts).
    - Fish marketing support (market demand, traceability services).



Example of fish density map



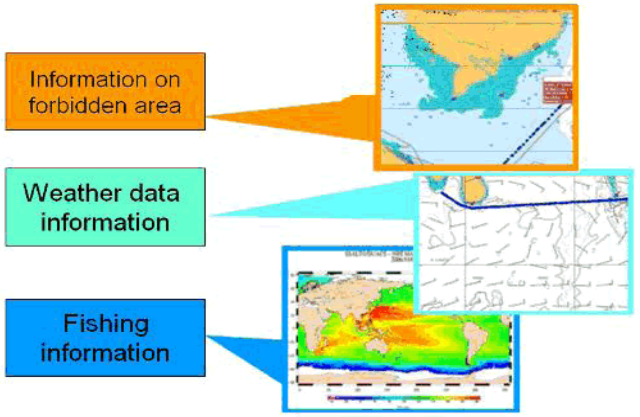
  - Sea monitoring authorities in law enforcement & safety:
    - Control the TAC limits by monitoring the catches of the fishing boats.
    - Assure ecosystem safeguard (e.g. prevent boats from entering forbidden areas).
    - Increase safety of fishing boats.
    - Prevent unfair competition, e.g. from foreign boats.

FishSAT (2/2)
Sustainable Fishing
Theme: Fisheries (planned)

- Objective of the Feasibility Study:
  - Development of integrated satellite-based services:
    a) to support fisheries providing:
    - operational fish support.
    - fish marketing support.

    b) to support sea monitoring authorities in their law enforcement and safety activities.
- Stakeholders involved:
  - Fishing associations.
  - Coastguards.

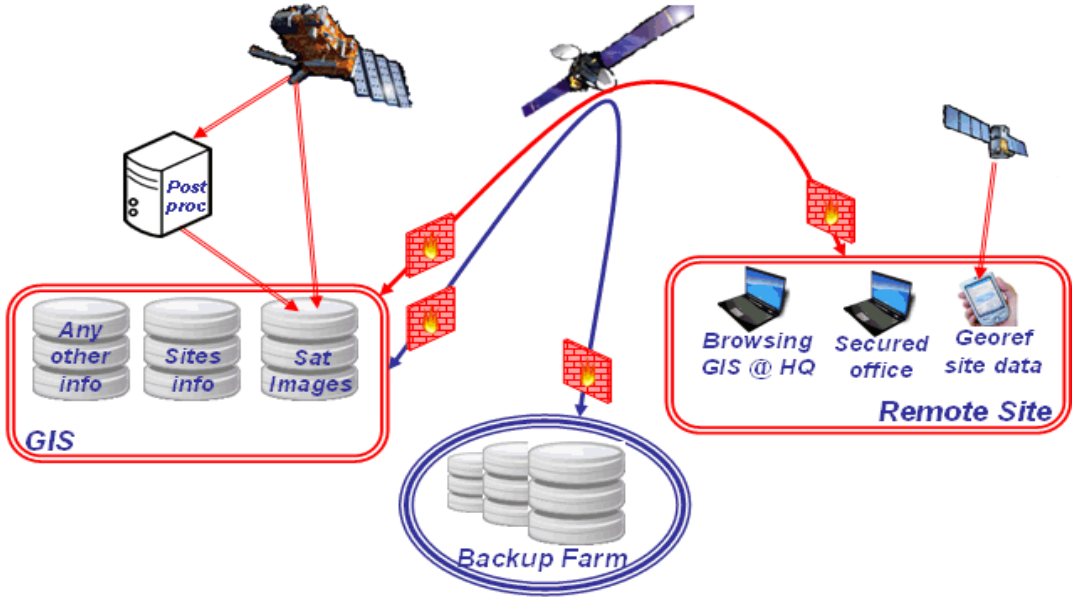
Proposed service scheme



- Added-value of space:
  - Earth Observation data:
    - Ocean colour, chlorophyll concentration, temp, currents, etc for the detection and forecast of fish.
    - Meteorological data for weather information.
  - Satellite Navigation for positioning, geo-fencing, tracking, and geo-location of collected data.
  - Satellite Communications (away from coast) for real-time communications, e.g. updating fish maps, communicating with fish markets and coordination centres, etc.

Integrated Satellite-based IAEA Safeguard Services (1/3)
Themes: Safety & Energy (planned)

- IAEA needs:
  - Connection of all Nuclear Power Plants to IAEA Headquarters.
  - Remote Monitoring of critical assets.
  - Secure data acquisition & processing in near real and in real-time (confidentiality is a must).
  - Support to on-site Inspections.
- Following a letter to ESA from the Director of IAEA requesting cooperation, a pilot activity started in July 2009 in 4 key sites in Ukraine, Armenia, Brazil and Hungary.
- Communication hub set up in Vienna.
- Space assets involved:
  - Satcom for secure and reliable communications (fixed and mobile).



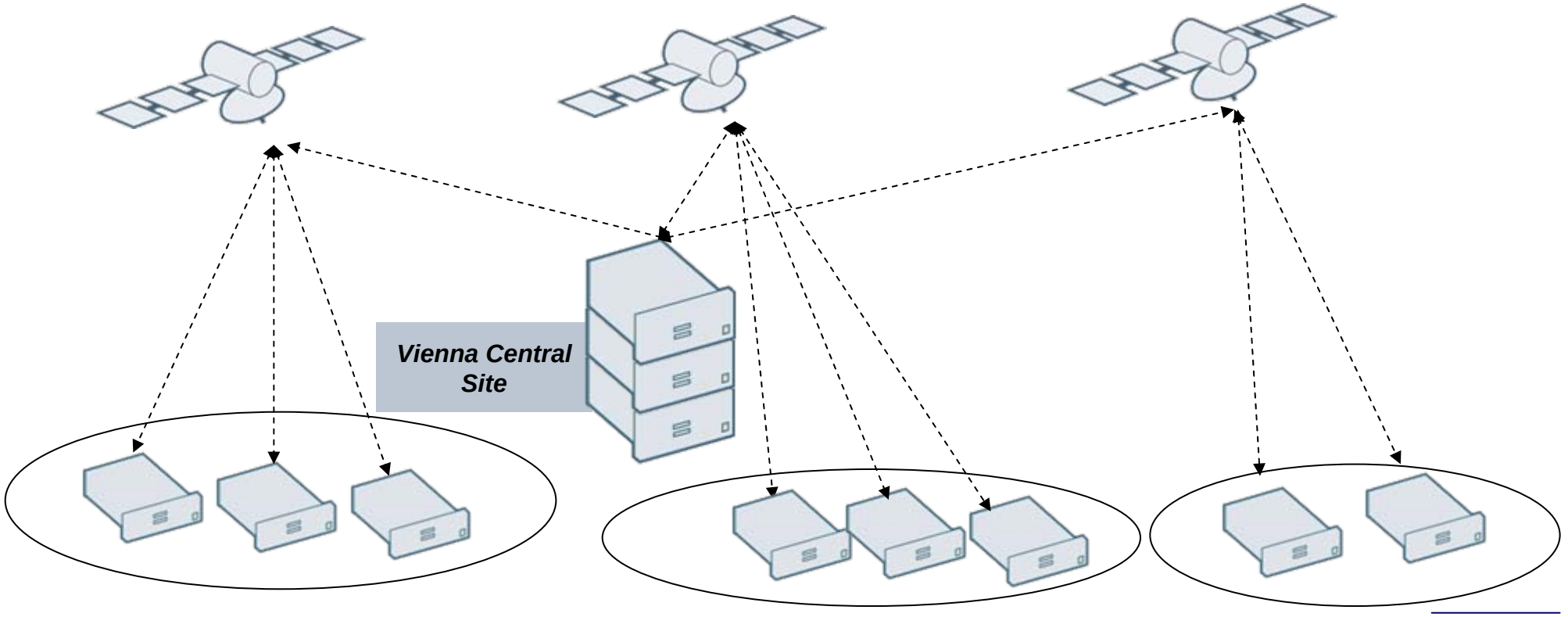
Integrated Satellite-based IAEA Safeguard Services (2/3)

Themes: Safety & Energy (planned)

World-wide coverage through access of **multiple** satellites.

Communication channel must **guarantee**:

1) Not to spy on the contents.
2) Not to reveal the identity and location of users.
3) Not to modify contents along the route.

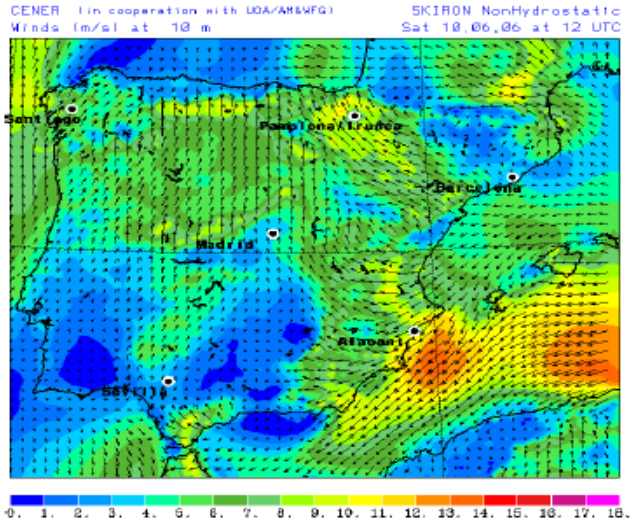


- Following the Pilot, IAEA has decided to extend the network of Remote Monitoring based on the preliminary development.
- NDsatcom will establish an operational Remote Monitoring network in 8 locations based on the already established Hub in Vienna:
  - Ukraine: Chernobyl, Zaparozhe, Rovno, South Ukraine, Khemelnitsky.
  - Armenia: ANPP.
  - Kazakhstan: Ulba.
  - Belarus: Minsk.
- Key example of how through IAP awareness, a European telecoms company has been able to increase its market share.
  - Before IAEA contact with ESA, SatCom was not used in any Remote Monitoring activity by IAEA.
- Potential to extend system beyond SatCom to include satellite EO for site monitoring (surrounding vegetation, access routes, etc), and SatNav for tracking the transport of nuclear fuel.

GRESIMET (1/2)

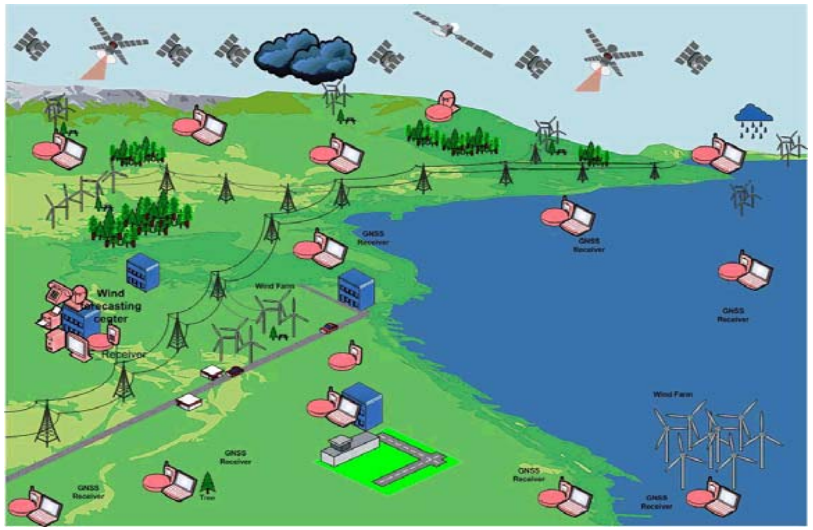
GNSS and Remote Sensing Integration for Applied Meteorology (Wind Energy Production Assessment) – Theme: Energy (planned)

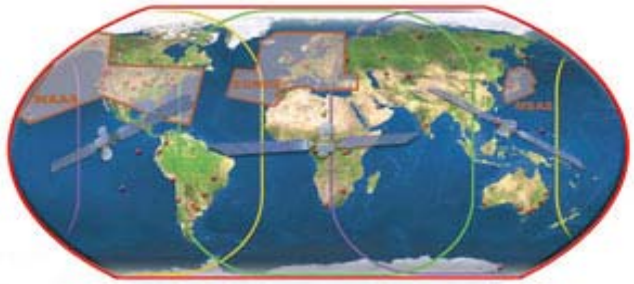
- Background:
  - Increasing number of countries adopting wind energy.
  - Lack of historical wind measurements for wind farm deployment.
  - Lack of wind characterisation for operational management. Wind is difficult to model close to surface.
- Required services:
  - Historical data for site selection of new wind farms.
  - Reliable wind forecasts for operations (control, maintenance and grid integration planning).

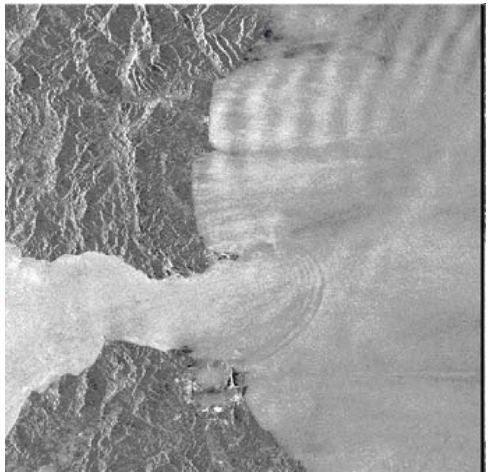


- Feasibility Study:
  - Consolidation of requirements.
  - Investigation of the potential of combined EO / GNSS technologies in the retrieval of wind close to surface.
  - Proof of Concept in experimental wind farm.
- Stakeholders involved:
  - CENER (Spain).
  - Wind farm operators, grid / transmission power operators.

- Space technologies provide added value to wind energy producers:
  - Utilisation of EO data (scatt, altimetry, SST, cloud motion) for standard wind prediction and characterisation and atmospheric parameters.
  - GNSS atmospheric tomography to retrieve ZTD information on a real-time basis at different altitudes.
  - Integration of EO + GNSS to provide real-time, accurate wind measurements at surface.
  - Satellite Communications for isolated wind-farms can provide communication with management centres.



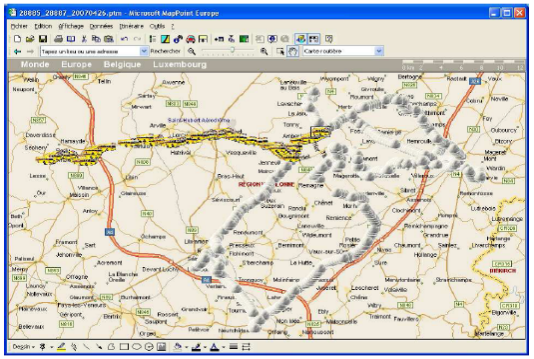




Hazardous Materials transport

Themes: Safety & Transport (running)

- Background:
  - About 9 **billion tonne-km dangerous** goods is transported every year within the EU
    - Road, Rail, Inland Water.
  - There is a need for services that support both the **transport sector** and the **rescue services** in handling and reacting to accidents related to dangerous goods.



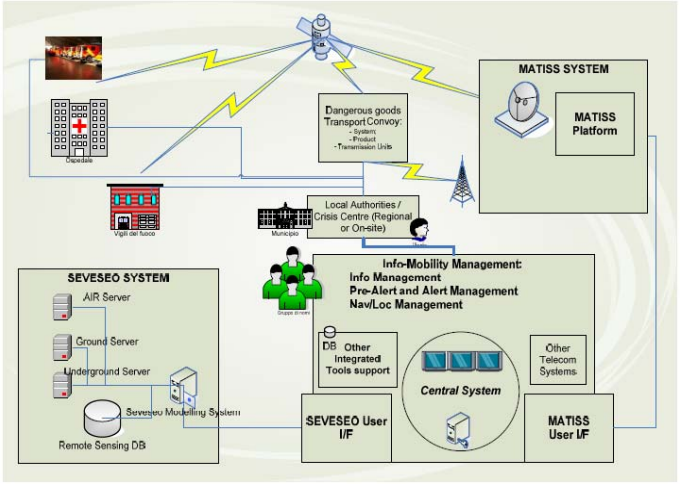
Tracking of goods

- Objective of the Feasibility Study:
  - To identify **new services** for:
    - Complying with national and international laws for handling dangerous goods.
    - Preventing accidents.
    - Reacting to dangerous situations and disasters.
  - Propose and validate a **Proof of Concept** covering:
    - A support tool for emergency services.
    - Sensors for goods monitoring.
    - User terminals and navigation.

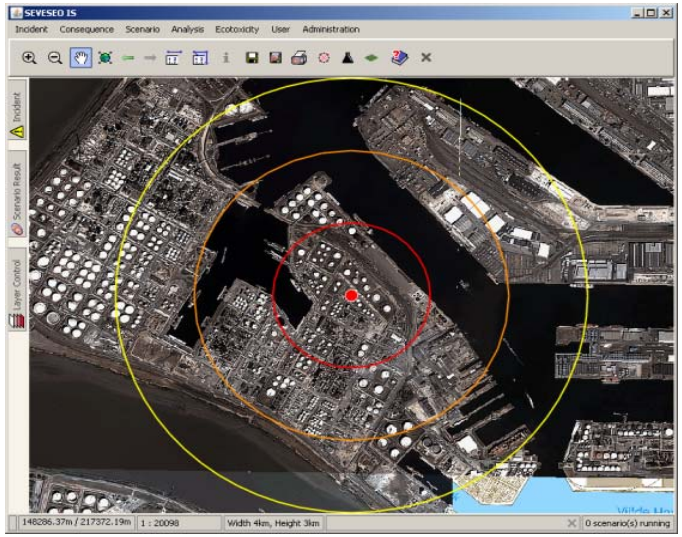
Hazardous Materials transport

Themes: Safety & Transport (running)

- Stakeholders involved (examples):
  - Institutional sector:
    - Regional authorities.
  - Commercial sector (Industry and Logistic companies):
    - SNCB – Belgian railway carrier.
    - Exmar - Belgian shipowners' association.
    - AREVA – Nuclear transport (F).



Proposed service scheme



SEVESEO: prediction of dispersion area

- Added-value of space:
  - Earth Observation data:
    - Hi-res images for decision making.
    - Used in modelling of atmospheric pollutants distribution from weather, land use, and elevation data.
  - Satellite Navigation:
    - Fleet management.
    - Positioning for Emergency Response.
  - Satellite Communications:
    - Communications for tracking, monitoring and alerting when terrestrial networks are unavailable.

UAS supported by Integrated Space Systems

Themes: Safety & Transport (running)

- Background:
  - Use of UAS (Unmanned Aerial Systems) is steadily become more important, e.g. :
    - Maritime surveillance (border control, water pollution, traffic).
    - Inspection of infrastructure (pipelines, power grids, etc).
    - Disaster management.
  - Advantages of UAS:
    - Can be deployed in remote and/or dangerous locations.
    - Deployment on demand.
    - Little terrestrial infrastructure needed.
  - Key challenges:
    - Regulations on use of UAS in non-segregated airspace.
    - Technology not yet proven.
- User Workshop to be held on 11th -12th May 2010 in Noordwijk.

IAI Heron UAV in flight

- Two parallel feasibility studies begun in Feb 2010:
  - An ESA IAP study led by INDRA Espacio (Spain) for civil applications, and an EDA study led by EADS Astrium France for military applications.
  - Objectives to Investigate the technical and economical feasibility of UAS services *in non-segregated air space* for
    - Command & Control, Sense & Avoid, Air Traffic Control.
    - Operational service provision (UAV payload data transmission).

UAS supported by Integrated Space Systems

Themes: Safety & Transport (running)

- Example of system concept

Satellite Relay of
- VHF Aeronautical Communication (bi-directional)
- Payload communication

UAV Ground Control Station

Ground control station can be located anywhere on Earth

The UAV carries a payload, e.g. camera, radar, or other electronic sensors.

VHF Aeronautical Communication

Air Traffic Management
- Should be able to handle the UAS as "any aircraft"

- Stakeholders
  - UAS service providers.
  - Regulatory and Aviation Safety community.
  - European Defence Agency (EDA).
- Added-value of space:
  - Very precise navigation
    - GPS, EGNOS (current).
    - Galileo (in future).
  - Highly reliable communication with global coverage
    - Low bit-rate secure connection for Command & Control, Link with Air Traffic Control, etc.
    - High bit-rate connection for real-time transfer of sensor data to a remote ground station.

Illustrations: [ESA, Wikimedia Commons]

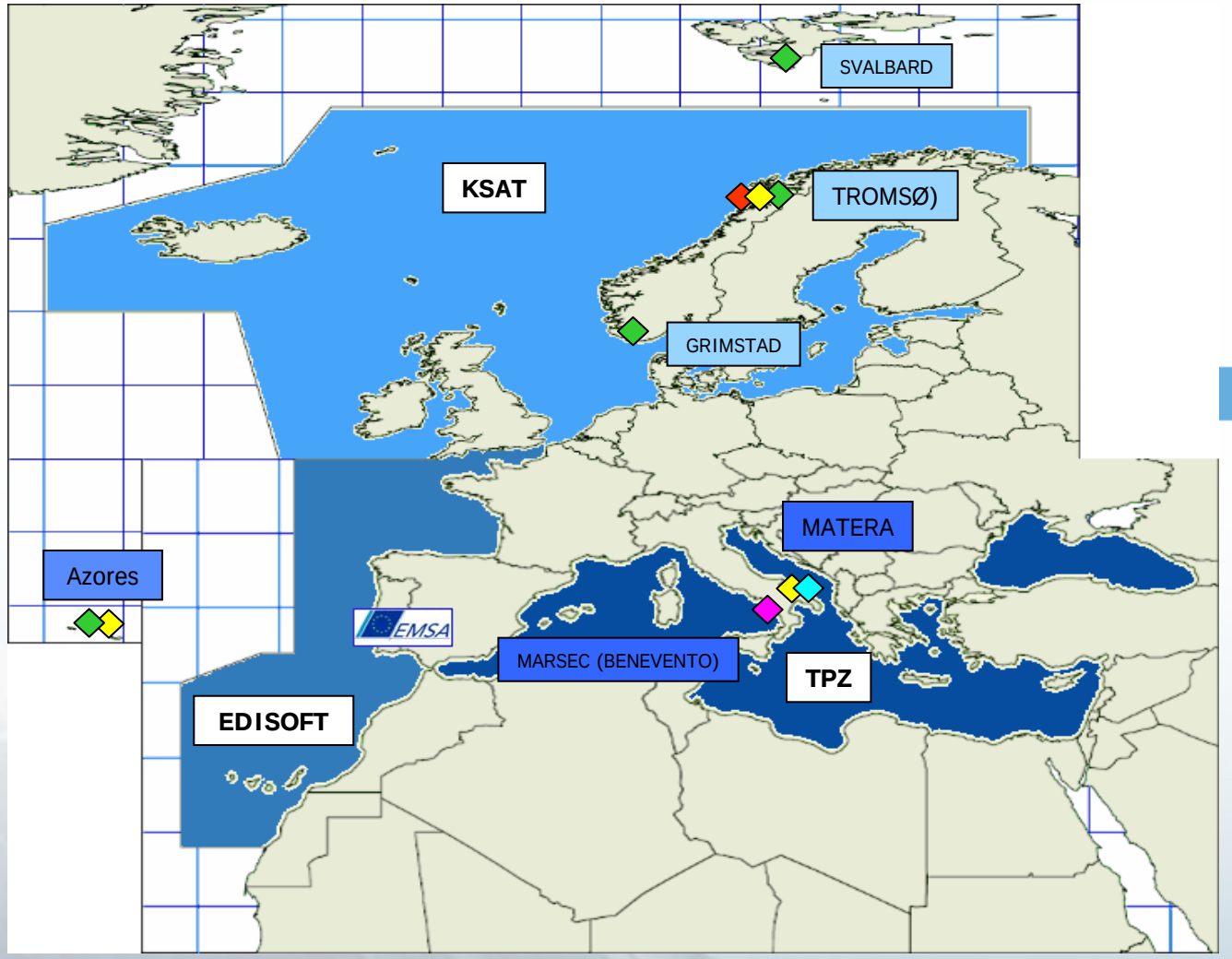
CleanSeaNet example of already operational application of EO and AIS data

- EMSA = European Maritime Safety Agency, set up in response to sinking of *Erika* off the Brittany coast in Dec 1999.
- 4 main operational services, including CleanSeaNet (CSN) for oil spill detection.
- Not part of the IAP programme, but an excellent example of the operational integration of satellite (EO SAR) and AIS (Automatic Identification System) data for maritime applications.
- Already covers the Baltic Region.
- Could be extended to include satellite AIS data in the future, though not a strong requirement for the Baltic.
- Slides on CleanSeaNet reproduced by kind permission of EMSA.

Photo BSAM – Douanes françaises

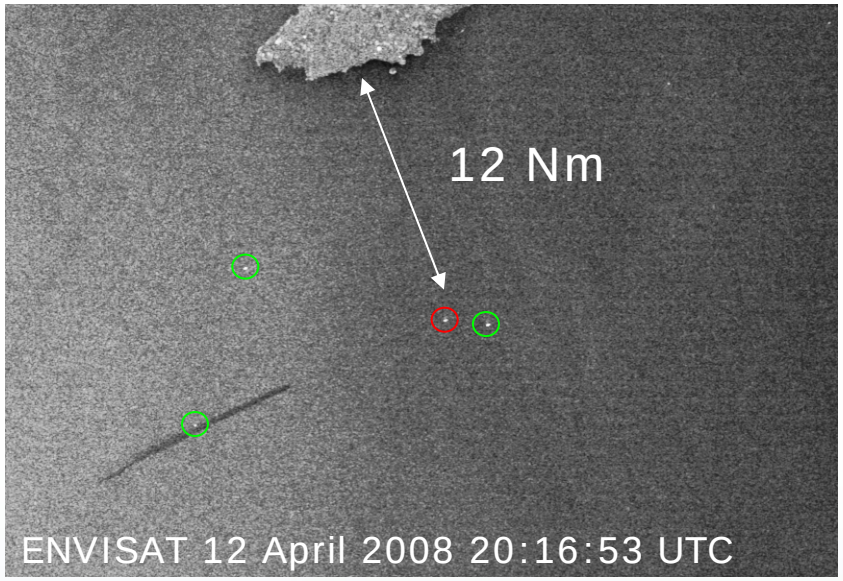
Real Time Access – CleanSeaNet Network

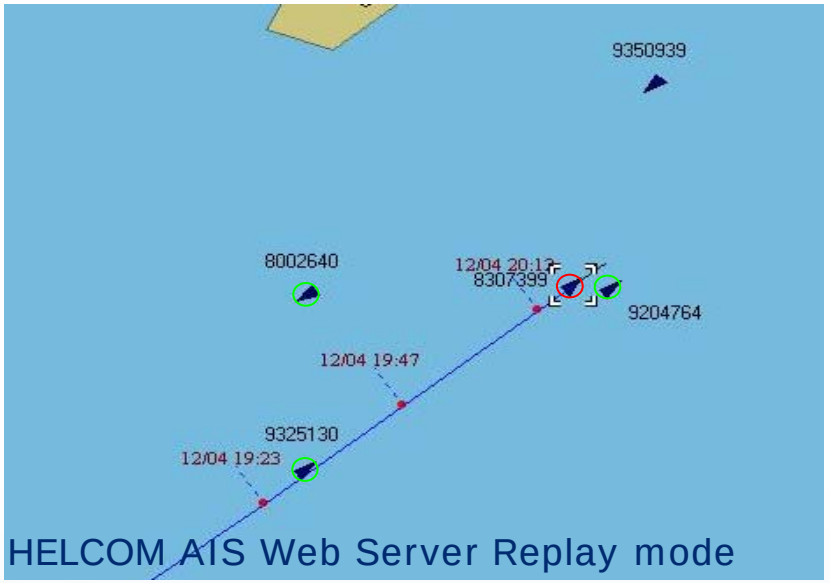
- Oil Service Desk
- Oil Detection Chain
- Ground Station (ENVISAT and RADARSAT)
- Ground Station (ENVISAT only)
- Ground Station (RADARSAT only)



All European waters will be covered as soon as the Azores ground station enters into service

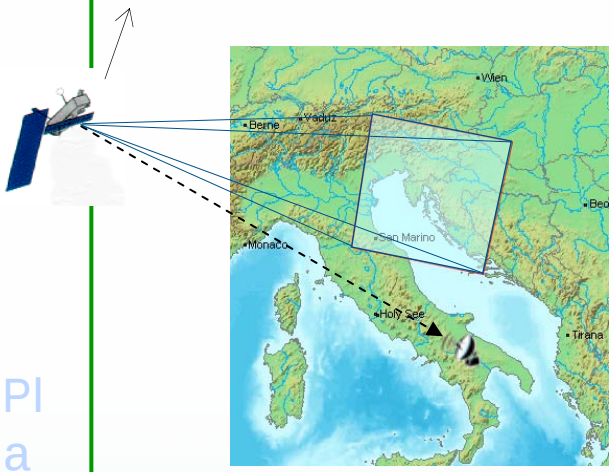
Ship detection in SAR images combined with AIS

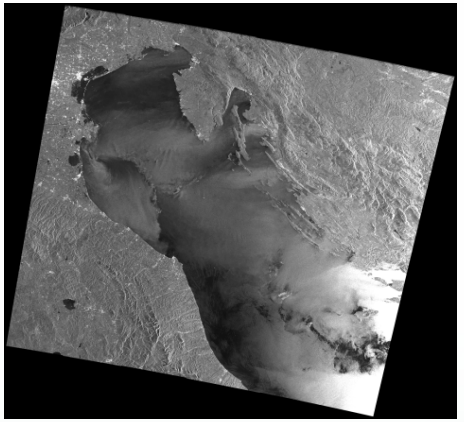




- Absolute and relative positions of ships detected in the SAR image compared to the AIS picture match.
- Identification of the originator of the spill with a high level of probability.
- Comparing SAR with AIS data will reveal uncooperative targets.

Near Real Time Service – 30 Minutes



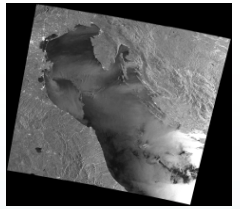


Phone and email alert

Oil Service Report

Image

(LR, HR)



Ancillary data

Planning

Acquisition and Processing

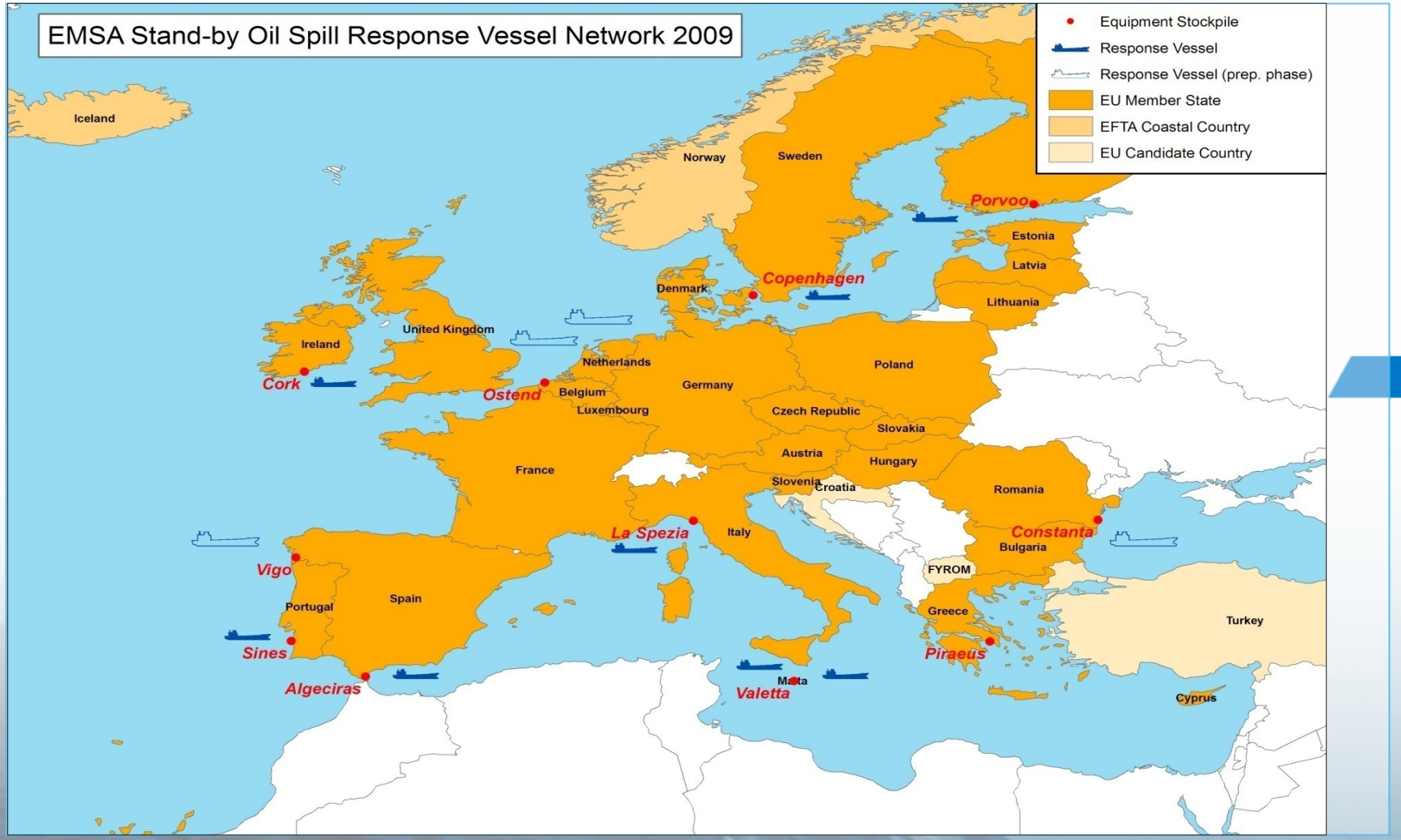
Oil Spill Analysis

Alert & Product Delivery
(Web Browser, EMSA)

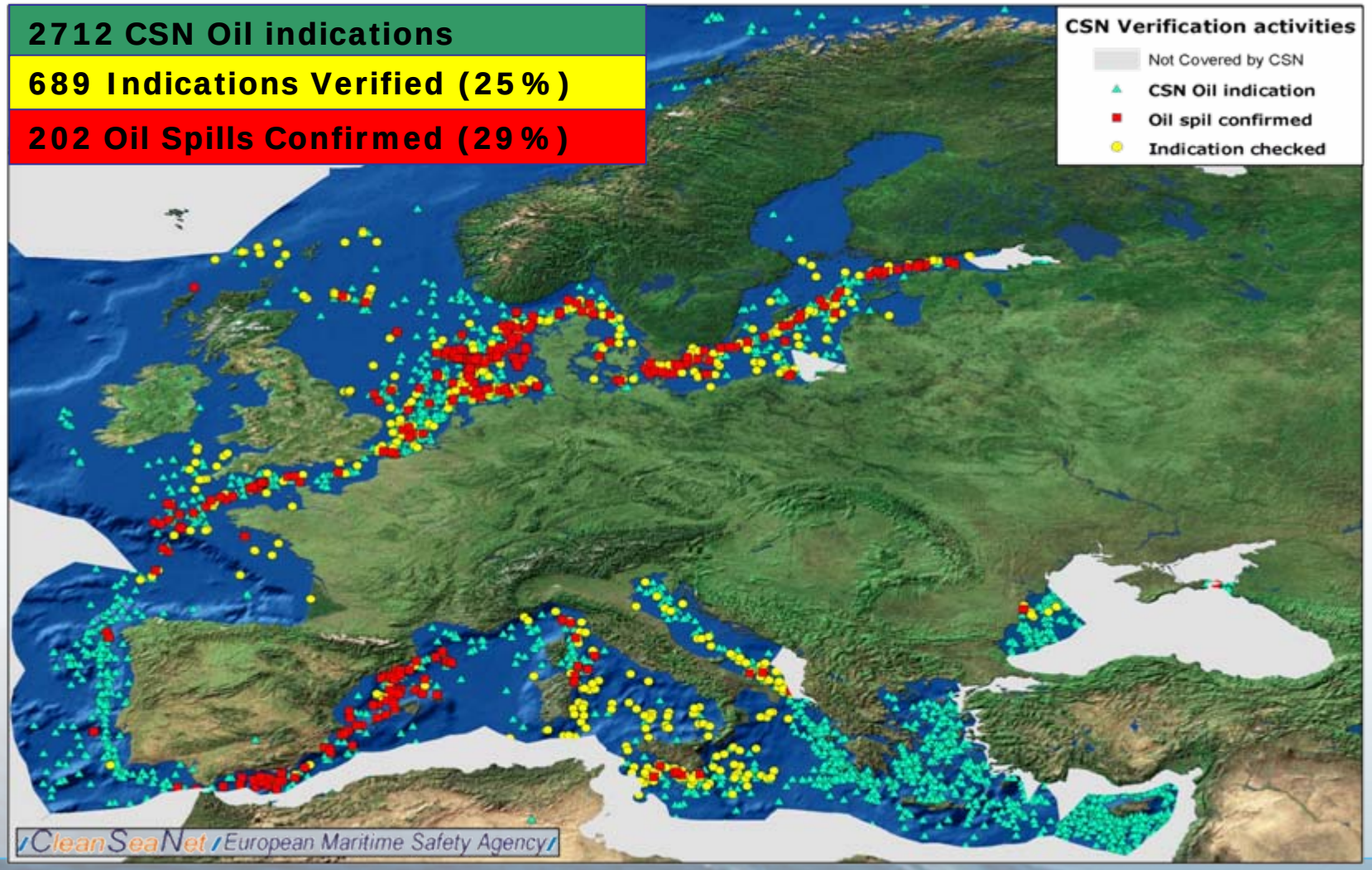
Feedback

T0 = End of scene acquisition

T = T0 + 30 min


EMSA Stand-by Oil Spill Response Vessel Network 2009
Equipment Stockpile
Response Vessel
Response Vessel (prep. phase)
EU Member State
EFTA Coastal Country
EU Candidate Country
Iceland
Norway
Sweden
Porvoo
Estonia
Latvia
Lithuania
Copenhagen
Denmark
United Kingdom
Ireland
Cork
Netherlands
Ostend
Belgium
Luxembourg
Germany
Poland
Czech Republic
Slovakia
Austria
Hungary
France
Slovenia
Croatia
Romania
La Spezia
Italy
Constanta
Bulgaria
Vigo
FYROM
Portugal
Spain
Greece
Turkey
Sines
Piraeus
Algeciras
Malta
Valletta
Cyprus

CSN: 2008 (Jan.-Sept.) Detection and verification information



Ideas for future IAP activities ?

- **An Arctic Maritime Fleet management system** to optimise time between harbours (departure and destination), cost (fuel + labour), safety …
- Would incorporate in-situ data from entire fleet of ships at sea:
  - Information from the vessel (ice thickness observations, etc) transmitted outwards in order to assist with ice charting.
- Standards for the use of EO data in electronic navigation systems are being developed, but EO data is not yet integrated into Arctic ship routing.
- In addition to SAR for sea ice, there could be interest in getting NRT wind and wave information to vessels near the ice edge, for example from altimetry.
- System could help to optimise choice of ship for a specific route (normal, ice-strengthened, etc).
- Vessel position, bearing and forward plan would be used as input to the EO planning / collection / processing system. Requires:
  - Scheduling the instrument (24 hour acquisition planning is now possible for SAR).
  - Downloading SAR image data at a favourable location.
  - Processing / extracting the relevant part of the imagery.
  - Optimising the communications routing to the vessel (the compression software could also build in the location of the vessel).

THANK YOU

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User driven space applications for the Baltic area region - Relevant examples
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http://iap.esa.int