

The GMES Space Component: Content and implementation approach by ESA

GMES Operational Capacity Workshop
Sofia, Bulgaria, 25-26 March 2010

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GMES is a user-driven EU led initiative

➤ **Services Component – coordinated by EC**

- Produces information services in response to European policy priorities in environment and security
- Relies on data from in-situ and space component

➤ **In-situ component – coordinated by EEA**

- Observations mostly within national responsibility, with coordination at European level

➤ **Space Component – coordinated by ESA**

- Sentinels - EO missions developed specifically for GMES
- Contributing Missions - EO missions built for purposes other than GMES but offering part of their capacity to GMES (EU/ESA MSs, EUMETSAT, commercial, international)

GMES is a perfect example of a system of systems

✓ **Monitoring Earth sub-systems:**

- **Land:** land use and land cover changes
- **Ocean:** sustainable ocean resources and impact of environmental hazards
- **Atmosphere:** effect of greenhouse gases and aerosols on climate change, air quality, and ultraviolet radiation

✓ **Other Services:**

- **Emergency:** rapid mapping services in case of humanitarian crises, and natural or man-made disasters
- **Security:** maritime surveillance, conflict prevention and mitigation outside Europe
- **Climate change** is cutting across the above domains

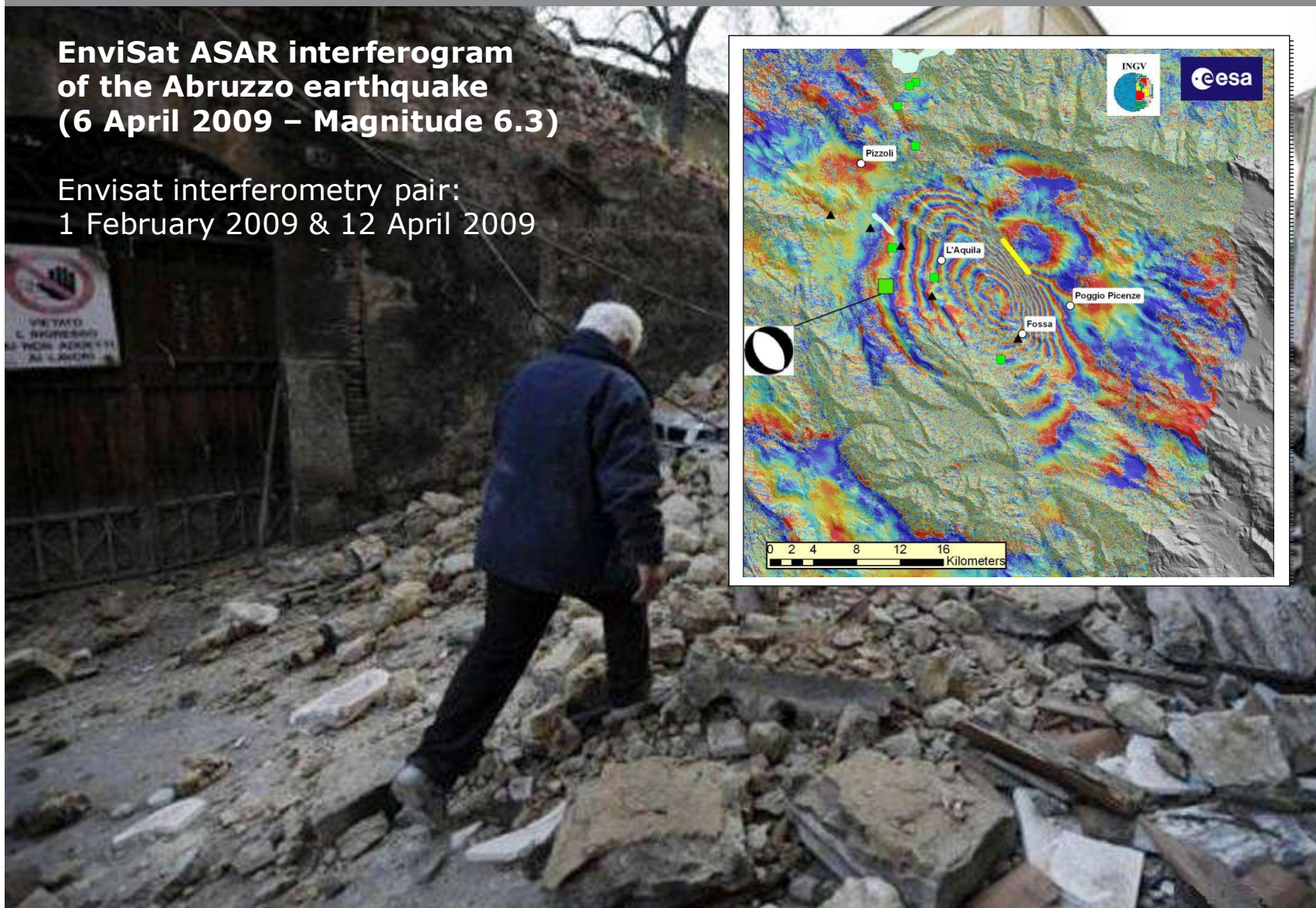
**~600 M Euro
since 2002
(EC+ESA)**

Example of land service: Subsidence Monitoring



**EnviSat ASAR interferogram
of the Abruzzo earthquake
(6 April 2009 – Magnitude 6.3)**

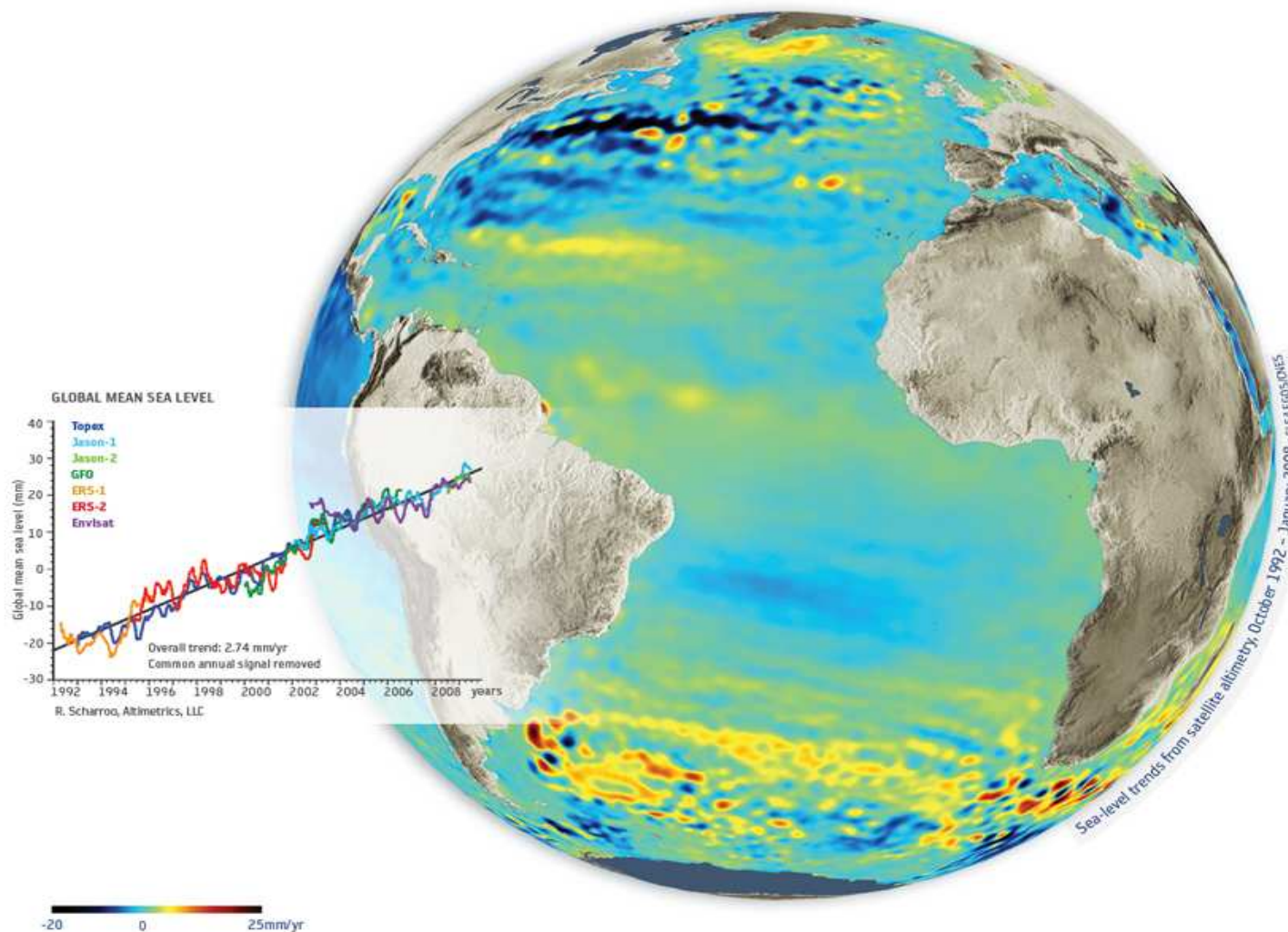
Envisat interferometry pair:
1 February 2009 & 12 April 2009



Example of marine service: Global Sea Level Rise



**Sea level
rise from
several
satellite
radar
altimeters**

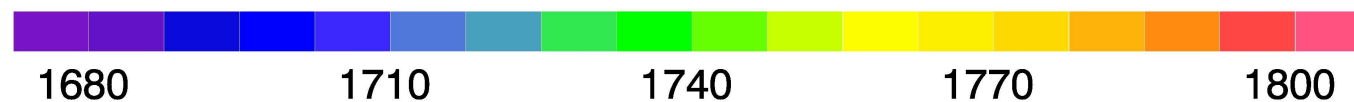
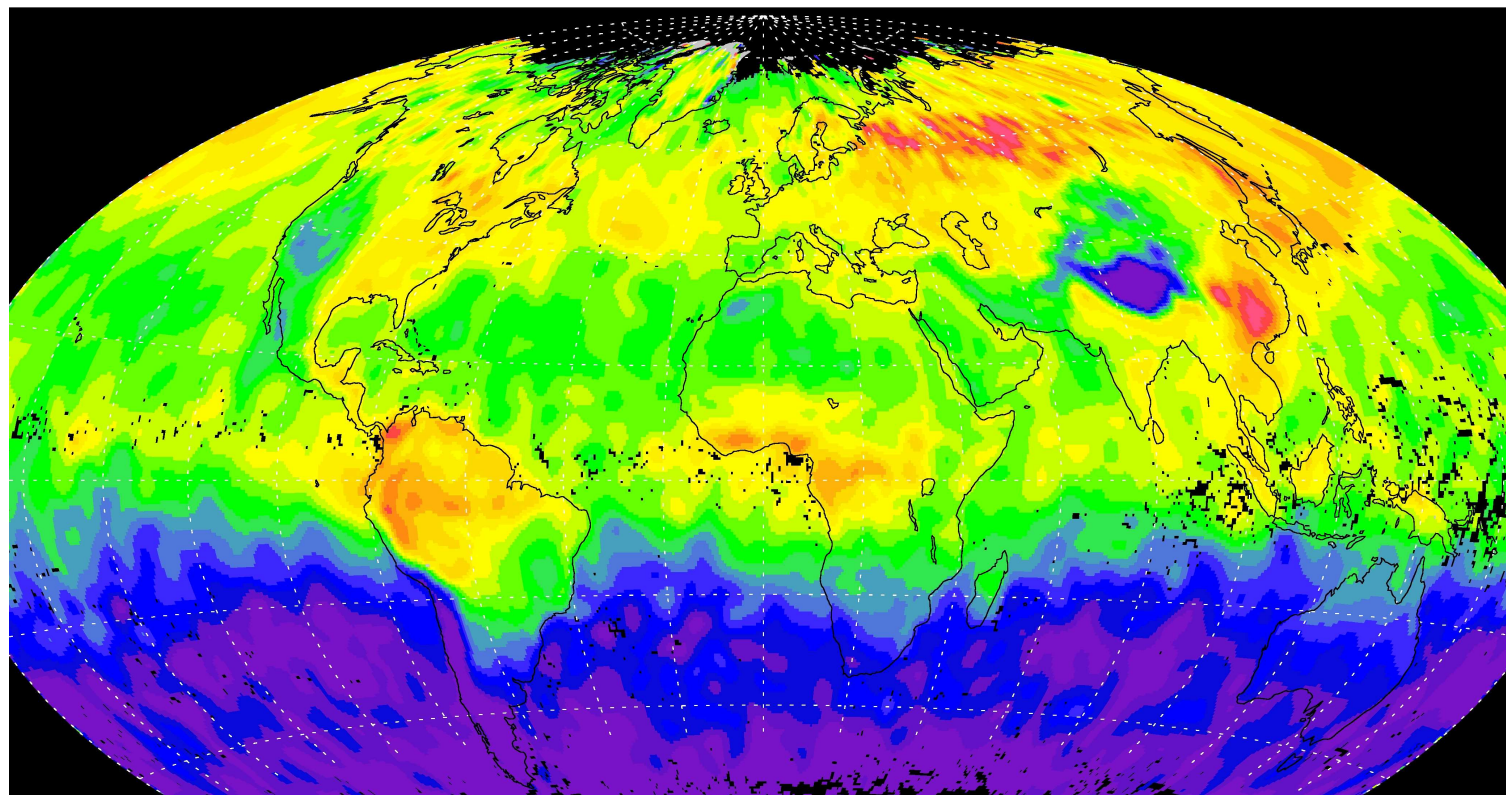


Example of atmospheric service: CH₄ Concentration



**2003-2005
ESA's Envisat
global
atmospheric
methane
distribution
(air mole
fractions in
parts per
billion)**

Credits: ESA
and University
of Bremen

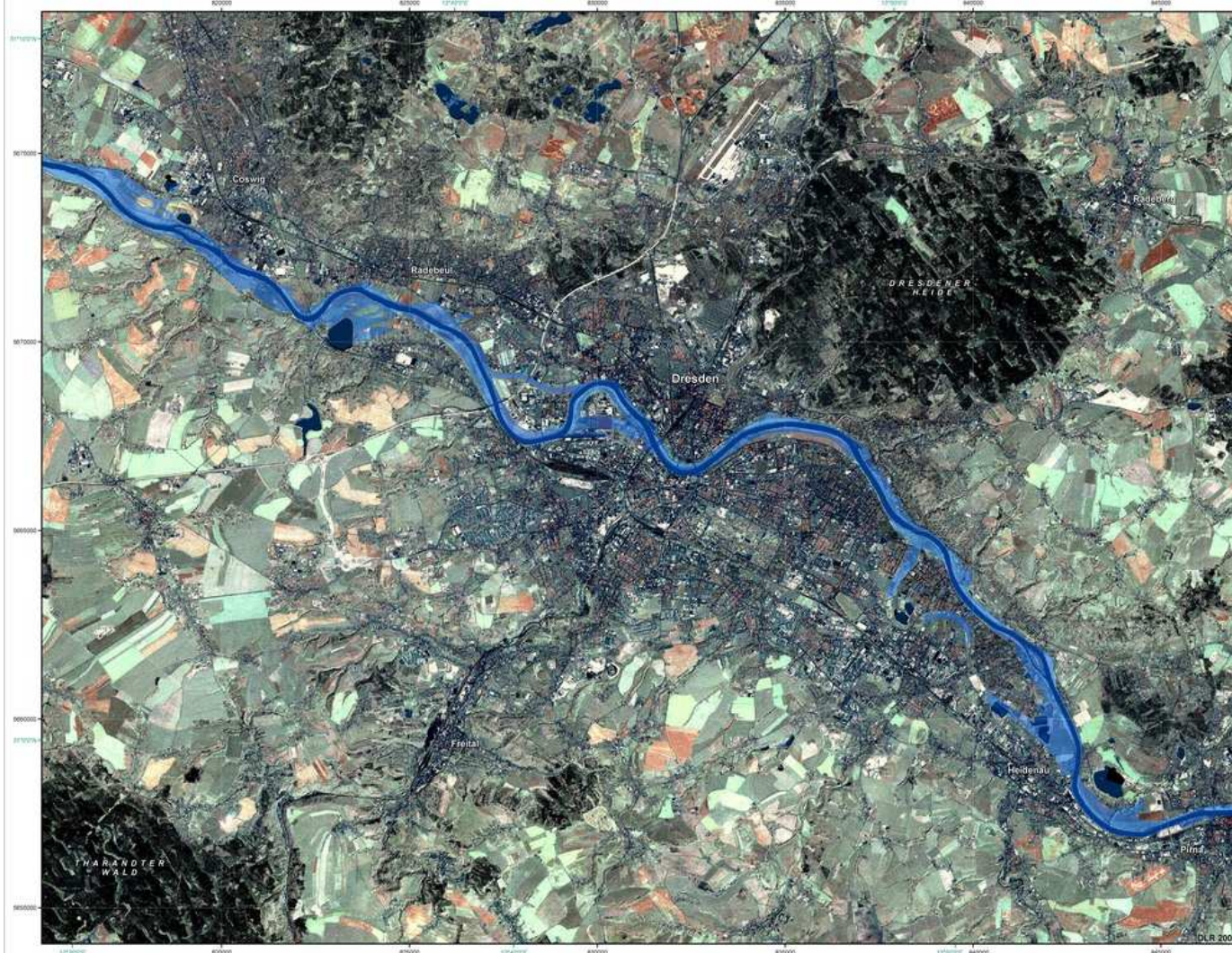


Example of Emergency service: flooding



Elbehochwasser April 2006 - Satellitenbildkarte Großraum Dresden

1 : 50.000



**Flooding
management
in the Elbe
region of
Germany –
April 2006**

Credits: NRSA,
USGS,
DLR/GMES
RISKEOS



Example of maritime surveillance



WEBGIS Coastline

SAR Image L1B

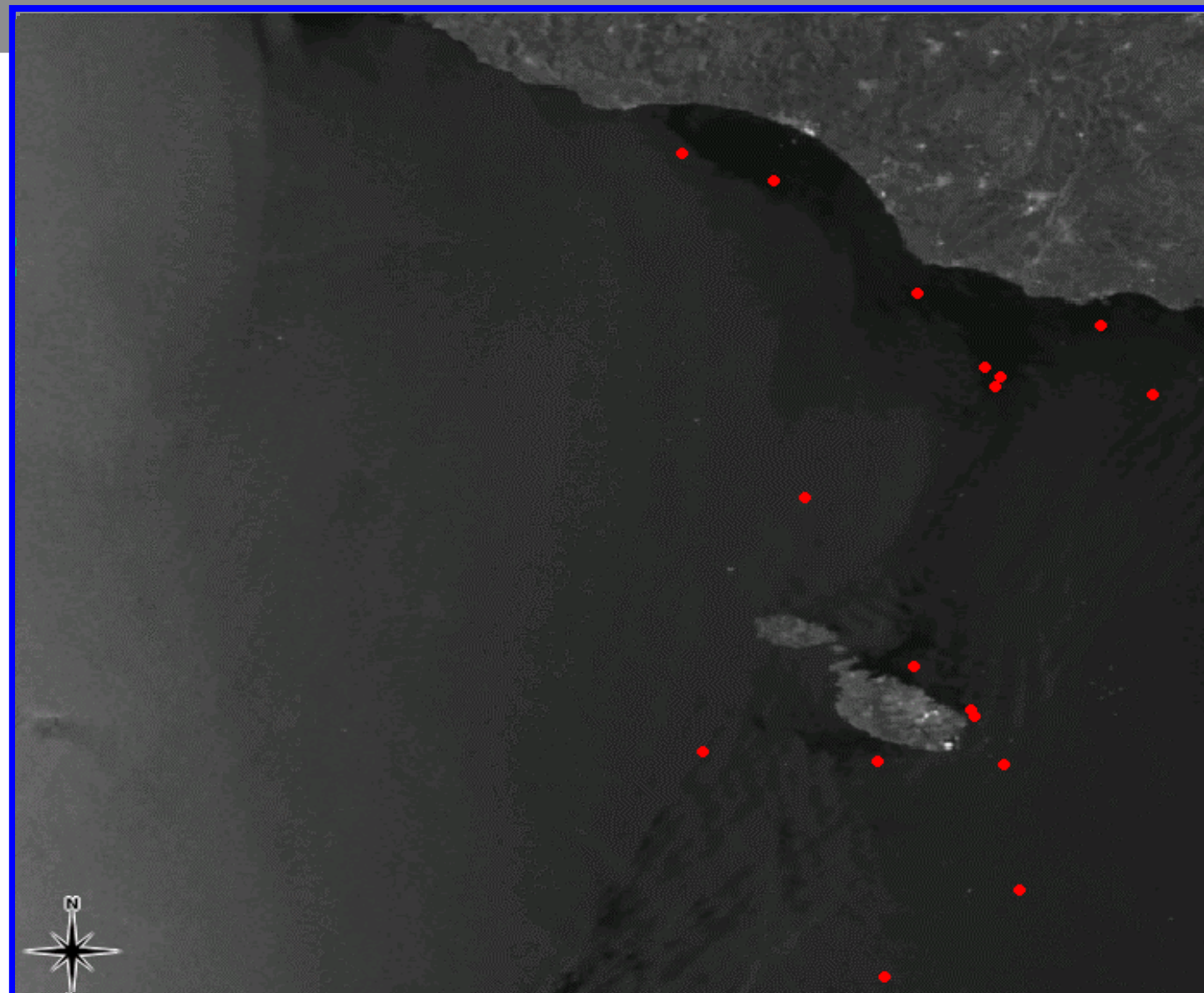
EO Plot

EO Plot and AIS Tracks

EO Plot Correlated with
AIS Tracks

EO not Associated Plot

Service Timeline



GMES dedicated missions: Sentinels



Sentinel 1 – SAR imaging

All weather, day/night applications, interferometry

2012, 2014+



Sentinel 2 – Multispectral imaging

Land applications: urban, forest, agriculture,..
Continuity of Landsat, SPOT

2013, 2014+



Sentinel 3 – Ocean and global land monitoring

Wide-swath ocean colour, vegetation, sea/land
surface temperature, altimetry

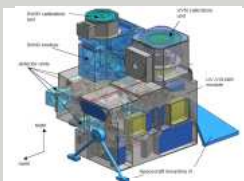
2013, 2014+



Sentinel 4 – Geostationary atmospheric

Atmospheric composition monitoring, trans-
boundary pollution

2018+



Sentinel 5 and Precursor – Low-orbit atmospheric

Atmospheric composition monitoring

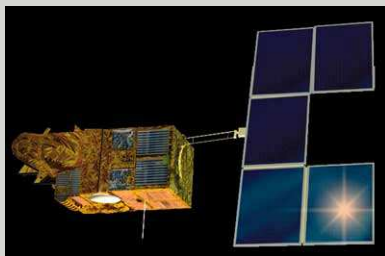
2015, 2020



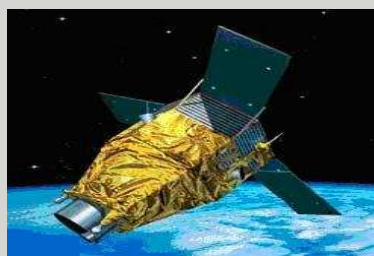
Potential Contributing Missions to GMES



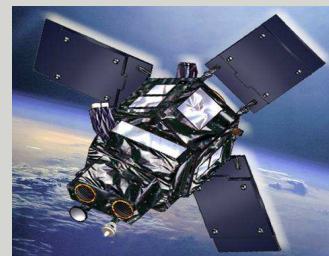
Cosmo-Skymed



SPOT



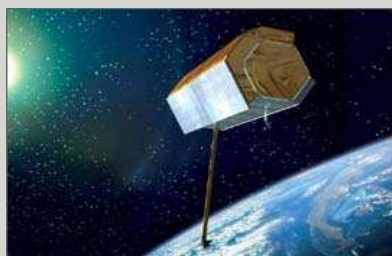
Pléiades



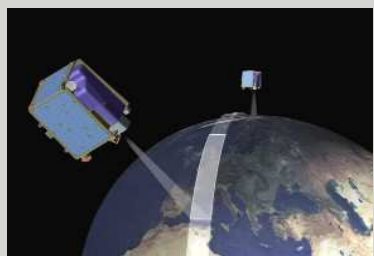
SeoSat



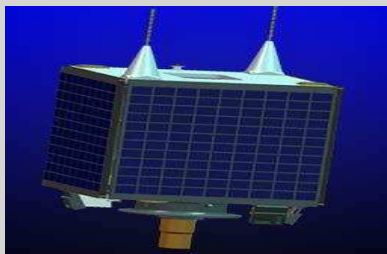
Radarsat



TerraSAR-X



RapidEye



DMCs



METOP



MSG

**List not
exhaustive**

**will evolve
based on
services
requirements
and mission
availabilities**

+ PROBA-V, Seosar, TanDEM-X, EnMAP, Venµs, Altika,
etc.



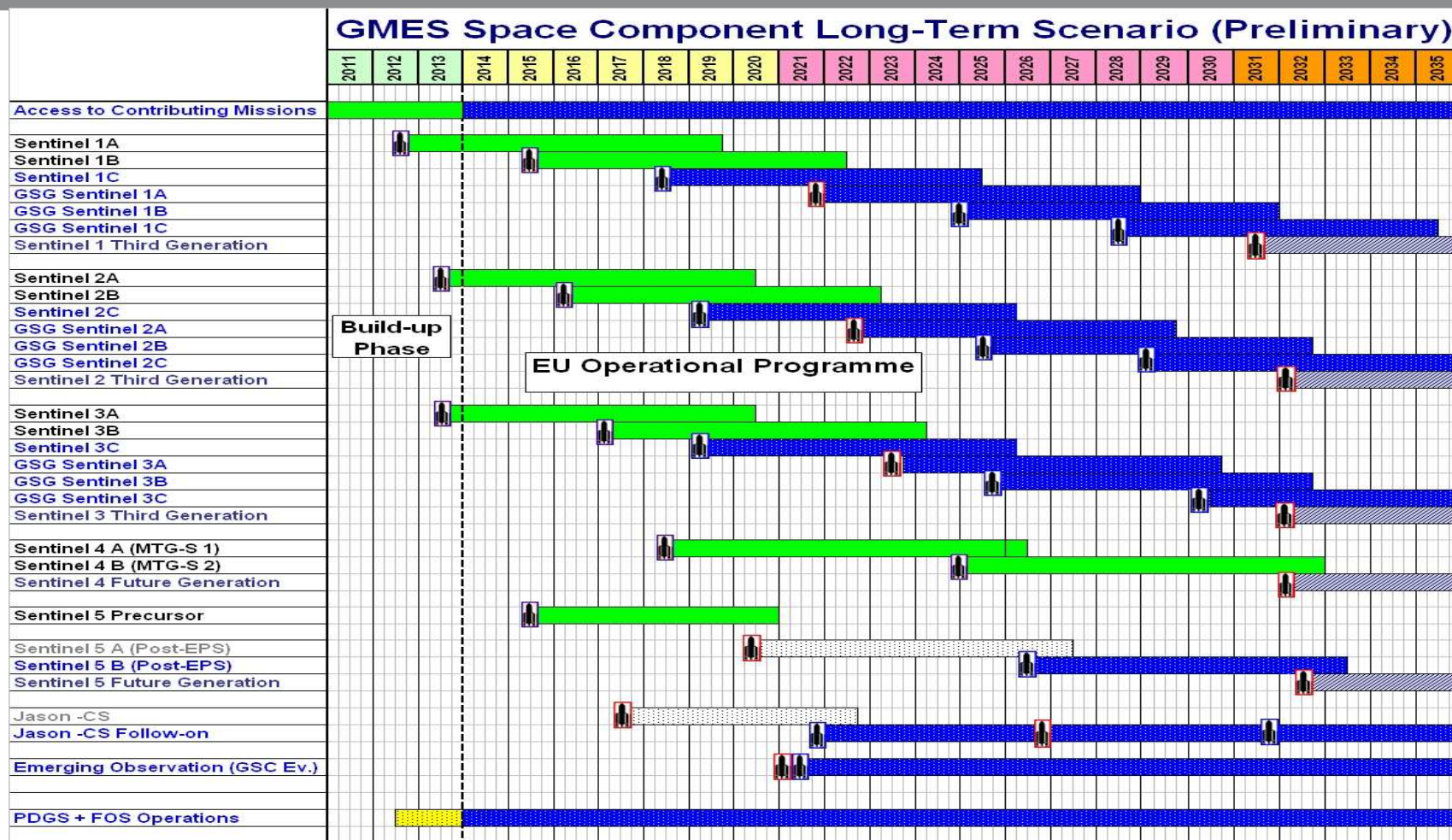
Example: Optical HR and VHR Contributing Missions



Optical High Resolution missions	Principal Owner	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Medium / High Resolution																	
Sentinel-2 A	ESA																
Sentinel-2 B	ESA																
Sentinel-2 C, ...	ESA																
SPOT 4	CNES																
SPOT 5	CNES																
SPOT Follow-on	InfoTerra/Astrium																
RapidEye - 5 S/C	RapidEye																
RapidEye Follow-on (TBC)	RapidEye																
UK-DMC & UK-DMCII	DMCII																
Deimos-1 DMC	Deimos																
Seosat / Ingenio	CDTI																
EnMap (Hypersp.)	DLR																
Venµs (Hypersp.)	CNES-ISA																
Very High Resolution																	
Pléiades 1 & 2 (VHR)	CNES																
HiRos (TBC)	DLR																



GMES Space Component Long Term Scenario



GSC build-up

**2.3 bn Euro
already
provided
by ESA MSs
and EC**



GSG = GMES Second Generation
EPS = EUTMESAT Polar System
MTG-S = Meteosat Third Generation - Sounder
FOS= Flight Operation Segment
PDGS= Payload Data Ground Segment



GMES Space Component Phasing



1. Build-up phase

Development of first generation of Sentinels, data access to MSs/EUM missions, ground segment: ~ 2.3 bn€ (2008 e.c.)

Financing – ESA GSC programme

- 790 M€ Segment 1
- 830 M€ Segment 2

Financing – EC FP7

- 630 M€ FP7 Space

2. Transition towards Operational Phase

Additional funding (~560 M€, in c.e.c.) is needed from the EC in the period 2012-2014 for the Sentinels Initial Operations, launches of Sentinel B units, Data Access and initial procurement of Sentinel C units.

3. Operational Programme

As from 2014, ~600 M€ in average per year (c.e.c.) will be needed from 2014 onwards for the operation of the GSC system as well as the preparation of the next generation

➤ **Coordinator of the overall GMES Space Component**

- Definition of overall GSC architecture and plan for future evolutions
- Coordinating access to GMES missions from national, EUMETSAT and third party satellite owners

➤ **Development and procurement Agency for dedicated space infrastructure**

- Development of first spacecraft and Ground Segment
- Procurement of recurrent elements

➤ **In addition, ESA is the ad-interim operator of Sentinel 1, - 2 and Sentinel-3 (land)**

- EUMETSAT is the proposed operator of Sentinel-3 (Marine), Sentinel -4 and -5



Upcoming Challenges (for GMES Space Component)



- ✓ Based on **GMES Dialogues**, define access to GCM data in the long-term
- ✓ Consolidate **GMES Space Component Long Term Scenario**, in particular including results from GMES Dialogues
- ✓ Obtain funding for **GSC Initial Operations** (-A operation, -B launch, -C advance procurements, data access)
- ✓ Obtain funding for **GSC build-up completion** (Sentinel-5, Jason-CS)
- ✓ Support EU / EC effort to organise **operational funding** post 2014
- ✓ Conduct **"S" of GMES** studies to provide input to discussion with EU/EC and with ESA MSs regarding the 'S' of GMES



Further information on GMES



For further information please visit:

ESA GMES website

www.esa.int/gmes

EC GMES website

www.ec.europa.eu/gmes



General Lines of Cooperation with ESA



- ✓ **Informal cooperation (e.g. exchange of information)**
- ✓ **Cooperation Agreements**
- ✓ **Cooperating States**
- ✓ **Accession to the ESA Convention
(= ESA Member State)**



Types of cooperation



✓ **Cooperation Agreements**

- **Privileges and immunities**
- **Exchange of information**
- **Training programmes**
- **Exchange of scientists**
- **Implementing Arrangements for specific projects**

✓ **Cooperation Agreements with Canada (Cooperating State)**

✓ **Agreements with International Organisations (EUMETSAT, ESO)**

✓ **EU Framework Agreement**



European Cooperating State Agreement (PECS)



- **Status created in 2000 - granted to European Union States that want to accede to the ESA Convention**
- **Main aim: prepare this European State in the most efficient manner for accession**
- **Duration of the Agreement: in principle five years**
- **This Agreement is associated to the participation in a specific “Plan for European Cooperating States” (PECS).**
- **Discussions are on-going with a number of countries. ESA welcomes all EU Member States in order to associate them with the European space effort, including the Agency’s programmes**

