



*ESA Integrated Applications  
Programme (IAP)  
Stimulating User Driven Projects*

TSB, BNSC & ESA Forum on Transport, Safety and  
Energy challenges - New Opportunities and Call for  
Projects Proposals

Nov. 12<sup>th</sup> 2009, Harwell

A. Ginati, European Space Agency (ESA)

- **Introduction**
- **ESA & IAP Programme Objectives**
- **Demonstration Projects, Illustrative Examples**
- **FlySafe & European AIS Mission**
- **Conclusion**

# ESA MS and Establishments

European cooperation states: Hungary

Cooperation arrangement: Canada

**ESTEC - Netherlands**  
European Space Research  
& Technology Centre

**EAC - Cologne, Germany**  
European Astronaut  
Centre

**Nov. 08 MC Approved**  
**Programmes 2009-2011**

**ESOC - Darmstadt, Germany**  
European Space Operations  
Centre

**9,6 B€**

**HEADQUARTERS -**  
Paris, France

**ESRIN - Frascati, Italy**  
European Space Research  
Institute

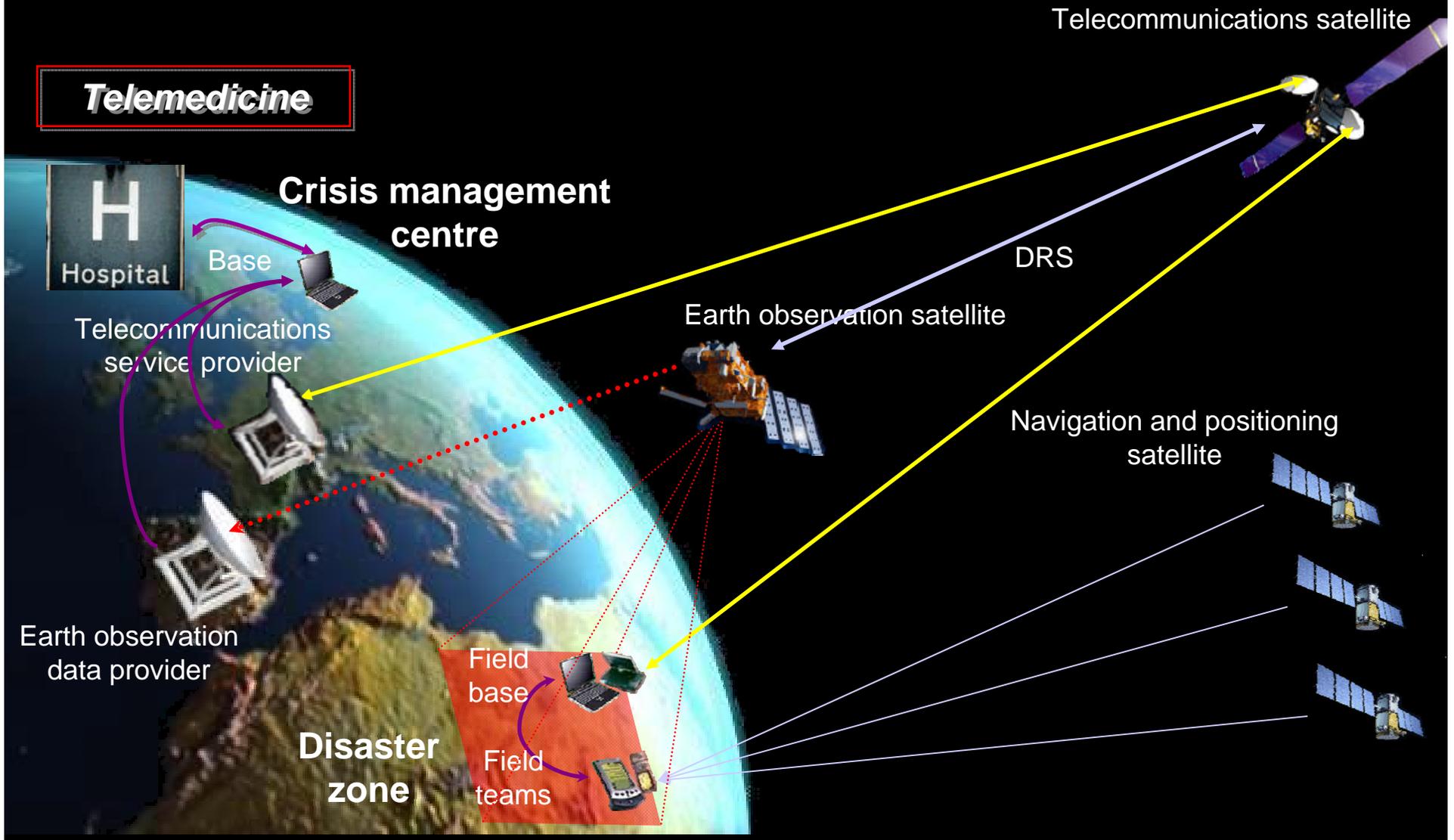
**ESAC - Villafranca, Spain**  
European Space Astronomy Centre



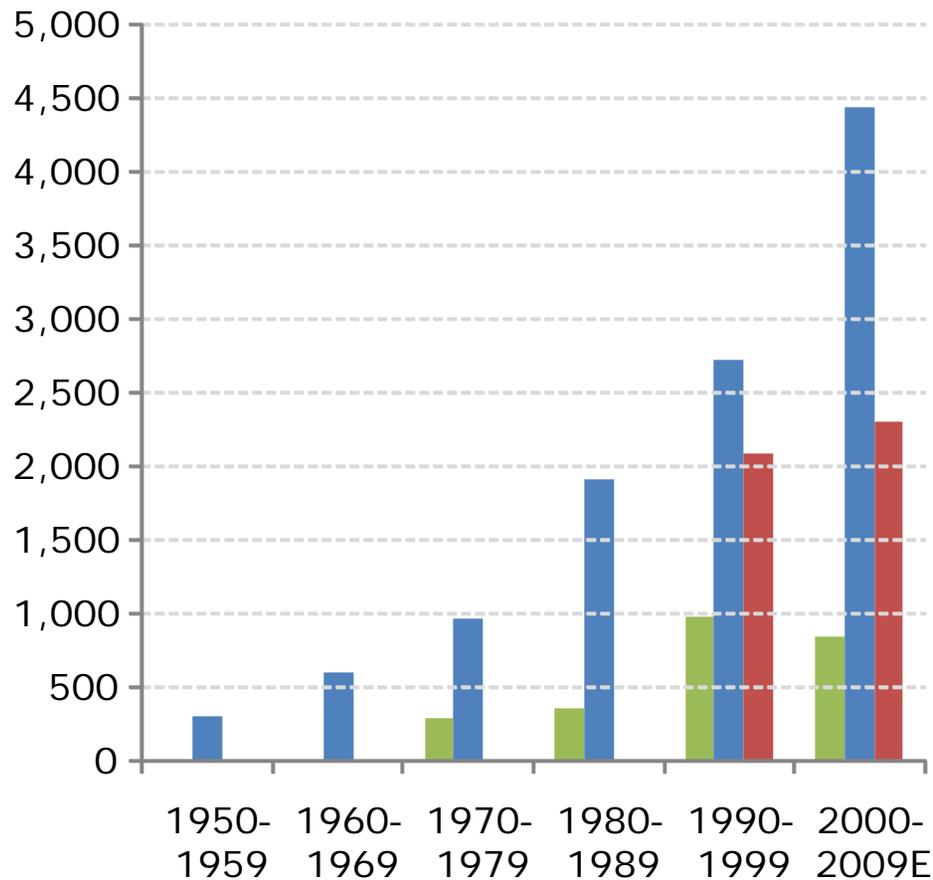
- **Pierluigi Mancini**
- **Ralf Huber**
- **Norbert Hubner**
- **Domenico Giunta**
- **Alan Brunstrom Tel: 01865 567 903**  
**[Alan.Brunstrom@esa.int](mailto:Alan.Brunstrom@esa.int)**

**Alan Brunstrom, Dedicated to the Integrated Applications Programme, Intended to be an honest broker who promotes IAP by:**

- Raising awareness of the programme among user communities and the whole service delivery chain, including press & PR activities
- Providing information and advice on the programme and how to use it, including the ESA tender process and points of contact
- Helping to put together partnerships to deliver IAP projects
- Working with the finance community to develop 3rd party funding and business structures to support IAP projects
- Liaison with TSB and other UK partners
- Listening to actual and potential *users* and working to ensure that the programme reflects their needs!



An increasing impact of disasters per decade:



- ➔ Fast growing number of disasters reported in the different world regions
- ➔ Over 2 billion people impacted
- ➔ Economic damage over \$500 billion



Source: ISDR, Euroconsult estimates

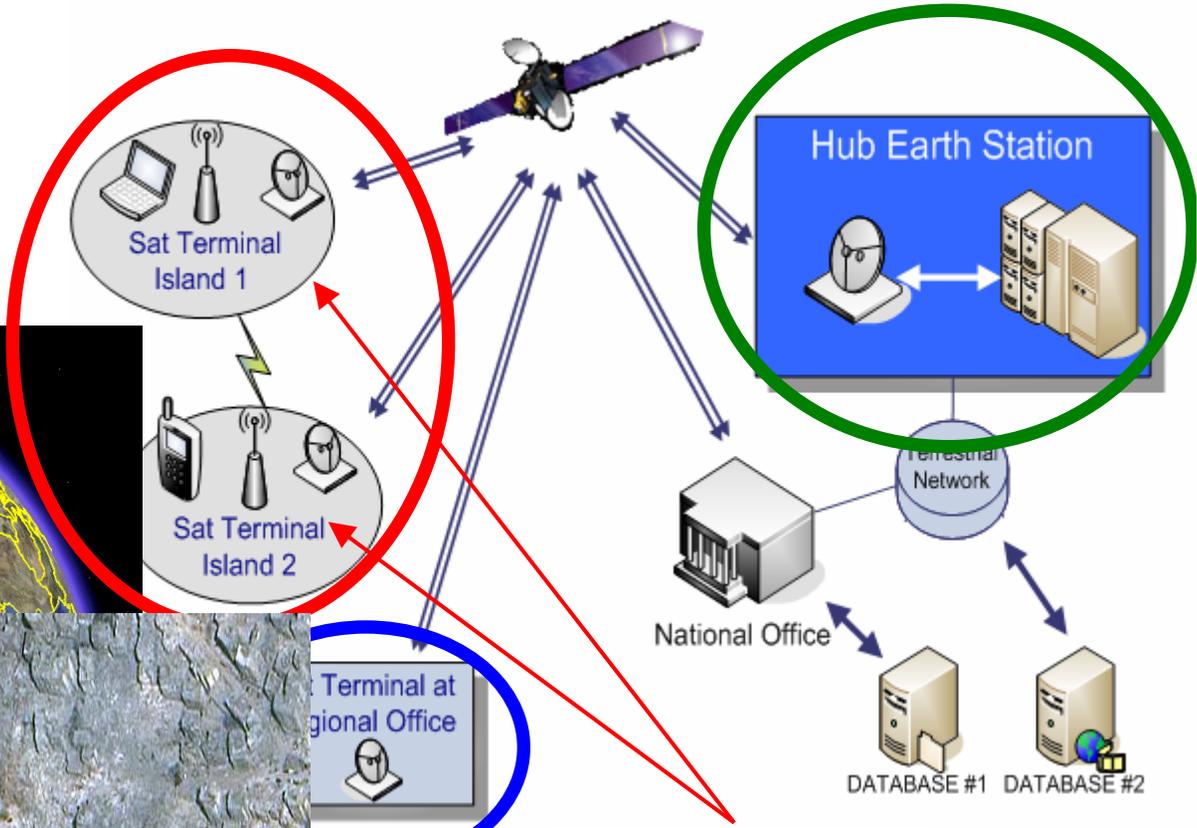
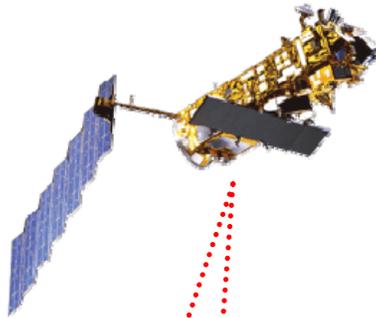
- **Lack of Providers** who can give **affordable** and ready-to-deploy solutions  
*Commercial solutions target mass-market*
- **Lack of Coverage** (global/regional) for some available solutions  
*Currently offered solutions might not be available in all crisis areas*
- **Lack of Synergy** or **interoperable** tools amongst different organizations  
*Proprietary standards limit the interoperability*
- **Lack of Robust** solutions/tools **suitable** for crisis environment  
*Commercial tools not always suitable for crisis*



# Deployment and Full Coverage

## Example: "Service-Buy" Model

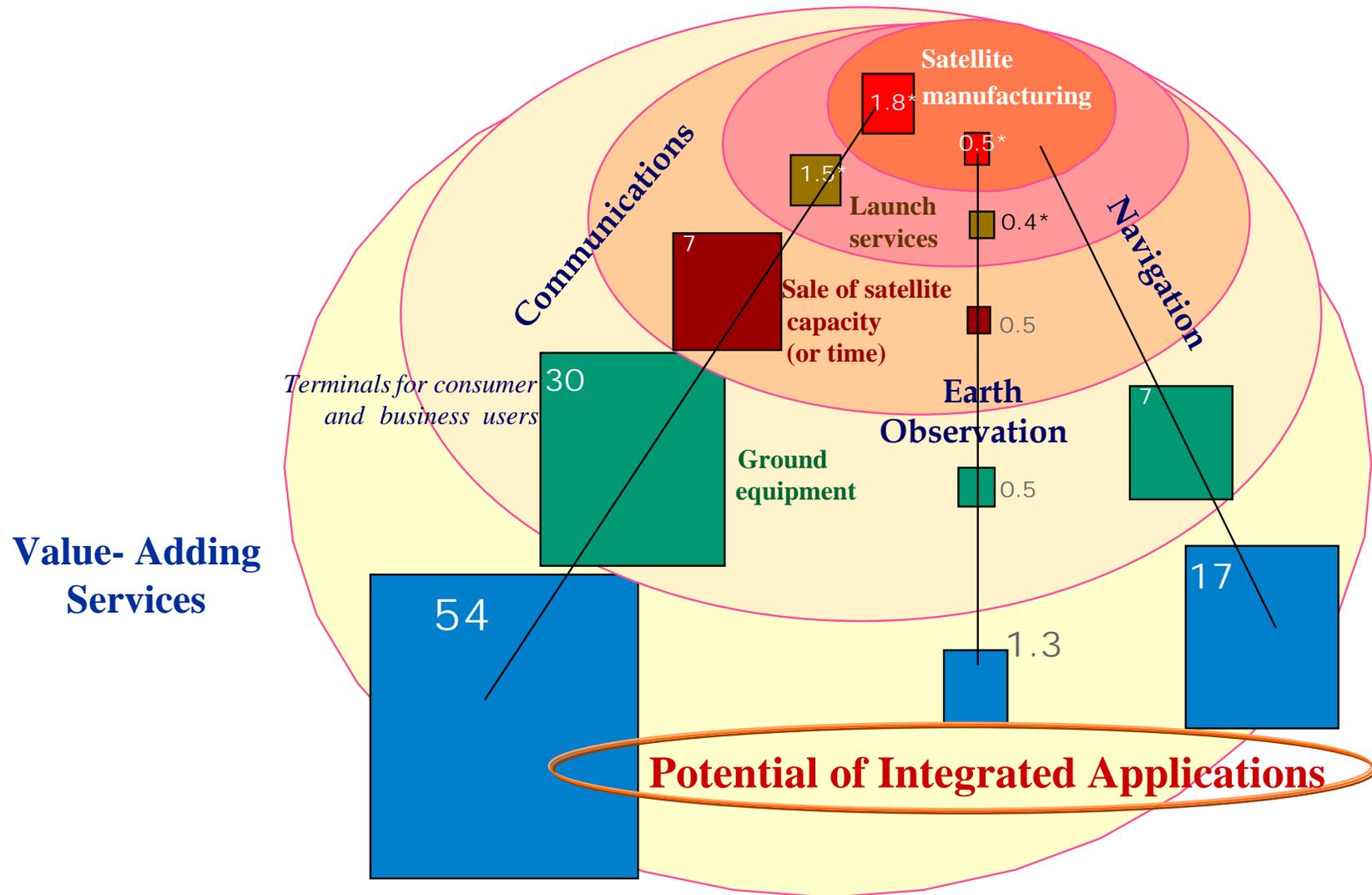
Optical, SAR  
Surveillance



ed Area

**Satcom Terminals  
+  
Wireless  
Extensions  
=  
Full Coverage  
&  
EO + Navigation**

# The three value chains in commercial satellite applications



Values for the year 2005 in billions of €

**Exploit systematically the extended use of space capacity and capability through the development, in close partnership with end-users, of integrated applications which can demonstrate a potential for user-side sustainable services.**

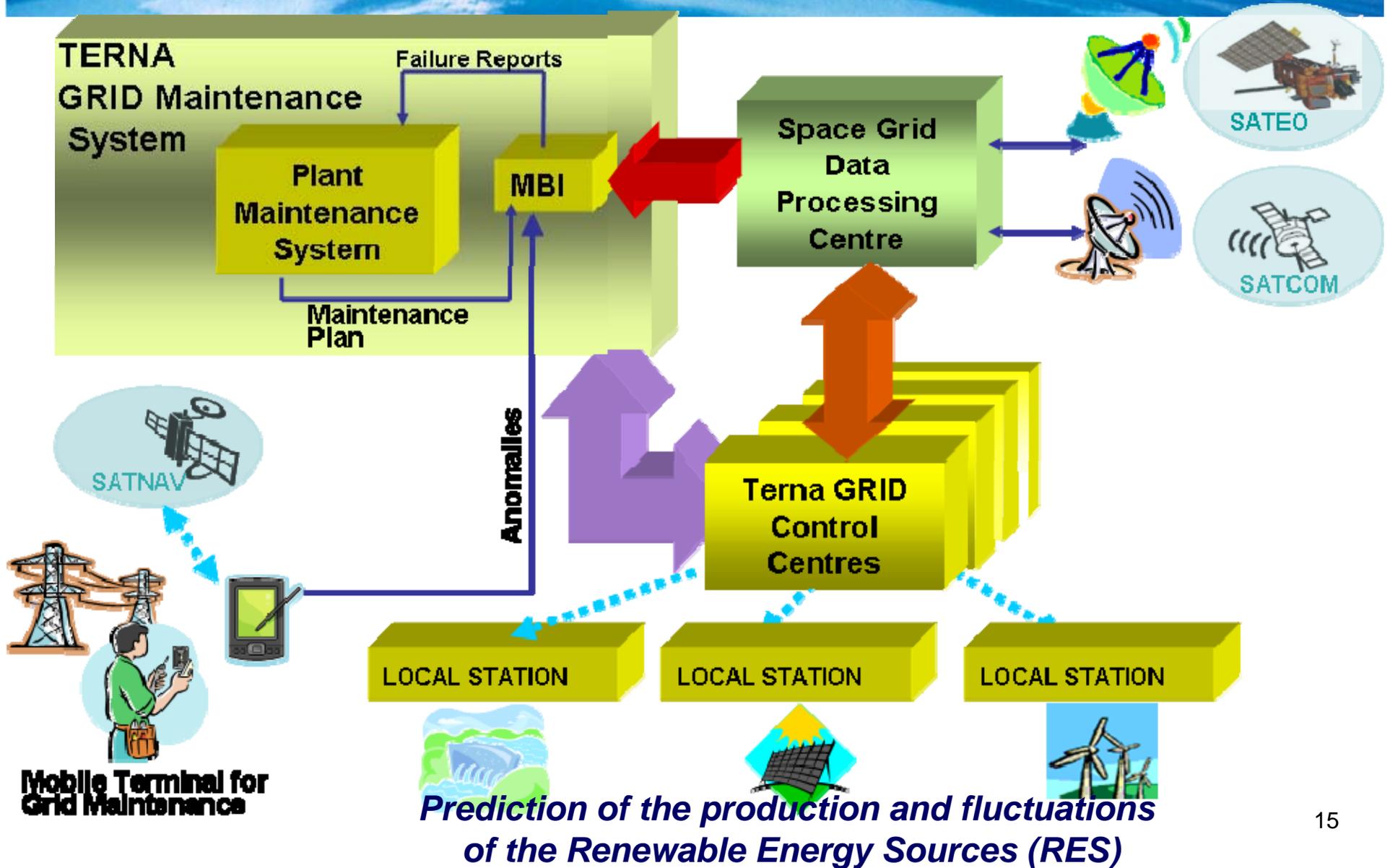
**“Connecting expert Communities  
&  
Combining Technologies”**

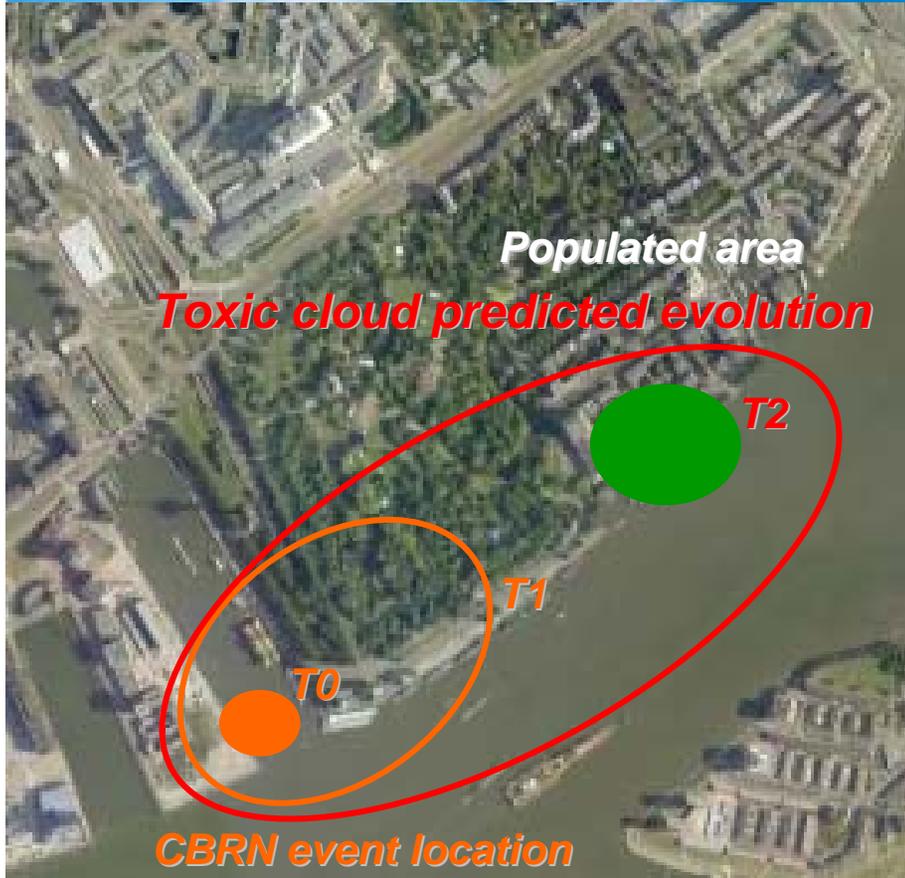
- Meet
  - Increasing demand for sustainable complete solutions using integrated space & non-space technologies/systems
  - Space Council Resolution May 2007 (Political will)
- Overcome
  - Cultural gap and lack of dialogue between potential users and the space sector (awareness)
  - Compartmentalization of the offer by space technology (synergy)
- Using
  - Principle of upstream and initial involvement of user/ partner/ service provider/ operator (partnership)

*“Incubator for Services”*

- 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 in Thematic Areas e.g.
  - Space for Health, Development...
  - Space for **Safety**, Knowledge ...
  - Space for **Energy**, Economy...
  - Space for **Transport**, Innovation...
- ...In Regional, National, European and Global scale

- ***Space for Safety / Transport***
  - Flight Safety: NL, B (D, F) - **Air Forces** (Airlines / Airports)
  - Satellite AIS System for Maritime Safety: **DG- MARE/EMSA**
  - Transport of Hazardous materials (SSMART): **AREVA**
  - Intelligent Railways via Integrated Satellites Services (IRISS) (UK)
  - Satellite Systems and operations for UAS :**EDA**
- ***Space for Health (thematic website: [www.esa.int/health](http://www.esa.int/health))***
  - Health in Peacekeeping Missions : G, F, I ,E **MoDs**
  - Telemedicine in Africa: **DG-DEV**
  - Tick-borne encephalitis risk mapping / Mosquitoes habitat mapping
  - Private medical insurance and assistance : **Europ Assistance**
- ***Space for Knowledge/Development***
  - Water Management, Water Quality in Egypt IAP Enhancement
  - Peace Building and Damage Assessments: (e.g. DG RELEX)
- ***Space for Energy***
  - Power grid management : **TERNA**
  - Nuclear site monitoring (e.g. Chernobyl): **IAEA**



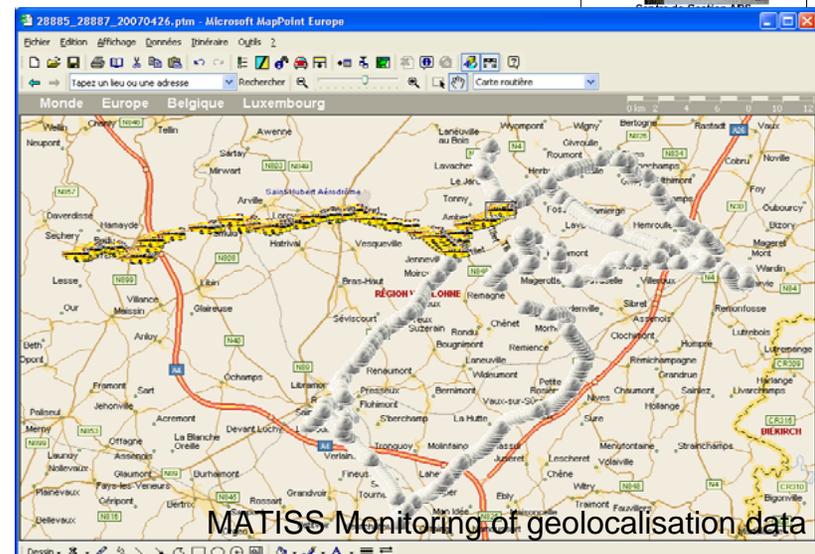
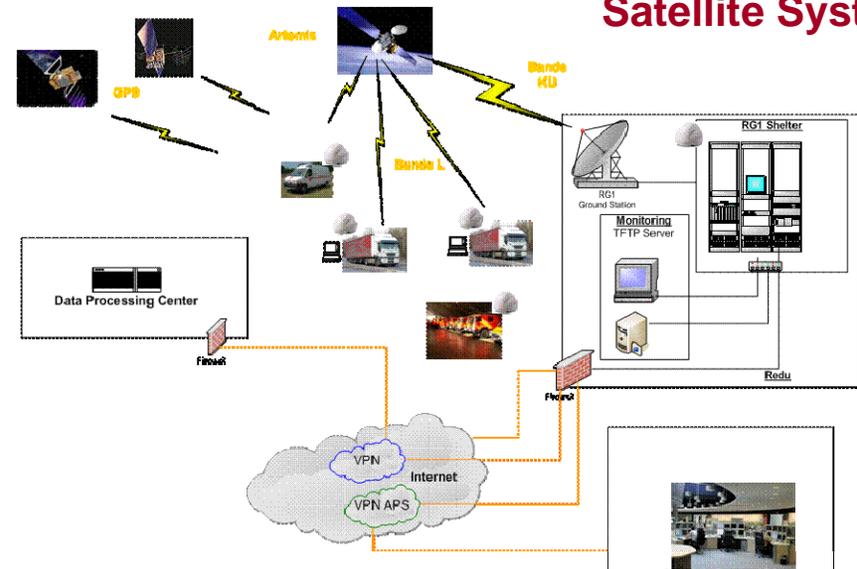


SEVESEO Images

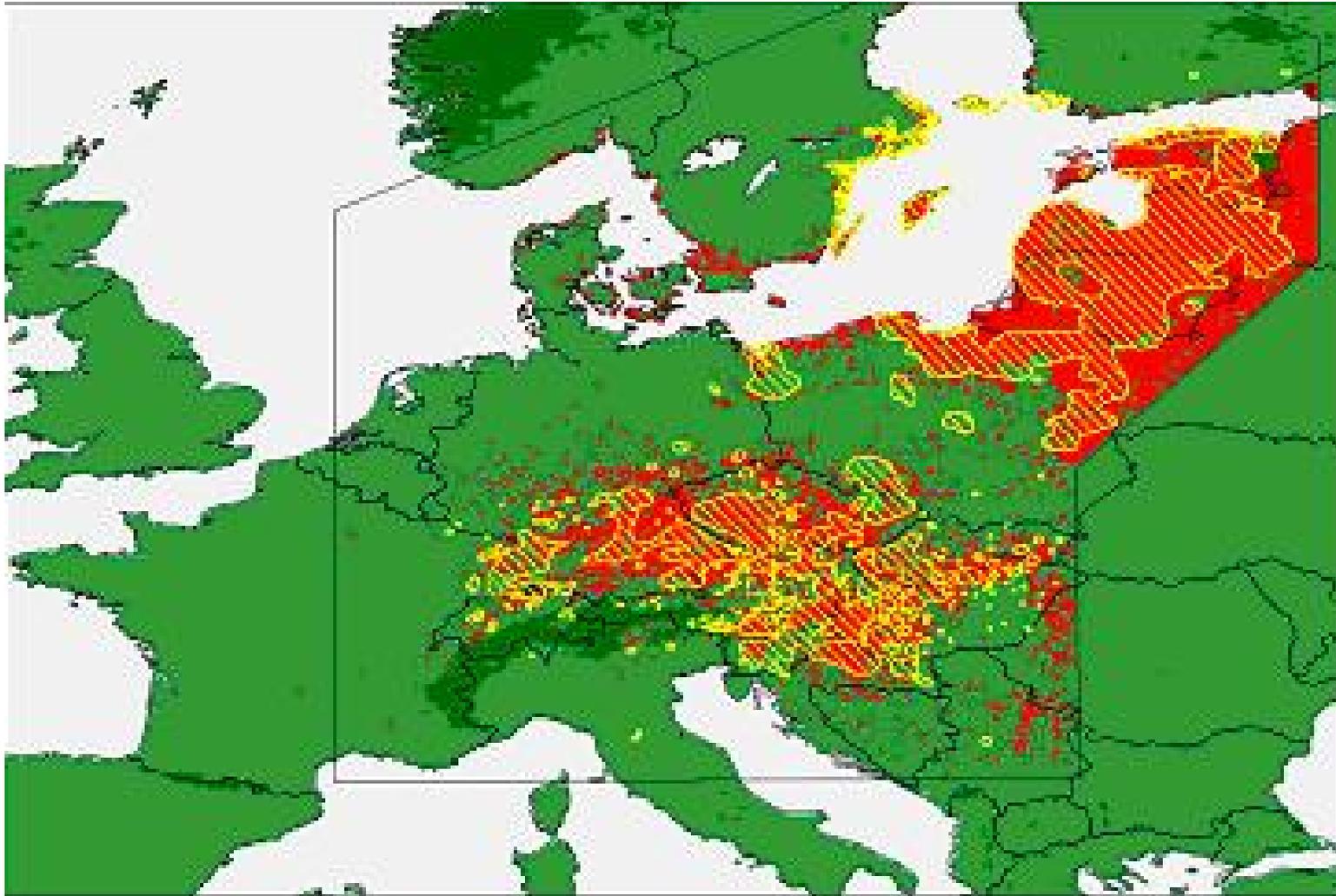
Accurate forecasts :

- Event propagation assessment
- Anticipation of responses
- Alerts to rescue teams and citizens

## Messaging and Tracking hybrid Infrastructure Satellite System

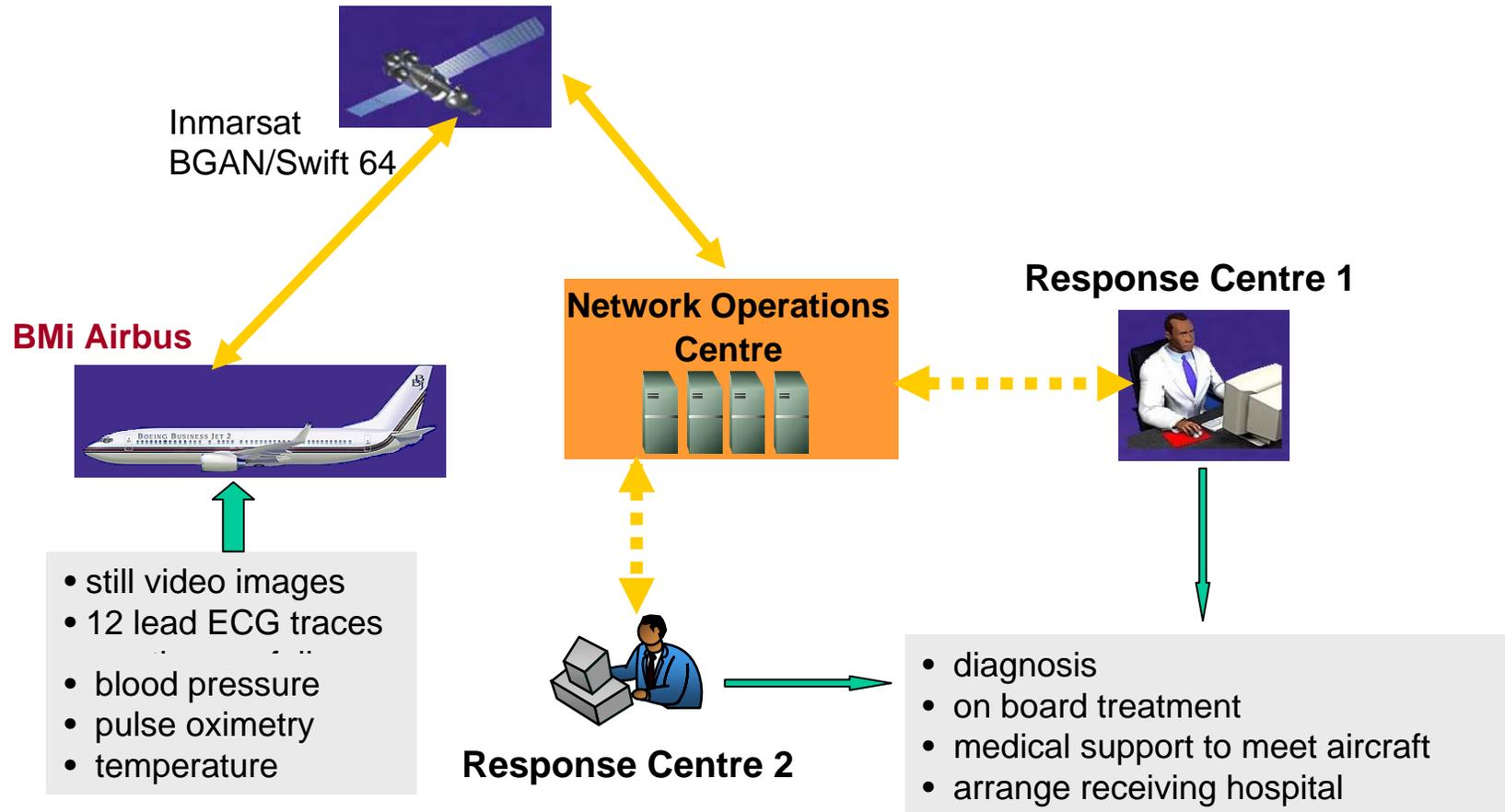


From “Observation” to “Prediction” (vaccine producers e.g. Baxter)



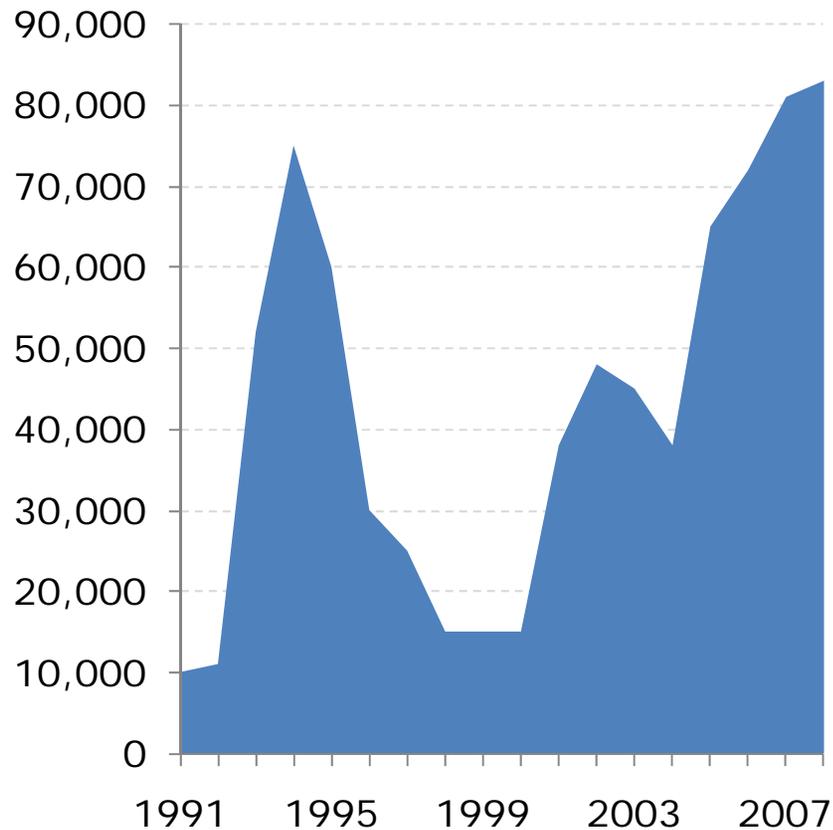
**Observed (yellow)** and **Predicted (red)** TBE in Europe, (Randolph and Rogers).

- **In one hand, every year in all world airlines between 700 and 1000 hundred people died during long duration flights (more than 6 hours) due to medical reasons; each day between 1 and 1.5 planes are landing in emergency conditions for medical reasons the statistic data on these landings showed that 45% can be avoid if a single electrocardiogram could be transmitted from the plane to an emergency medical department in an hospital; the cost of such re-routings is about 80K€**
- **In the other hand , the travel duration are more and more long i.e. the next A380 planes (more than 15 hours non stop); the number of passengers will increase with the new capacities of the planes**



**The aim of the system is to determine if the medical condition of the passenger is serious enough to cause a diversion**

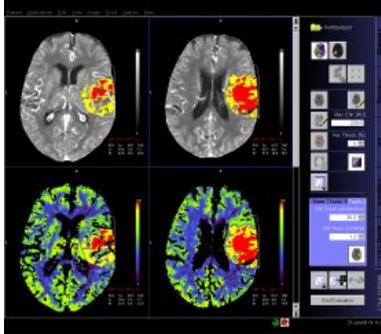
**Uniformed personnel in UN peacekeeping operations**



Source: UN

- ❑ **Political instability in a number of geographical areas has resulted in an increasing number of multilateral government operations for peacekeeping and security**
  
- ❑ **Increasing costs of peacekeeping information in recent years:**
  - ❑ 1993: \$3.6 billion
  - ❑ 1998: \$1 billion
  - ❑ 2001: \$3 billion
  - ❑ 2004: \$2.8 billion
  - ❑ 2006: \$5.03 billion
  - ❑ 2008: \$6.8 billion
  - ❑ 2009: \$7.1 billion (budgeted)

## Imagery

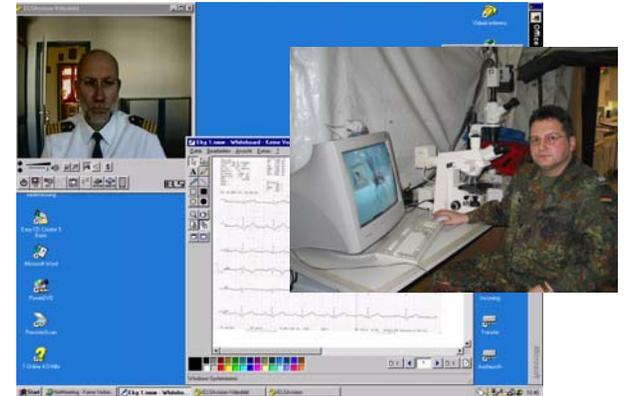


CT Scan



Data management  
Communication  
Prioritisation

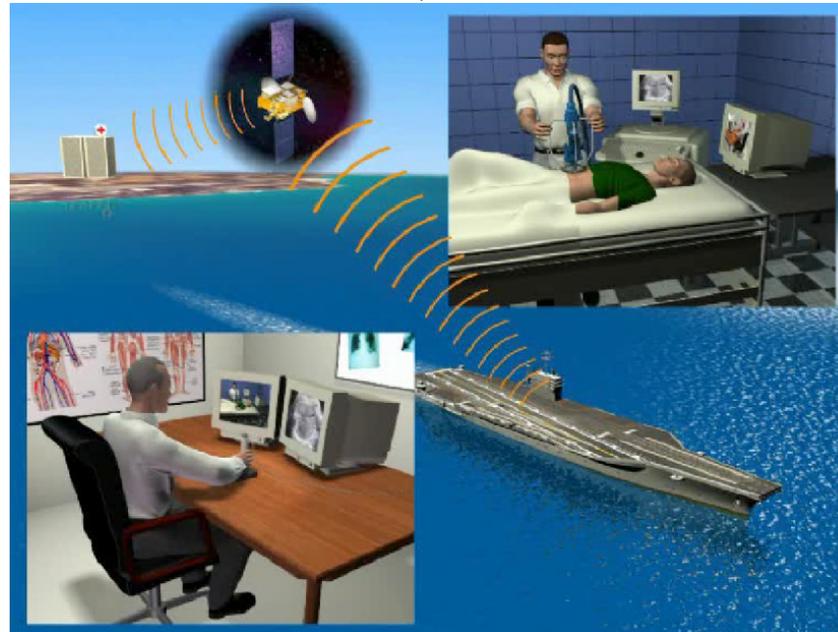
## Voice/video



## Remote guiding



Robotic assisted surgery



## Complex operations



Maintenance

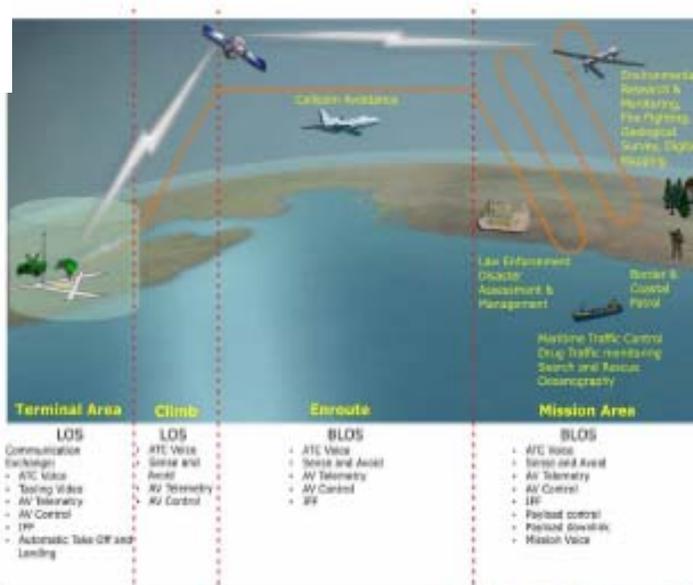


# UAS-Satellite Co-operative Missions

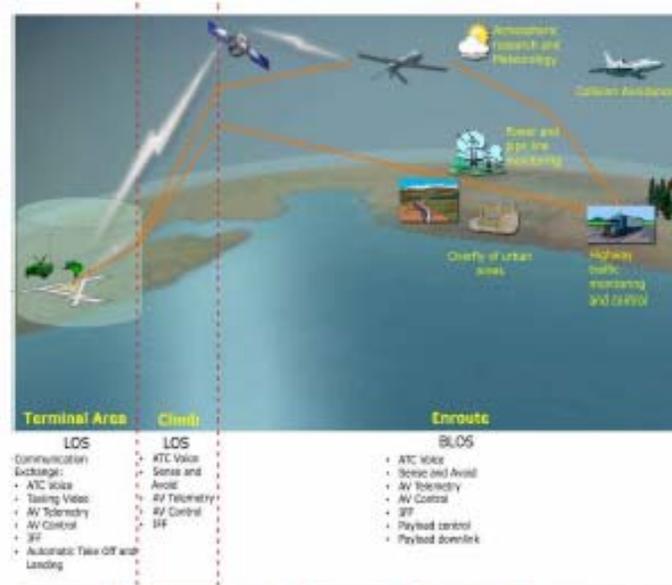
## Preliminary mission scenarios

T

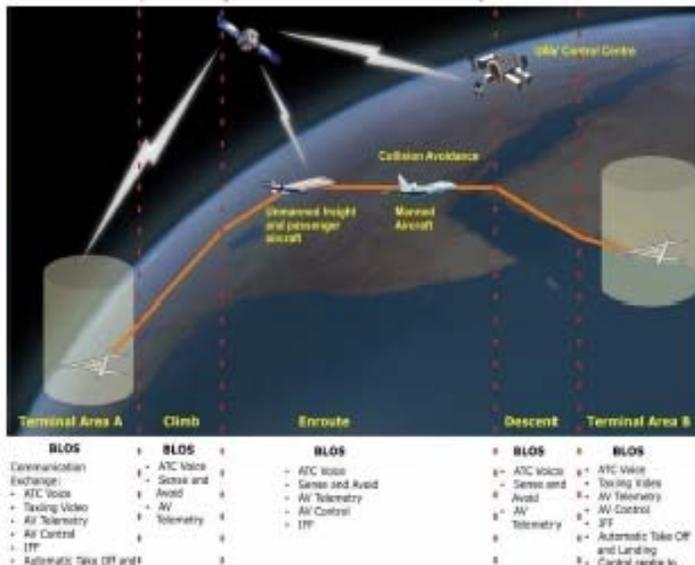
Scenario 1  
Civil Area  
Operation



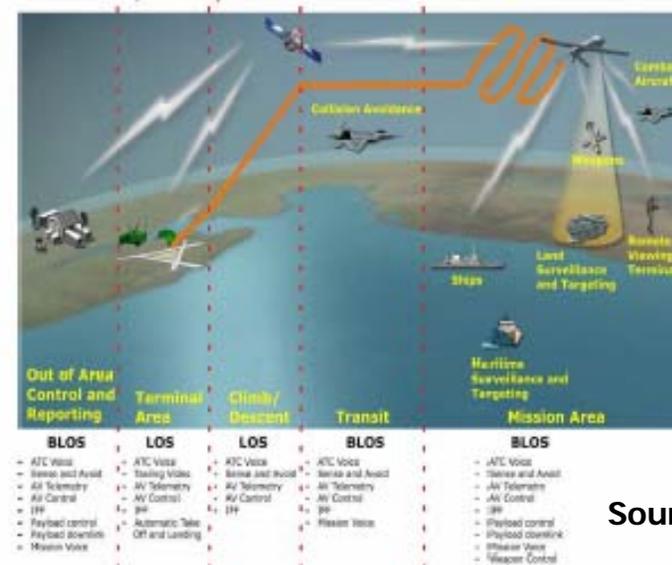
Scenario 2  
Civil Route  
Operation



Scenario 3  
Civil En-route  
Integration



Scenario 4  
Military Operation



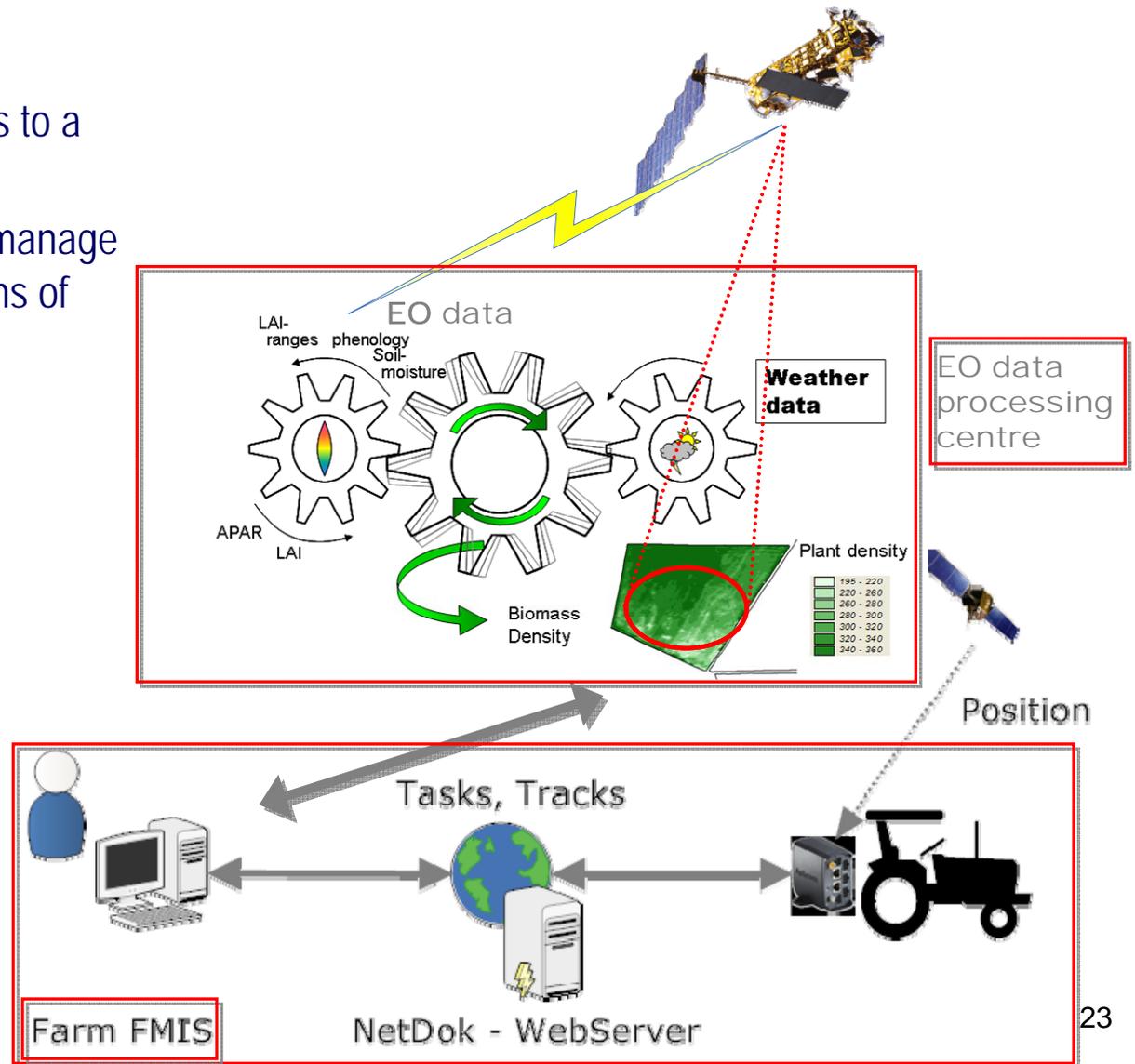
Source: Thales Alenia

- **End-to-end chain:**

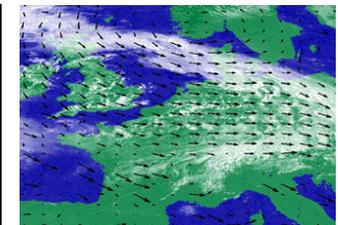
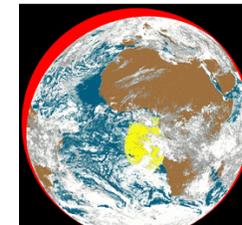
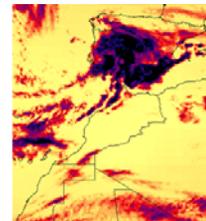
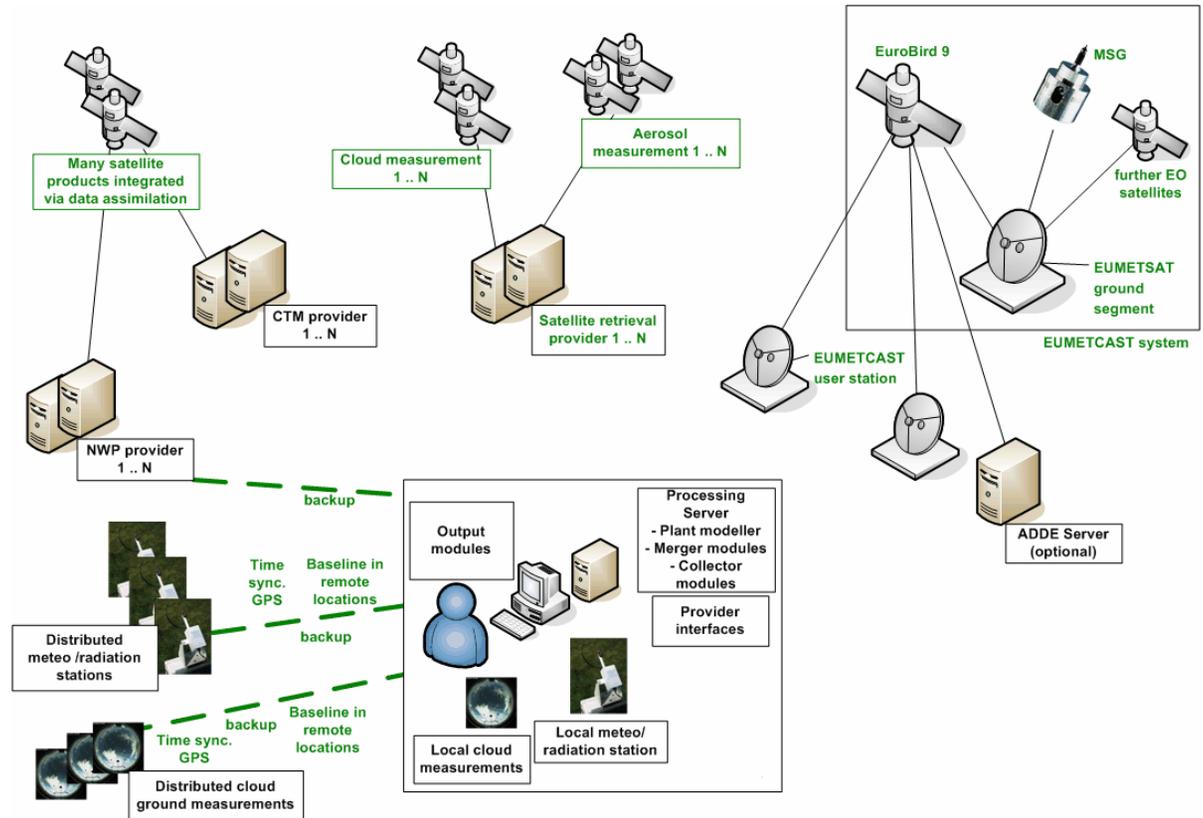
- Users request EO products to a service provider
- The products are used to manage the farm internally by means of GPS and GIS tools

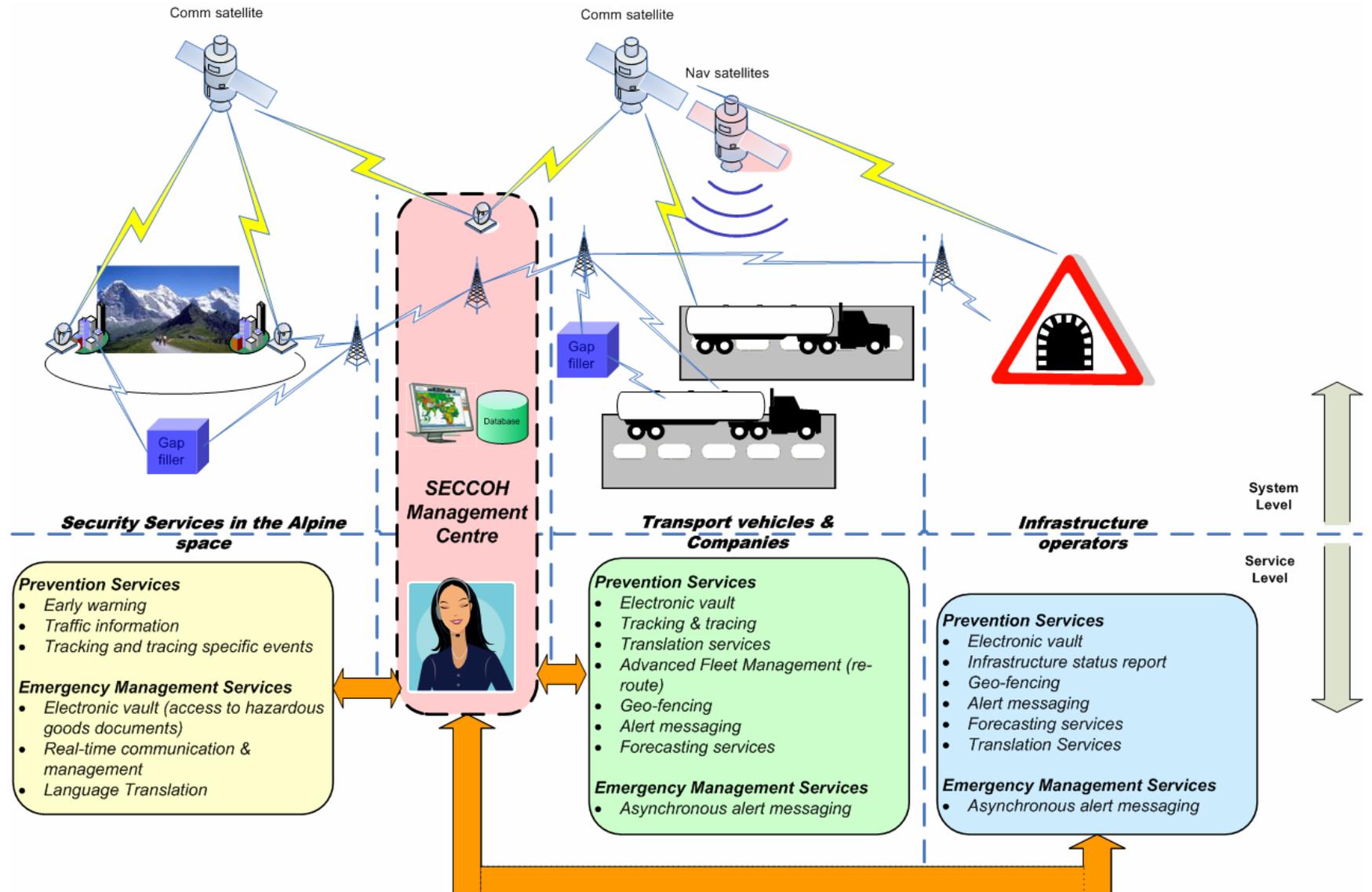
- **Bi-directional:**

- Farmer provides information to create customised products.
- It is possible to provide further assistance to the farmer by means of telematics tools.



- Real-time forecasting services can be achieved by:
  - Earth Observation data.
  - Real-time transmission through satellite
  - GNSS synchronisation
- A power plant model can combine all these data to create power management information







# IAP FlySafe Project



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**





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.

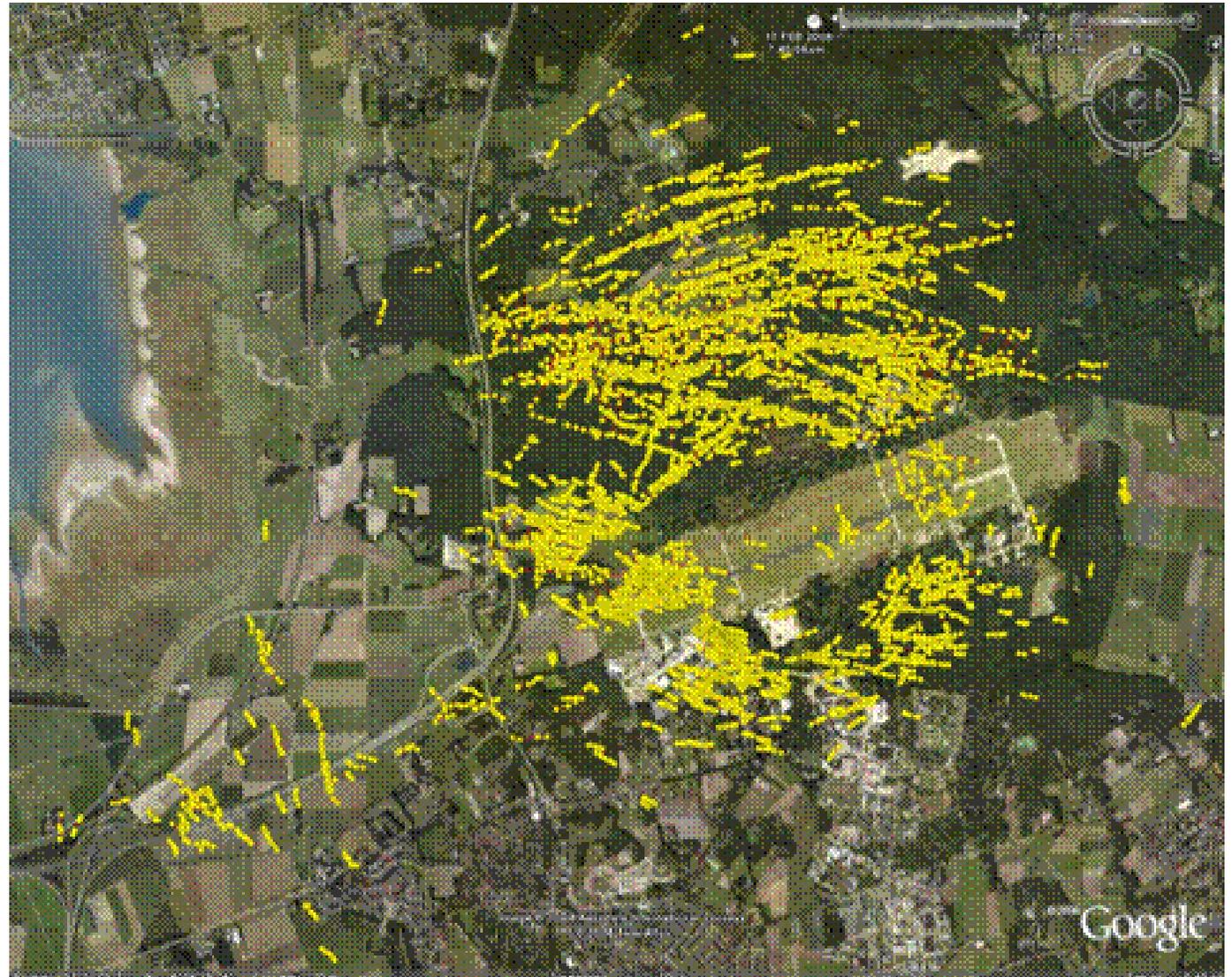


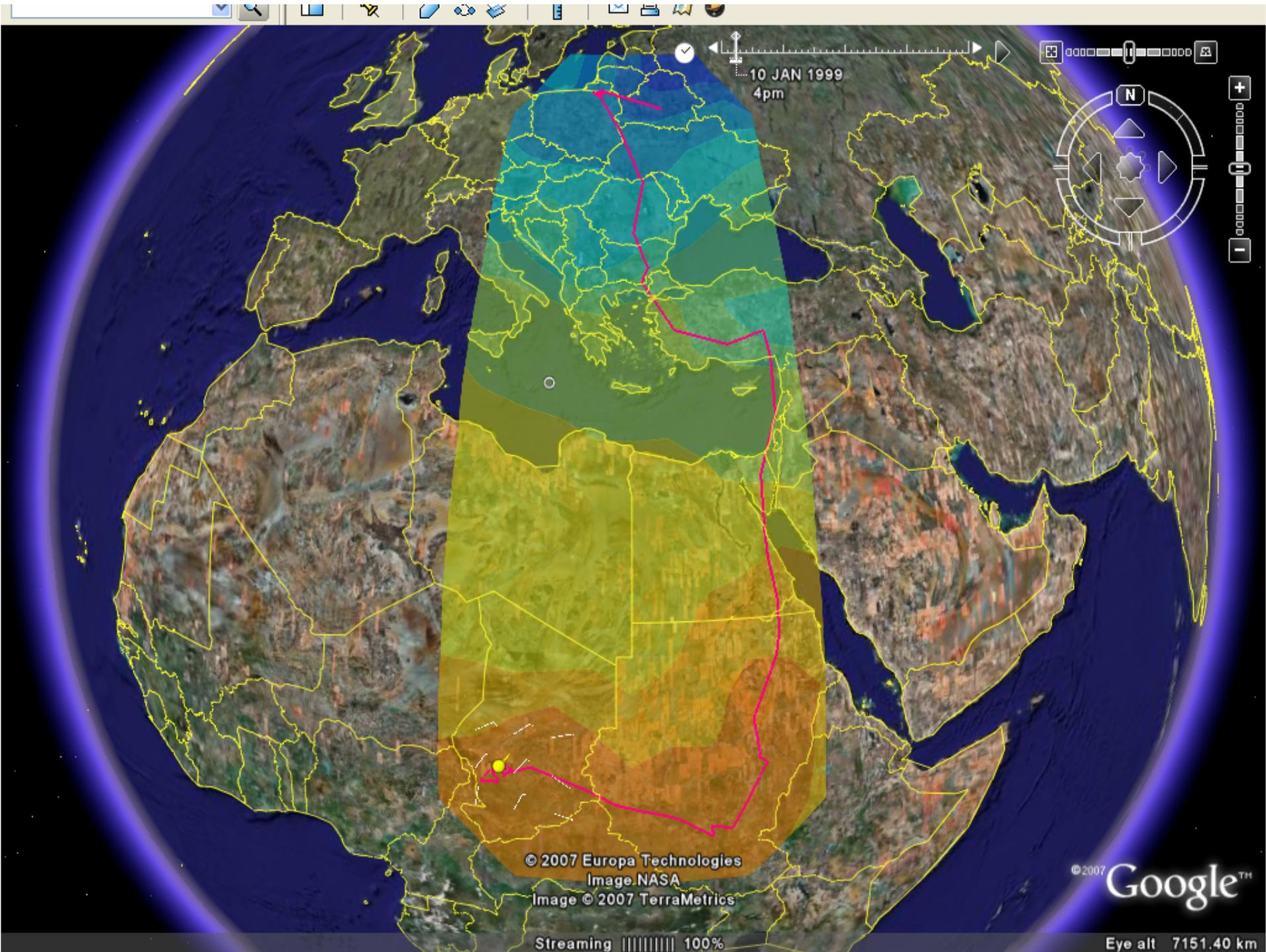
**“It’s just to let you all know that FlySafe is really able to do spectacular things”**

Example: Gulls  
movement  
Woensdrecht  
Airbase, NL

Night of  
Feb.20th  
2008

(photo RNLAF).





10 JAN 1999  
4pm

© 2007 Europa Technologies  
Image NASA  
Image © 2007 TerraMetrics

© 2007 Google™

Streaming ||||| 100%

Eye alt 7151.40 km



# Studying behaviour using tracking data

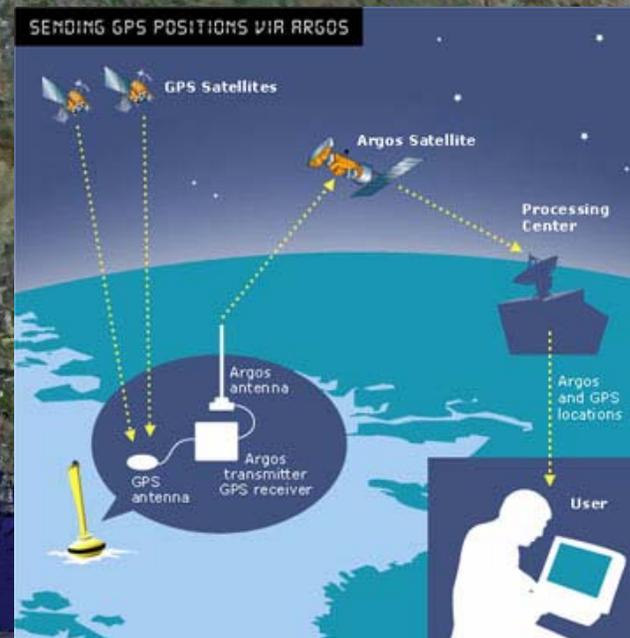
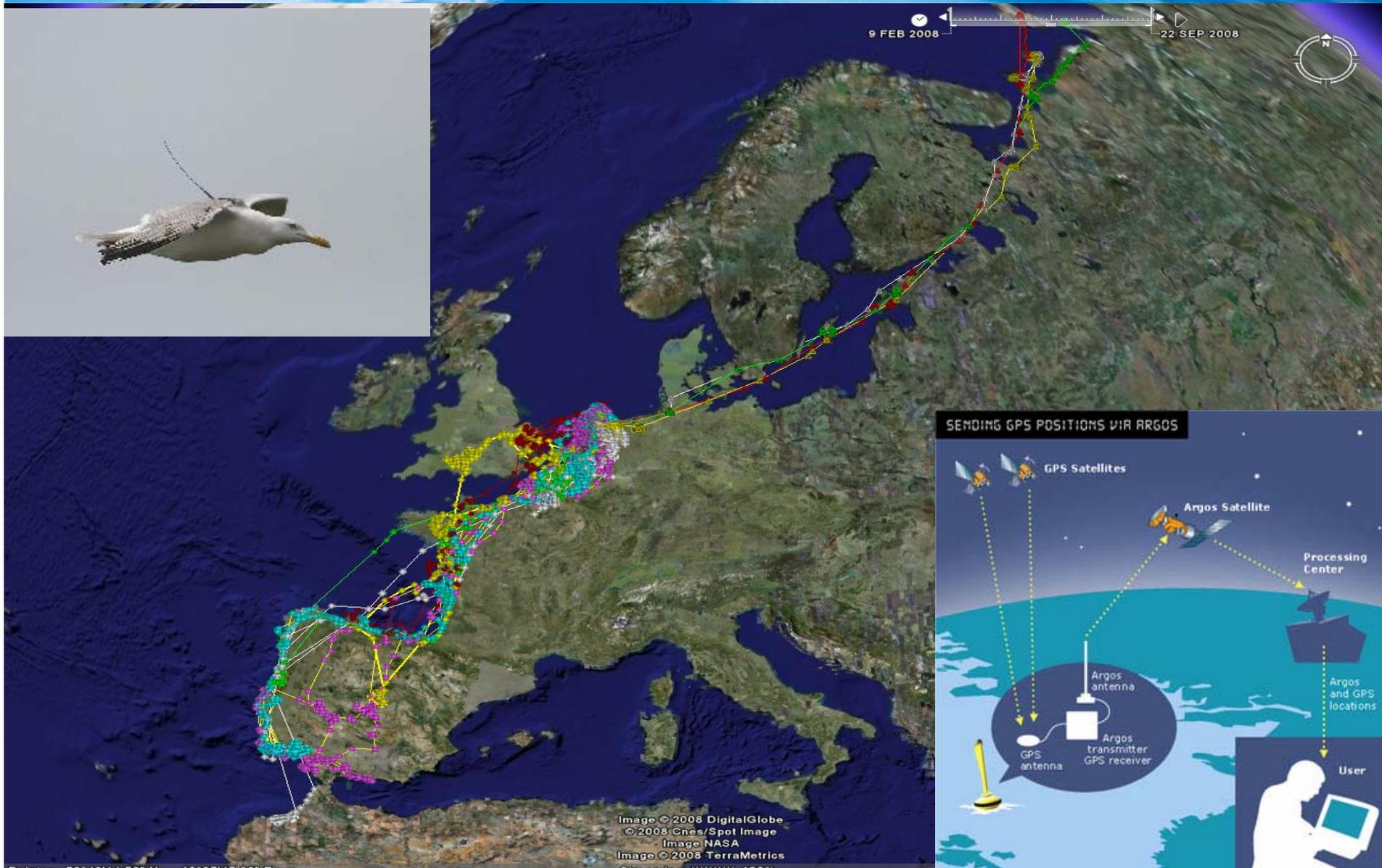


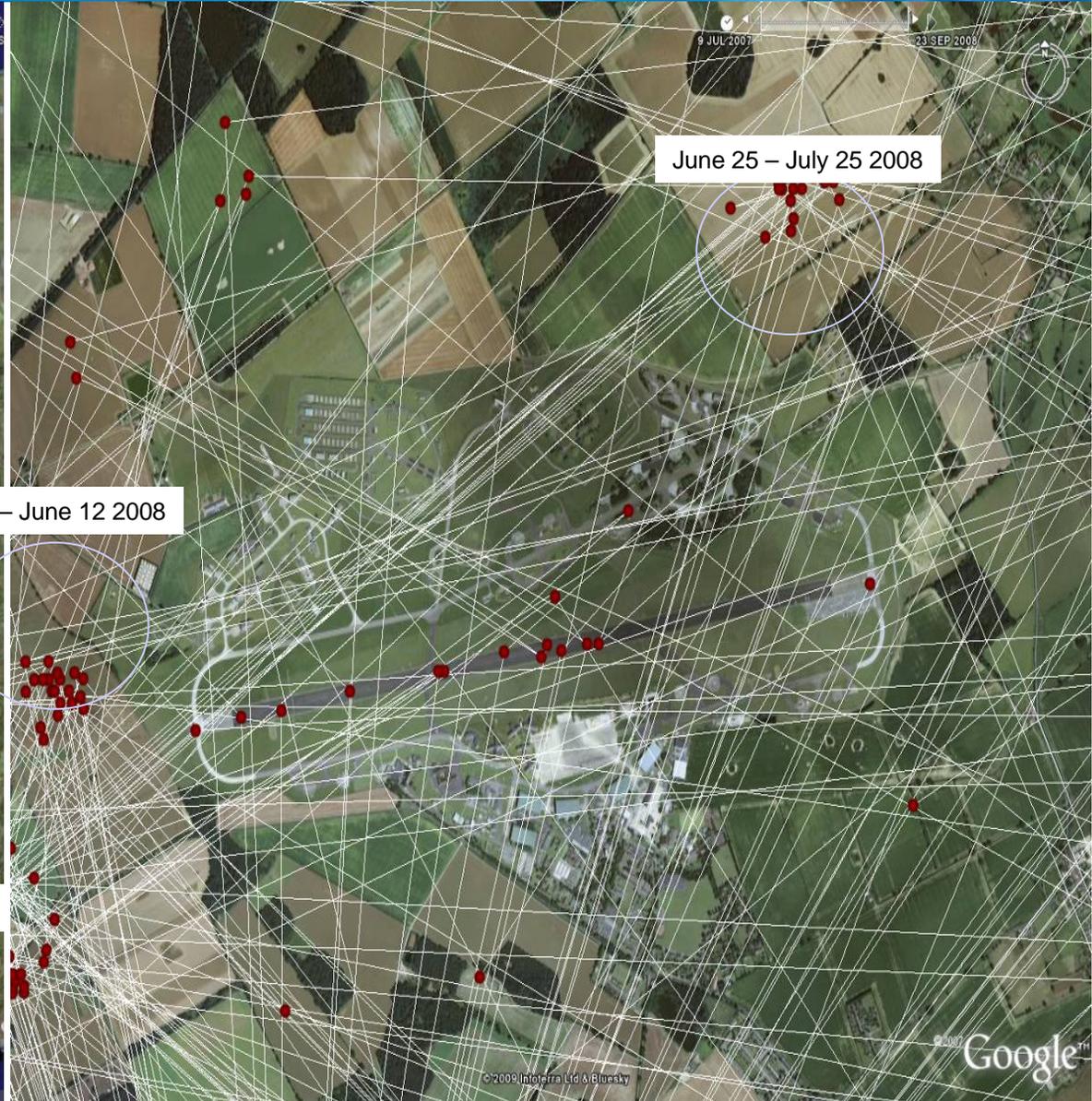
Image © 2008 DigitalGlobe  
© 2008 Cnes/Spot Image  
Image NASA  
Image © 2008 TerraMetrics  
Streaming 100%



*LBG 41757 on Honington airfield in UK on several days between 10 July and 15 August 2007 and back again in 2008*

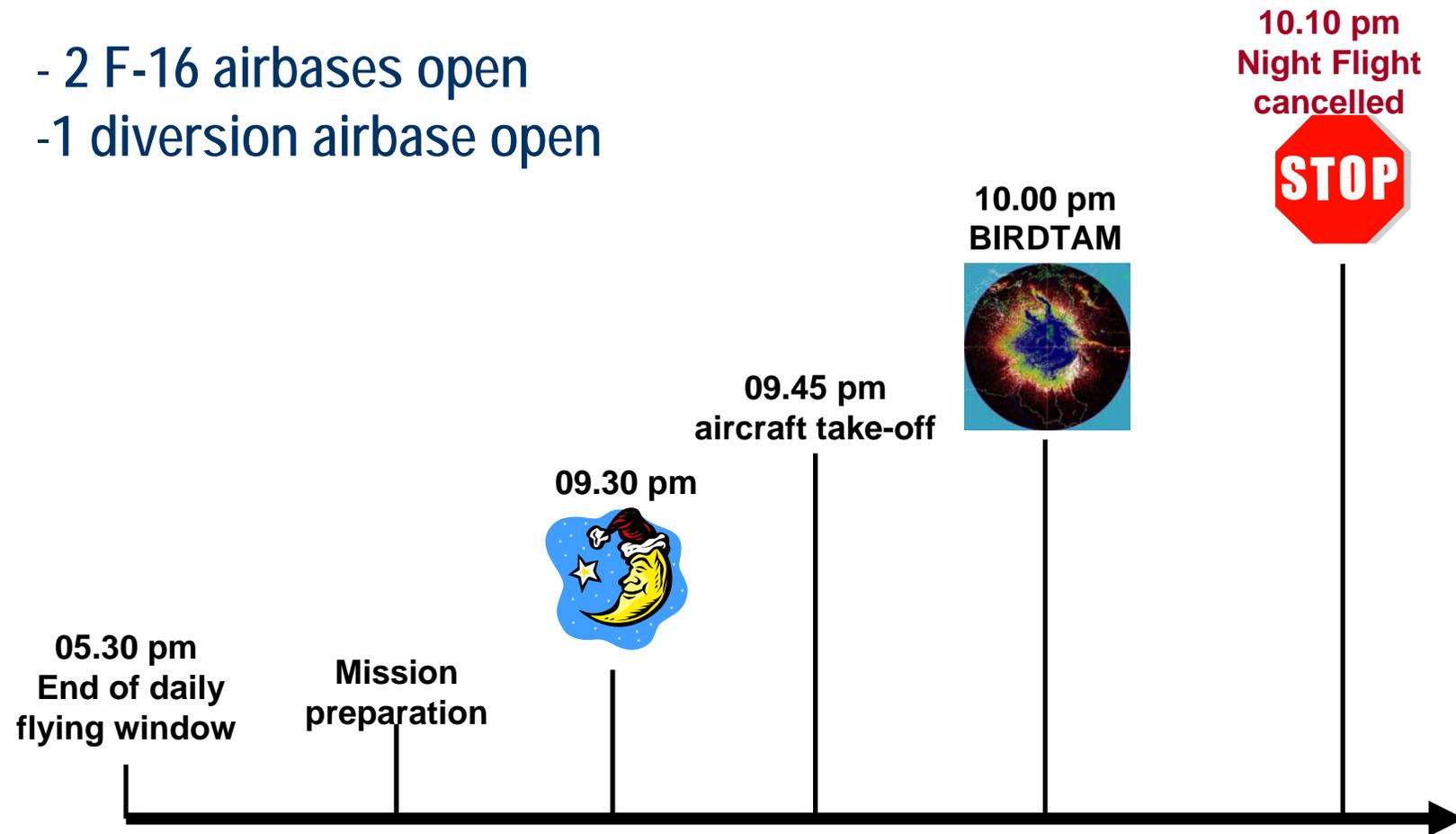


May 11 – June 12 2008



## *Impact of bird migration on F-16 night flight*

- 2 F-16 airbases open
- 1 diversion airbase open



*Impact of bird migration on F-16 night flight*



*Stand-by for nothing !*

*Flight planning disturbed, time & money lost*



# FLYSAFE Web Service

The FlySafe Bird Avoidance Model - Microsoft Internet Explorer

File Edit View Favorites Tools Help



Address http://public.flysafe.sara.nl/bambas/migration/index.php?radar=glons&subwindow=nw

Web Search Bookmarks Settings Get IE8 now! Translate Page Mail My Yahoo! Answers Games Anti-Spy



European Space Agency

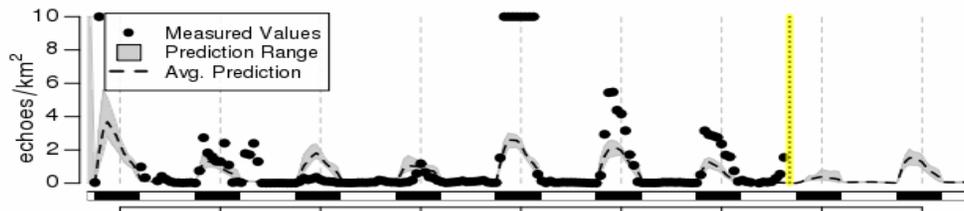
ESA Home Migration Spatial Models More information Legal Disclaimer

## Welcome to the FlySafe bird migration prediction module

This page provides a 72-hour forecast of bird migration intensity for the **Central Belgium** location. The predictions are provided in two formats. The **Hourly predicted and measured migration intensity** plot shows the measured bird density values in bird echoes/km<sup>2</sup> (black dots) as well as the mean predicted bird density (dashed line) and prediction range (gray). The prediction range is produced by an ensemble forecast of ~50 models. The **Hourly BirdTAM Intensity** plot shows the bird densities converted to BirdTAM warning levels for pilots from seven days in the past and three days into the future. If the measured value is available, the BirdTAM intensity reflects that measured value. If no measurement is available, the mean bird migration density prediction is used (indicated by small yellow circle).

These predictions are made using the European Centre for Medium Range Weather Forecast Deterministic Model. The most important weather variables in the predictions are visualized in the plots on the right. Wind speed and direction at multiple pressure heights in the top plot. The tails point in the direction FROM which the wind is coming, and the bars indicate the speed of the wind. Following plots are surface pressure (hPa), hourly precipitation (mm) as well as the percentage of cloud cover. Cloud cover is given in both a **lower** and **total** component. The final plot provides temperature (deg).

### Hourly predicted and measured migration intensity



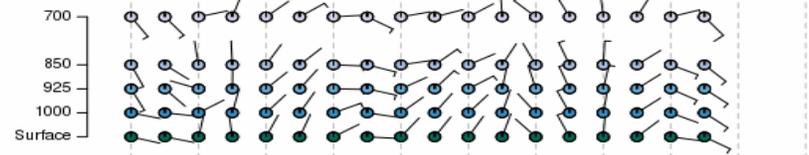
### Hourly BirdTAM Intensity



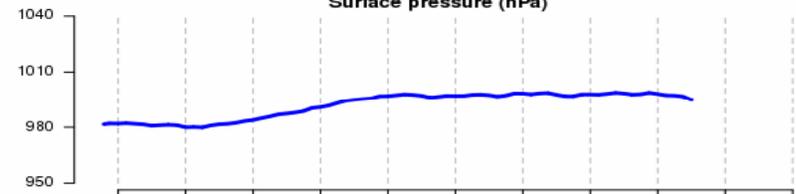
2009 Apr 16 Apr 17 Apr 18 Apr 19 Apr 20 Apr 21 Apr 22 Apr 23

Location: Central Belgium, Last modified: Wed Apr 22 2009, 6:18 pm, Next run: Wed Apr 22 2009, 6:48 pm

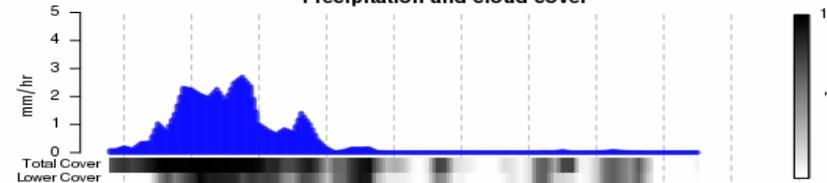
### Wind at different pressure levels (hPa)



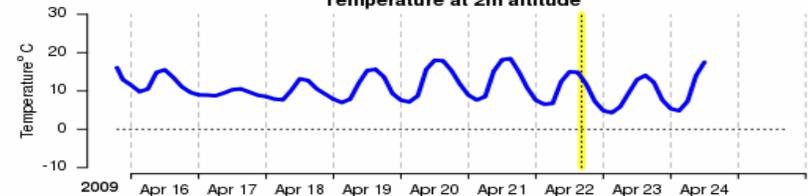
### Surface pressure (hPa)



### Precipitation and cloud cover



### Temperature at 2m altitude



Last modified: Wed Apr 22 2009, 6:17 pm, Next run: Wed Apr 22 2009, 6:47 pm



vle



Koninklijke Luchtmacht

sara



*Improvements Needed for the Local Situation  
Anticipation of Birds Crossing the Airport*





# Hudson river (New York – 15/01/09)



Hudson river (New York – 15/01/09)  
(simulation)

Hudson River

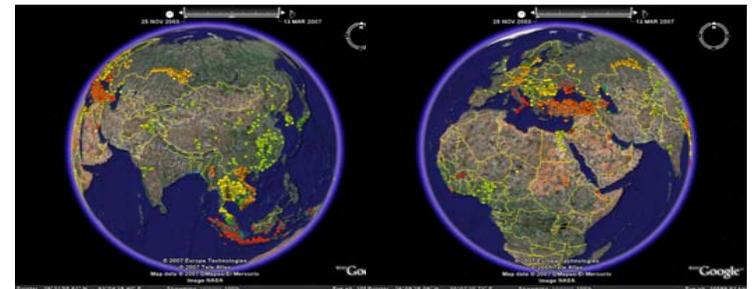
- Birds and Energy



- Birds and Agriculture



- Birds and Health



## Avian Influenza H5N1 outbreaks

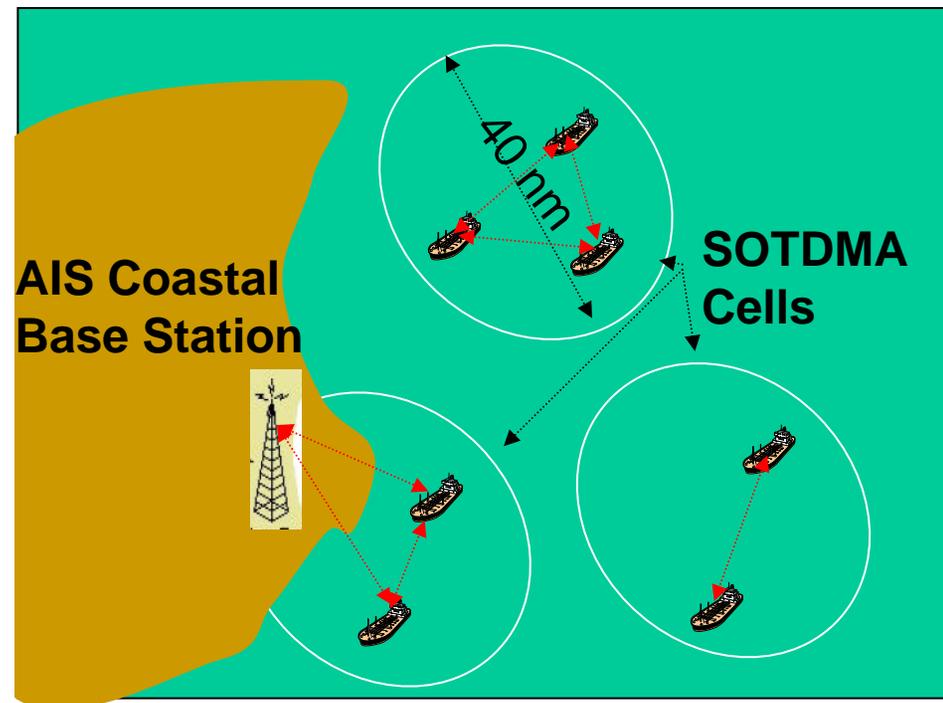
Source: Declan Butler <http://declanbutler.info/blog/?p=58>



**Application Driven  
Small Satellite Missions  
European AIS Mission**

- The Automatic Identification System (AIS) is communication system provides identification and location information to vessels and shore stations
- Aim of exchanging data (position, identification, course and speed).
- This allows vessels to anticipate and thus avoid collisions in the sea by means of a continuous traffic monitoring with several navigation aids
- AIS also offers important ship monitoring services to coastal guards or search and rescue organizations.

The system is based on the broadcasting of fixed length digital messages using the Time Division Multiple Access (TDMA)



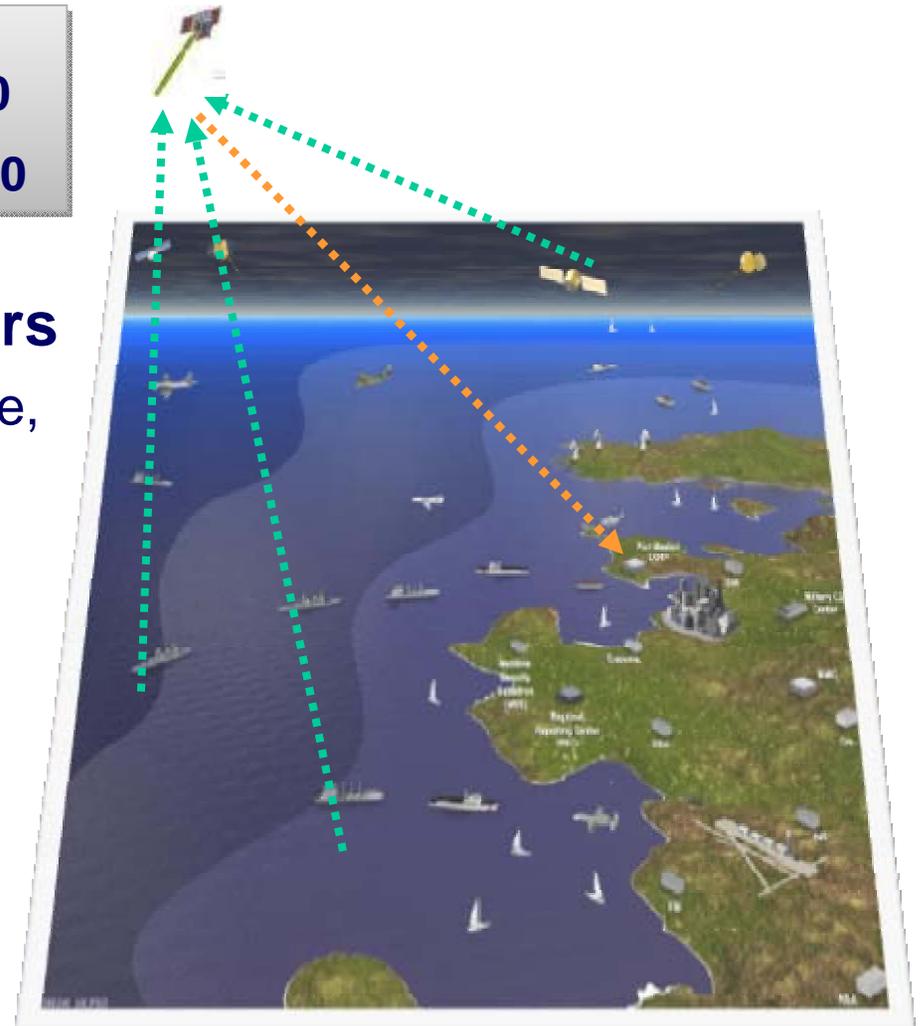
## AIS message fields

Start buffer	Training sequence	Star flag	Data	FCS	End flag	End-buffer
--------------	-------------------	-----------	------	-----	----------	------------

Number of AIS class A vessels  
(> 300 gross tonnage, ferries, etc.) 64.000

Number of AIS class B vessels > 500.000

- **Governmental and public users**
  - Maritime offices (e.g. Customs, Police, Military)
  - Traffic management
  - Search and Rescue
- **Commercial users**
  - Ship agents
  - Ship owners
  - Shipping companies
  - Logistics



# *Satellite-based AIS for maritime*

*security policy*

*DG-MARE / ESA*

*Joint*

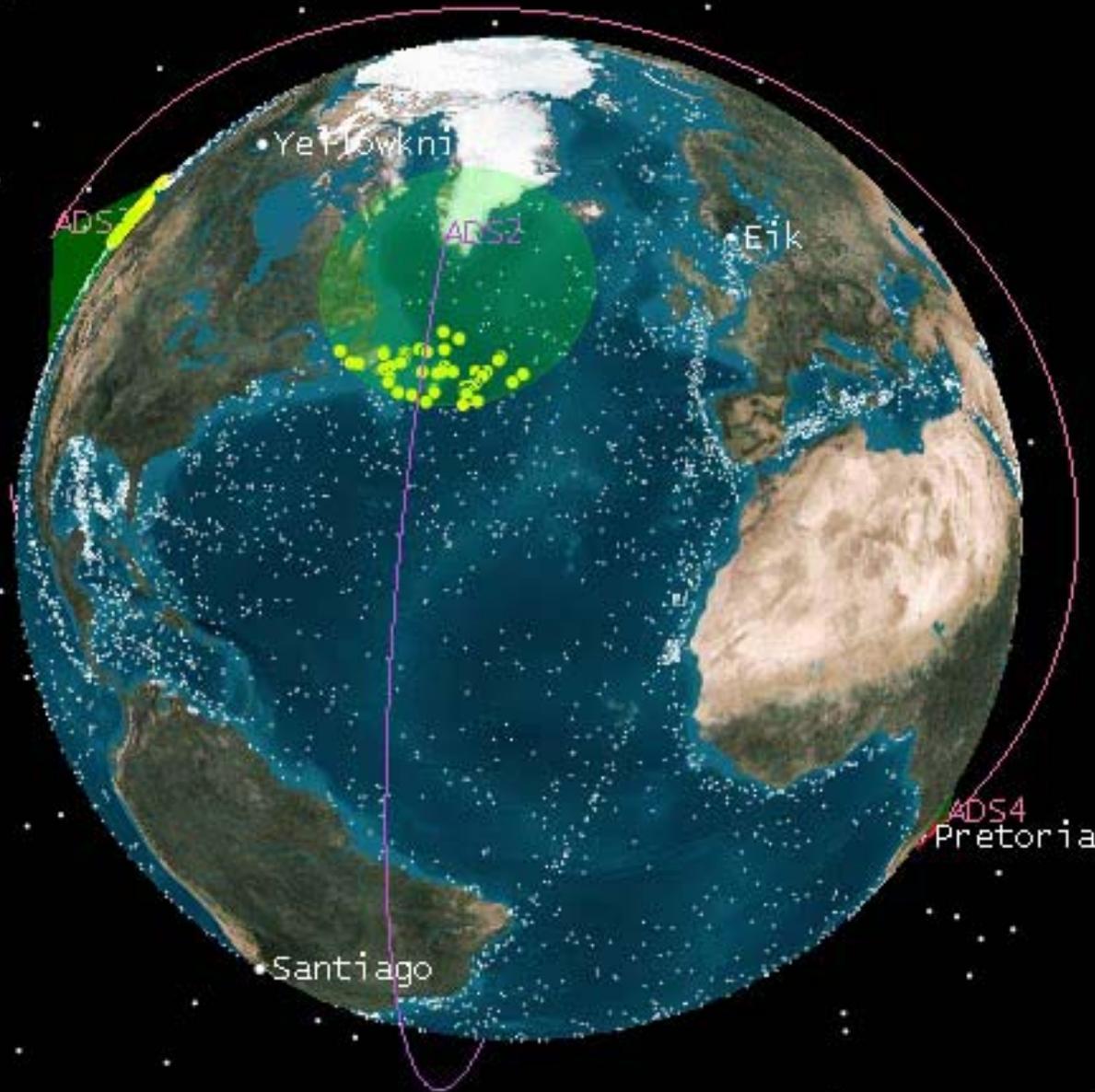
*Action Team*

*&*

*European*

*Steering group:*

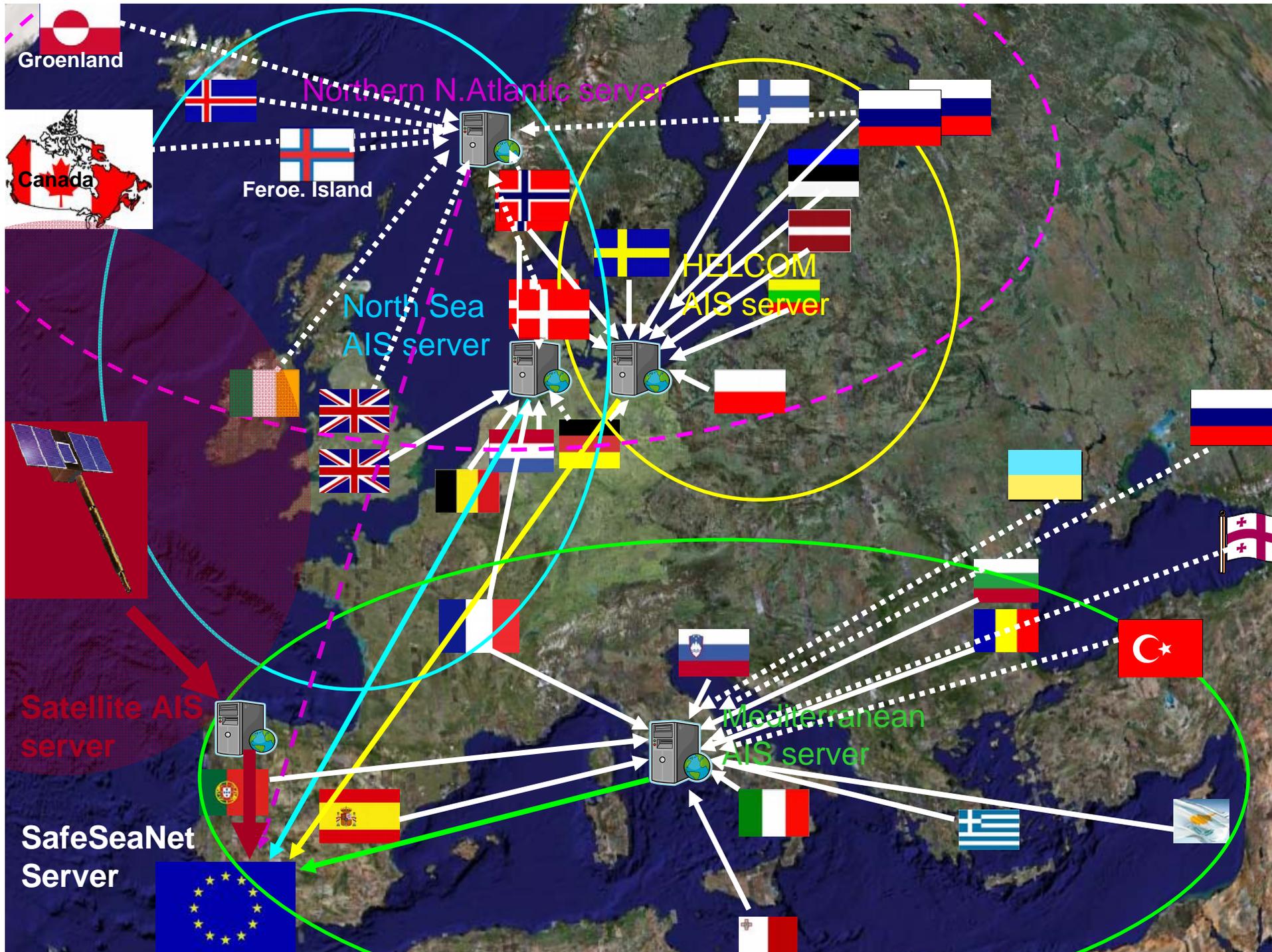
*EC DGs ( Mare, ENV,  
TREN, JLS, INFSO,  
TAXUD, ENTR, JRC)  
FRONTEX, EMSA,  
EDA, ESA*



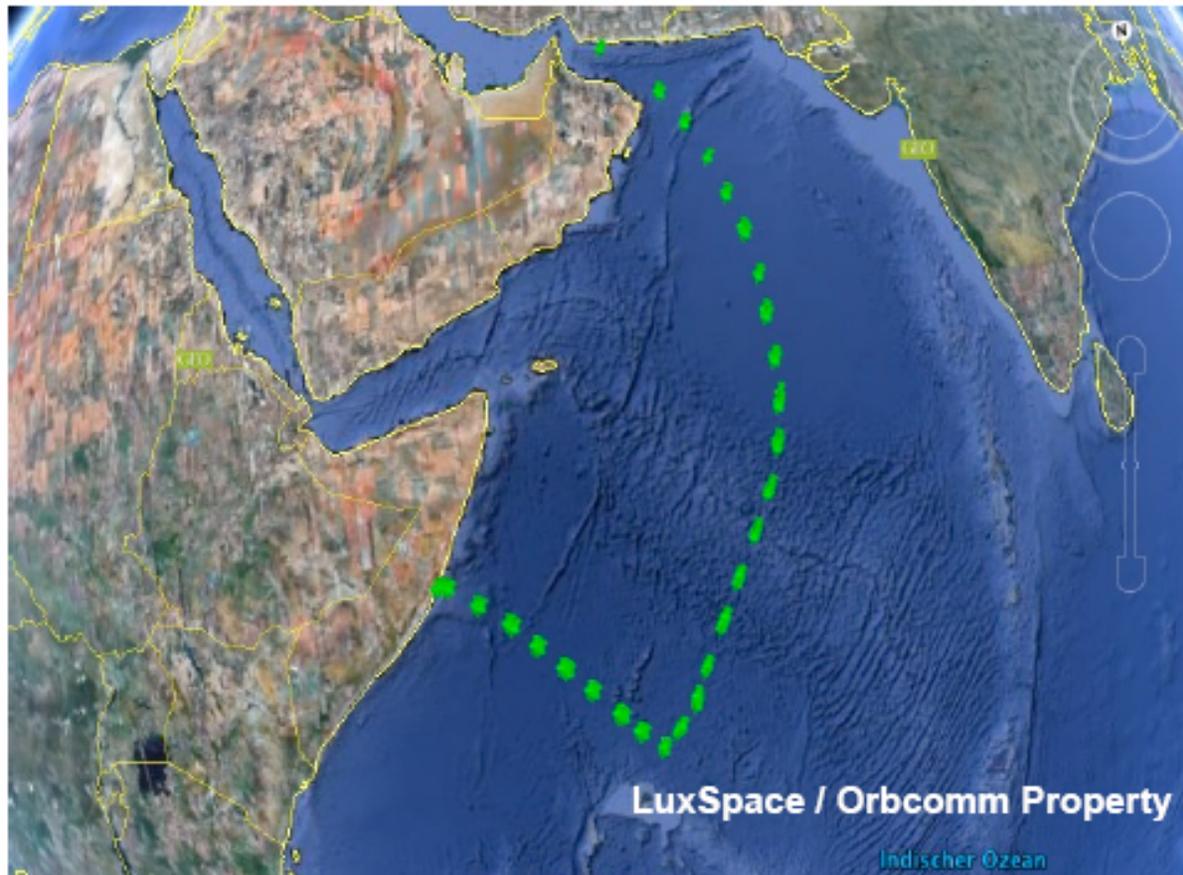
1 Mar 2010 15:00:10.000

Time Step: 10.00 sec

COURTESY OF COMDEV

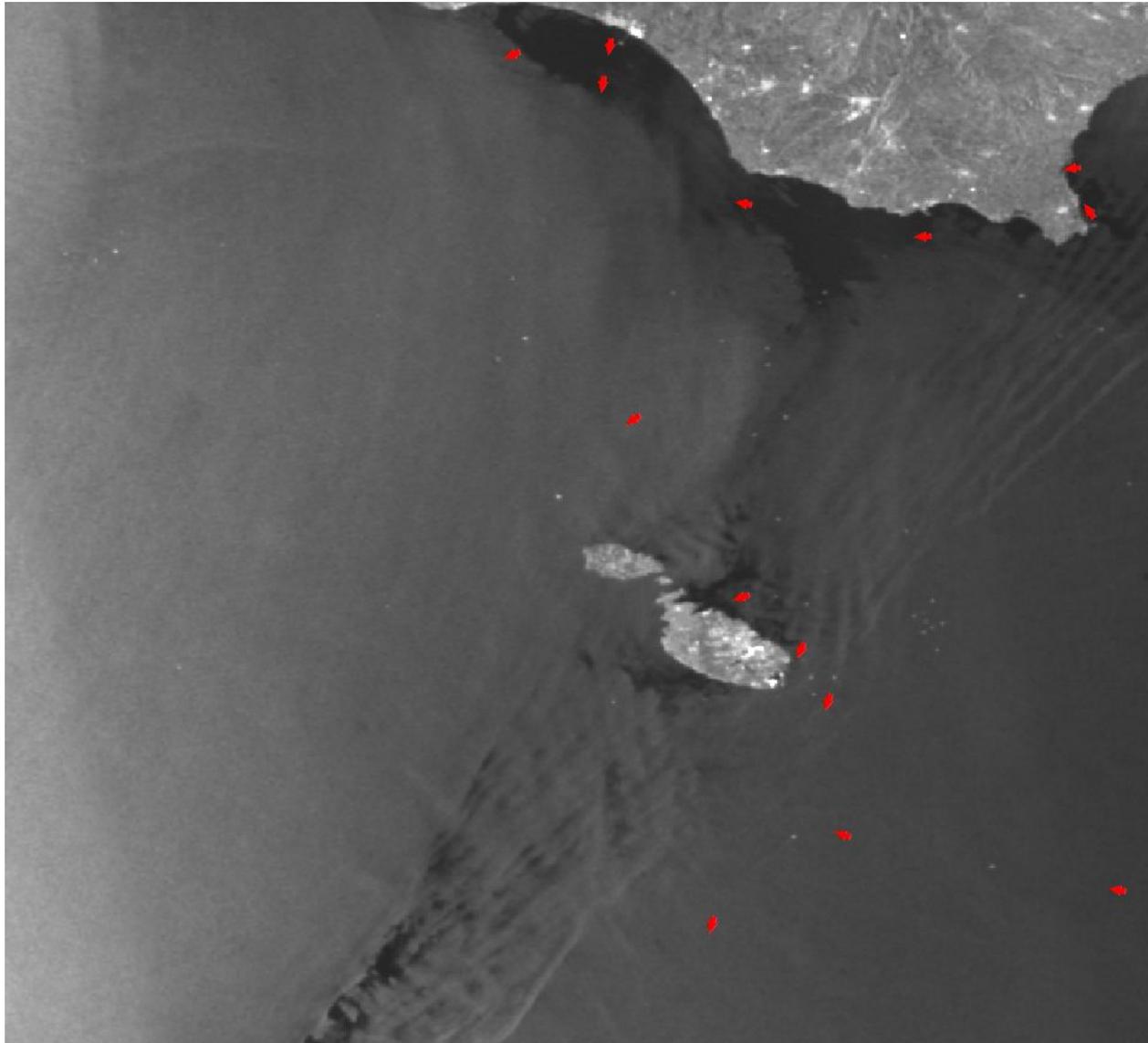


## „POMPEI”



Ship was hijacked 700 nm off Somalia coast and 100 nm from destination (Port Victoria / Seychelle Islands)

- Request of DG MARE based on information demand of Belgium Crisis Centre, having lost the vessel POMPEI and asking for latest position at 14:00 on April 21, 2009
- Delivery of latest vessel position by LuxSpace at 16:00 (captured at 7:00 of the same day)
- Request for vessel track of the past days at 19:00 of 21 April
- First information available at 22:00 on 21 April
- Second information with final anchor place (4:56) on April 22 at 23:00



SAR detected ships

SAR ships & AIS tracks

Correlation SAR & AIS

Remaining  
uncorrelated ships

- The IAP initiative is an opportunity for ESA and Europe to demonstrate and promote the added-value of Space in support of Member States, European public policies and citizens in various new domains, beyond current individual space programmes.
- The IAP initiative is an opportunity for European & Canadian operators and Industry to exploit their expertise for the purpose of new initiatives and to identify new lines of business in various fields.
- The leveraging and systematic expansion of the EO, Navigation and Telecom domains through the IAP initiative is expected



*Small satellites image*

The Second Palm Island, Dubai

[Proba CHRIS – 26 Aug 2005]

© SSTL distributed through ESA

**A World of  
Opportunities  
&  
The Space is  
the Limit**

**[iap@esa.int](mailto:iap@esa.int)**

***Thank you!***

