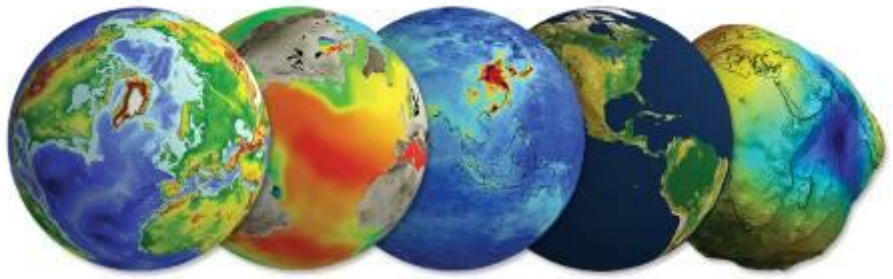
ESA Earth Observation Info Days

Mission Operations and Ground Segment



ESA EO Ground Segment and Mission Operations department (EOP-G)

March 2013

PROGRAMMATIC FUNDING …

In EOEP-4, the EO mission operations including data management, and the generic ground segment development are funded by the following elements:

1. ***Missions Operations and Maintenance [MOM]***:
   Phase E (GOCE, SMOS, CryoSat, Swarm, ADM, EarthCARE) and
   Phase F (data management for Envisat, ERS, GOCE)
2. ***Generic Ground Segment Development [GSD]***: support science with appropriate generic ground segment infrastructure
3. ***Level 2 Element***: support development of higher level products and validation activities for Earth Explorer missions in development and in operations

Further support comes from:

4. ***EARTHNET:*** *Third party missions and international presence*
5. ***LDTP:*** *long-term data preservation*

Benefits to ESA member states

1. Procurement through open tenders with large number of SMEs, industrially complements the contracts with satellite Primes

2. Develop industrial capabilities in ESA member states

3. Supports development of industrial skills also in smaller, sometimes under-returned countries

4. Enables Member states to establish a long term architecture for own activities/facilities and to cooperate in future ESA programmes, thanks to the cooperation and joint interface standardisation efforts.

Mission Operations and Maintenance
- missions in Phase E -

GOCE
- End of operations currently foreseen end 2013 / early 2014 (depends on solar activity)
- Then data management including data reprocessing (i.e. new geoid versions)

SMOS
- Operations funded until February 2017 (4.2 years)
- Mid-term review in early 2014, in synergy with CNES review (CNES funds and performs the platform operations)

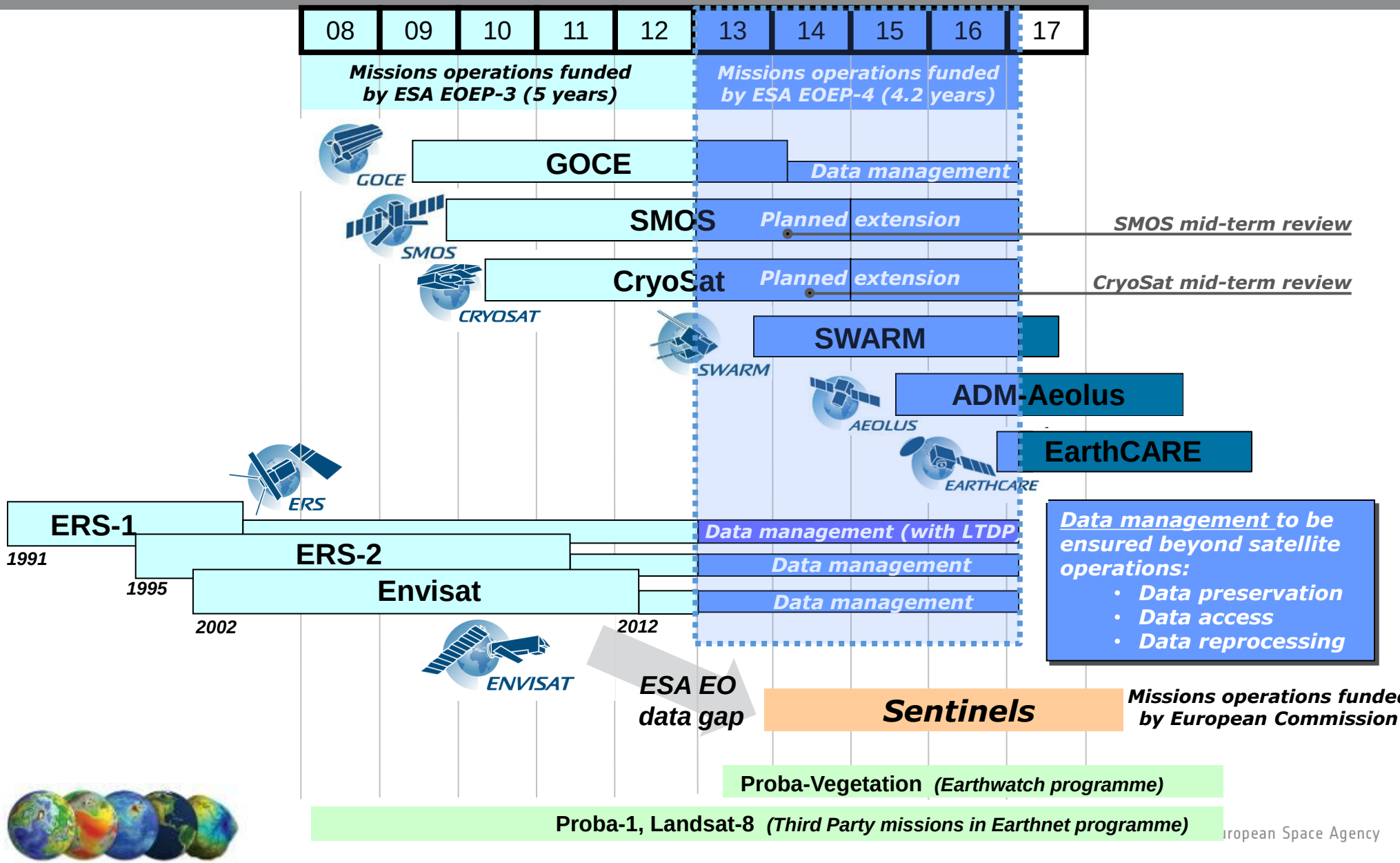
CryoSat
- Operations funded until February 2017 (4.2 years)
- Mid-term review in mid 2014

Swarm
- Design nominal lifetime of 4.3 years after launch; operations funded until Feb. 2017

ADM-Aeolus
- Design nominal lifetime of 4 years after launch; operations funded until Feb. 2017

EarthCARE
- Design nominal lifetime of 3 years after launch; operations funded until Feb. 2017

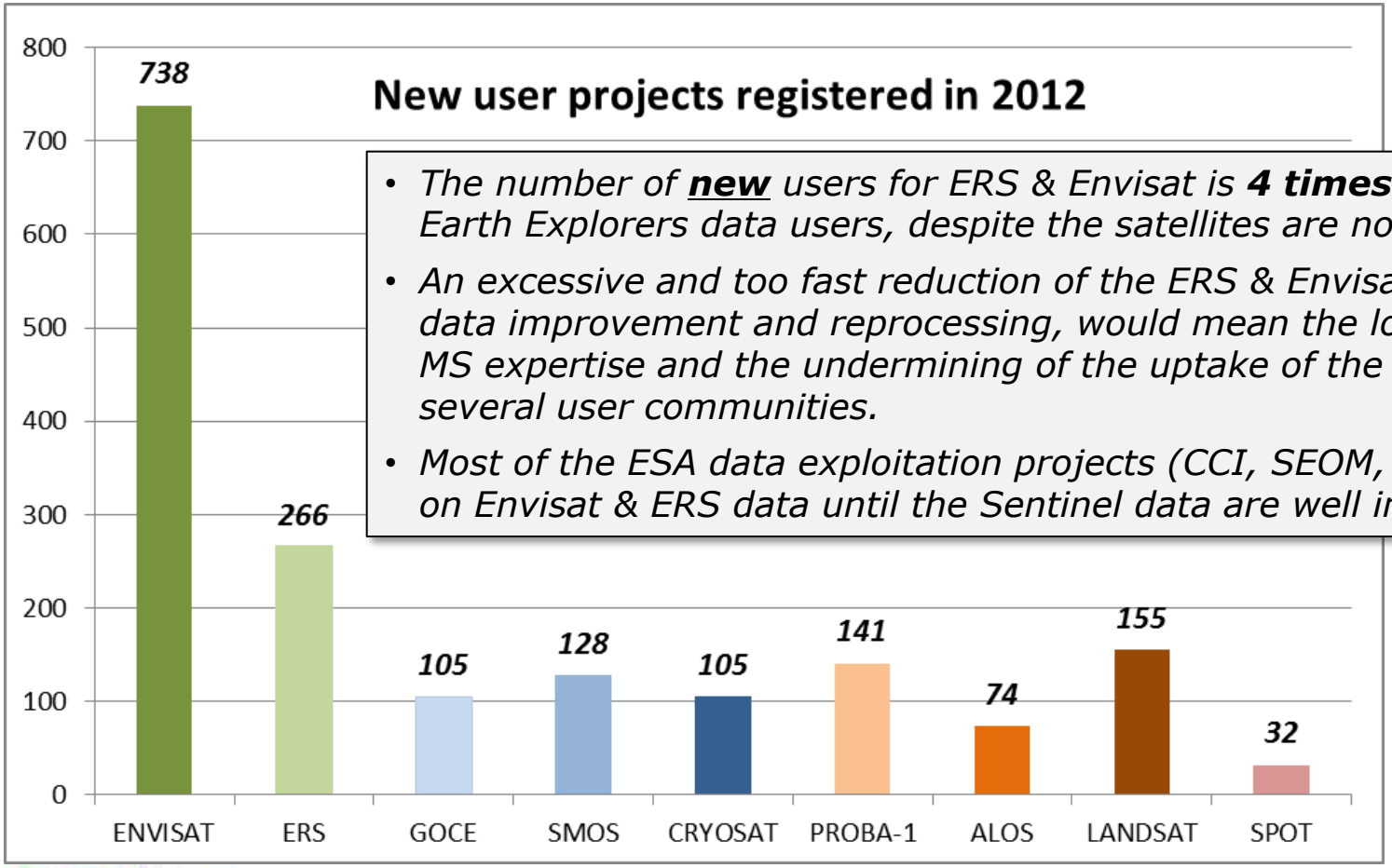
Mission Operations and Maintenance
- overview -



Mission Operations and Maintenance
- missions in Phase F -

Envisat & ERS represent ~80% of ESA EO data users

Envisat & ERS represent ~80% of ESA geophysical measurements



- *The number of **new** users for ERS & Envisat is **4 times bigger** than new Earth Explorers data users, despite the satellites are no more in operations.*
- *An excessive and too fast reduction of the ERS & Envisat activities, including data improvement and reprocessing, would mean the lost of the accumulated MS expertise and the undermining of the uptake of the Sentinel data by several user communities.*
- *Most of the ESA data exploitation projects (CCI, SEOM, VAE, DUE) will rely on Envisat & ERS data until the Sentinel data are well in operations.*

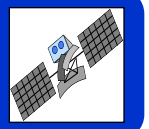
In the last 10 years, **32 projects led by scientists in Romania** have used or are using Earth Observation data provided by ESA

ESA EO missions operations concept

Mission operations functionalities

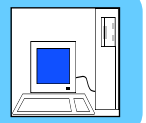
Mission management and User consultation

Satellite control Payload operations



Plan data acquisition Receive satellite data

Process & reprocess data Archive & preserve data



Data products quality & performance monitoring

Data products access User support services

The mission operations are based on a multi-functional ground segment: a unified structure, developed to meet the user requirements of ESA and Third Party missions, both individually and collectively by:

- Integrating ***national capabilities and facilities*** into a common European framework:

  → **collaboration** with other EO operators

- Responding to increasing data volumes and ***evolving user requirements*** for more sophisticated products

  → **collaboration** with user communities

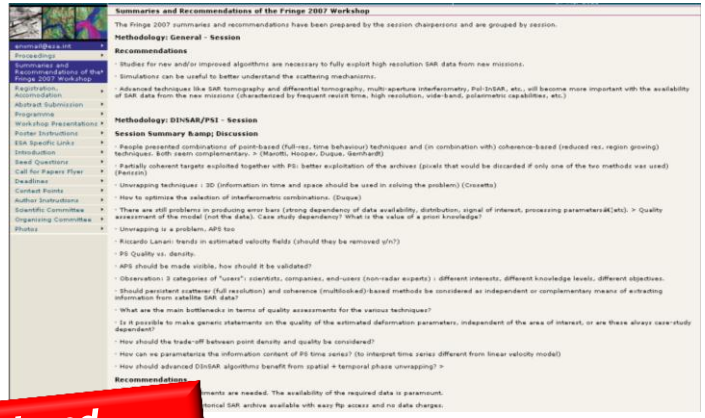
- Ensuring the ***highest quality of Earth Observation data*** products
- Facilitating data access ***to stimulate*** applications development, science and downstream industry
- Providing ***benefits to Member States*** through access to ESA technology and systems related to ground segment

Users involvement during operation phase

Lessons learned are captured by the user communities themselves

USER WORKSHOP

RECOMMENDATIONS



Listening user demand and modifying the mission accordingly

REPORTING

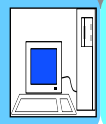
ACTIONS

Modification Mission setup
Mission extension
Upgrade Algo & Toolbox
Training

ESA EO missions operations concept
THE ESA MULTI-MISSION GROUND SEGMENT: THE PRINCIPLE

Plan data acquisition
Receive satellite data

Process & reprocess data
Archive & preserve data

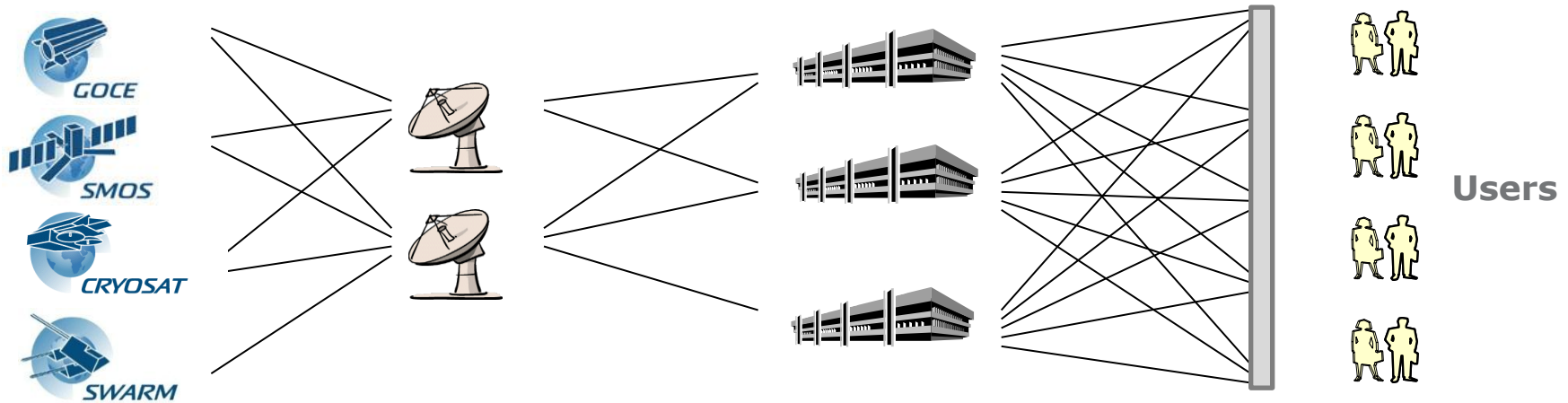


Data products quality & perfo monitoring

Data products access
User support services

1. **Evolution into a single, distributed and shared Ground Segment**

2. **Consist of a *network of Centres* providing data reception, processing, distribution, archiving services or support on processing algorithms and data quality, to the missions operated by ESA and member states**
   - Reusing Member States' ground segment technology and infrastructure (for acquisition, processing, archiving, etc)
   - Developing joint standards and new technologies in collaboration with Member States (through GSCB or CEOS)
   - Supporting spin-off of ESA-developed ground segment and user support technology into Member States' national initiatives



Mission Operations and Maintenance
- generic PDGS infrastructure-

The multi-mission ground segment is composed of elements specific to a mission (e.g. for data processing) and elements common to many missions composing the generic PDGS infrastructure:

The operations and maintenance of the generic PDGS infrastructure includes:

- the ***data dissemination network*** amongst facilities and for user data access, including the enforcement of the network security directives;
- the operations of multi-mission elements (e.g. ***G-POD, ESA EO portal***) as well as the ***services in support to users*** (e.g. Help Desk, data access web interfaces),

In addition, it also includes:

- the systems and operations of ***facilitating functions*** associated with international cooperation activities, e.g. ***Charter***, GeoPortal, infrastructure related to the activities of the Ground Segment Coordination Body (GSCB) Cal/Val Infrastructure Working Group (CVI-WG), DDS-Africa, demo systems/facilities).

DATA QUALITY & PERFORMANCE

Performance improvement is a process

During mission exploitation and after the end of the satellite operations, the data quality gradually improves thanks to the efforts put in processing algorithm upgrades, in validation and in reprocessing.

In the case of MIPAS, the process of data quality improvements had also to cope with several instrument on-board anomalies.

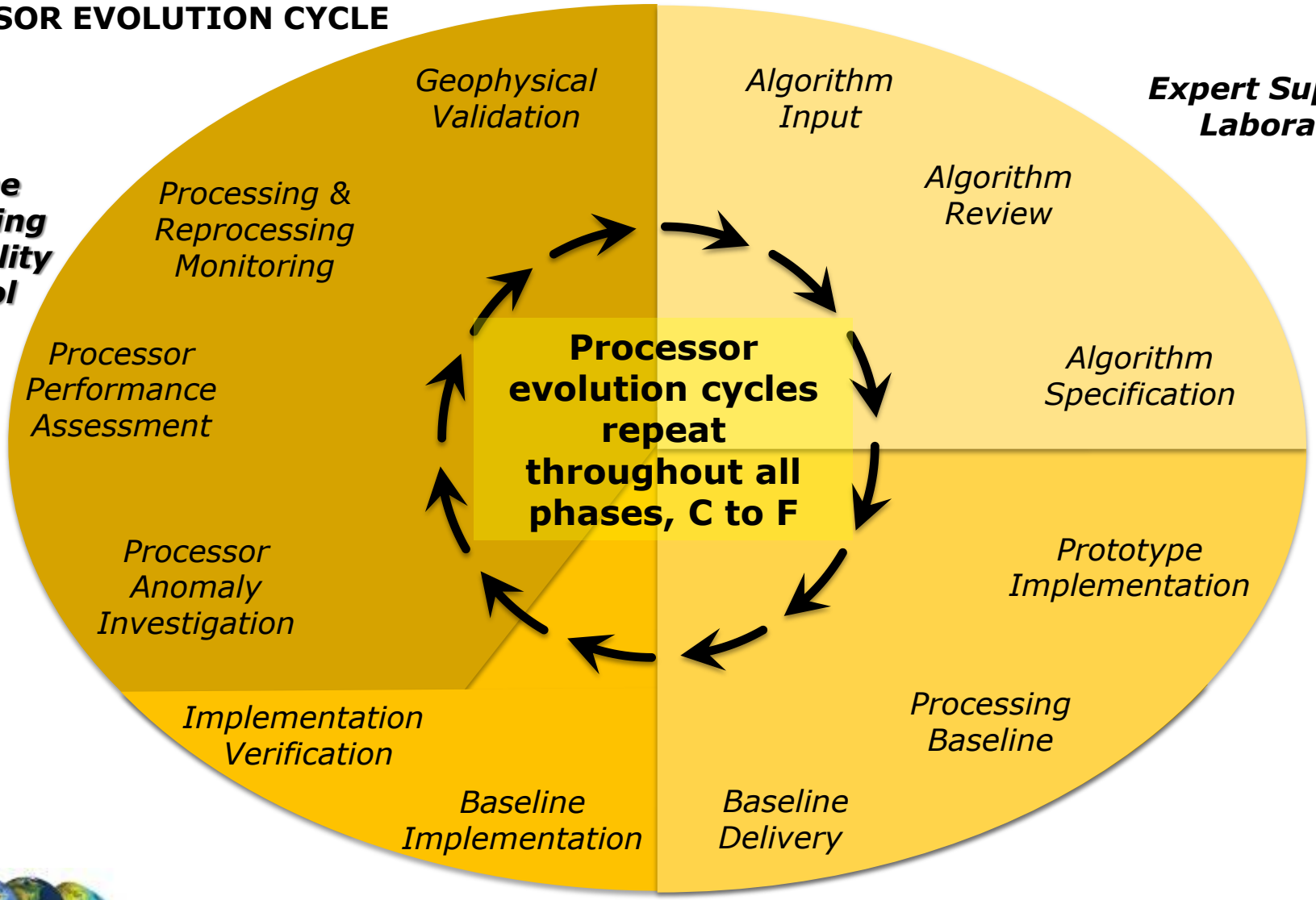
MIPAS			Pre Launch	2007	2010
Temperature	Bias	18-40km	2K	2 K	1 to 2 K
		40-65km			2 K
	Precision	18-40km	1K	5 K	<1 K
		40-65km			2 K
O_3	Bias	18-23km	5%	<10%	20 to 50 %
		23-52km			~0 %
	Precision	18-23km	1%	<10%	15 to 30 %
		23-52km			2 to 5 %
NO	Bias	23-35km	Not specified	10-20%	~0 %
		35-50km			10%
	n	23-35km		5-15%	10%
		35-50km			10%
		17-34km	5-20%	<10%	10 to 15 %
	Precision	17-34km	4%	<10%	20 to 30 %
N_2O	Bias	12-40km	20%	5-30%	~0 %
	Precision	12-40km	10%	10-28%	< 20 %
CH_4	Bias	12-40km	8%	5-20%	-10 ? 2 %
	Precision	12-40km	5%	5-18%	< 20 %

Data quality is essential for a mission success → achieved through cal/val, processing algorithms upgrade and data reprocessing

Data products quality & performance monitoring

HOW TO ENSURE HIGH DATA QUALITY?

PROCESSOR EVOLUTION CYCLE



Routine Monitoring and Quality Control

Expert Support Laboratories

Expert Engineering Support

Potential opportunity

Procurement for Sensor Performance, Product and Algorithms Maintenance and Operations of the Earth Observation Payloads (2013-2018)

→ *Open tender to be issued in 2013 Q3*

Activities under this procurement include for the missions above:

- Product quality anomaly investigation for anomalies identified during the systematic product quality control and for anomalies raised by users
- Instrument anomaly reports and investigation of results
- Instrument configuration settings, including instrument commanding for calibration and for complex background missions
- Data processing configuration management, including processor settings and auxiliary data validation and generation
- Support to processors upgrade and implementation, including preparation of the processing baseline for reprocessing activities and verification of the reprocessed datasets
- Support to Calibration and Validation activity plan (Phases E1, E2 and F)
- Maintenance of Calibration algorithm baseline
- Product specification generation and update
- Quality control of reprocessing data sets

ACCESS TO EO DATA

A constant ESA objective:
- ease access to Earth Observation data

1. **Revised ESA EO data policy:**
   - ESA data is open and free of charge

2. **Constant upgrade of ground segment for easier access to data through Internet for Near Real Time (NRT) data and for archived data**

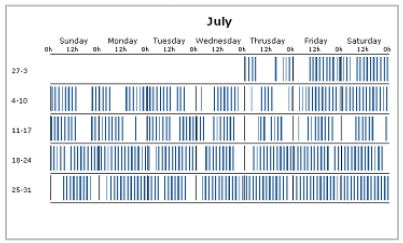
3. **Development of alternative ways to provide EO data:**
   - **data/algorithm toolboxes → e.g. BEAM, GUT, etc…**
   - **processing on demand → e.g. G-POD**
   - **user exploitation platforms → e.g. Geohazard Supersites**

Processing-on-Demand (G-POD)

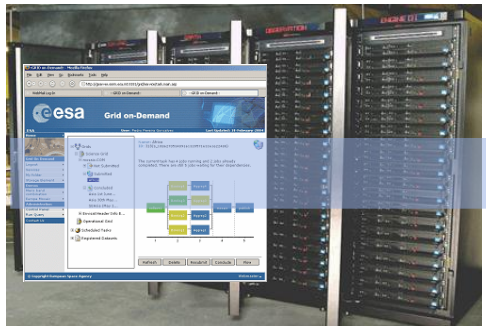
Technology spin-off in PDGS and user support infrastructure

Grid *Processing-on-Demand* (G-POD)

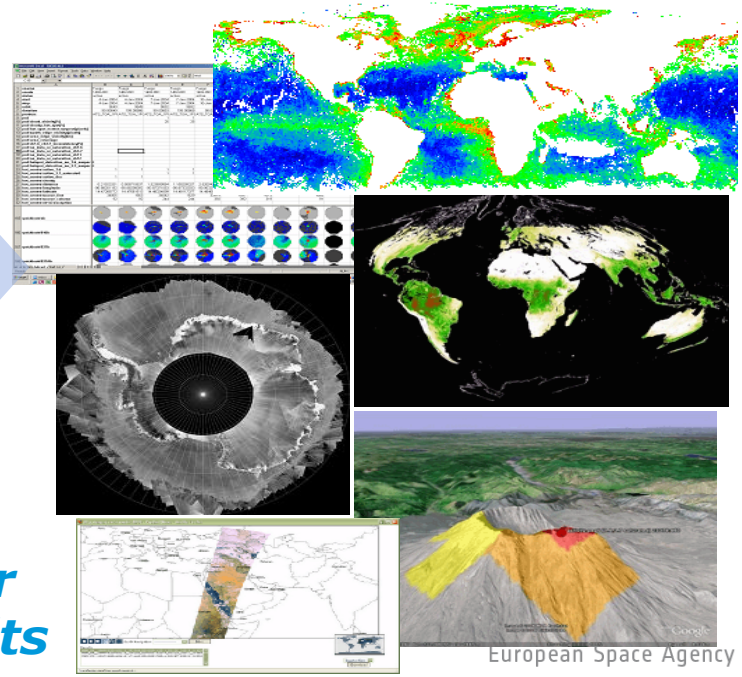
1. Promote the development of new algorithms requiring large data and computing resources: "***bring the user's algorithms to the data***"
2. The service makes available to EO PIs processing capacity, such as a grid environment with online access to EO data from ESA and non-ESA missions
3. G-POD users can test a new algorithm on large datasets, improve and validate it, re-iterating this process until the scientific goal is achieved.



on-line data archives



user triggers and controls from the G-POD website its own processor running on eogrid computers



http://gpod.eo.esa.int

user results

Data products access

User support services

User Exploitation Platforms

Pilot project:
Geohazard Supersites Exploitation Platform

New concept currently under definition

- built around a thematic topic and a specific user community
- use more ***up to date technologies and concepts*** in data management (e.g. cloud)
- fostering the development of ***science user exploitation platforms***
- ***strong partnership/collaboration*** with development partners
- co-developed with ESA but operations a-priori not funded by ESA

- ✓ Built around a thematic topic and a specific user community
- ✓ Easy access not only to **EO datasets** but also to **in-situ datasets**
- ✓ **Processing on-the-fly** and **toolbox elements**
- ✓ Scientific forum with access to scientists' results

Earth Explorer Level 2 products

This element includes the development of Level 2 products (i.e. geophysical products) for Earth Explorers in Phase B/C/D and the running and evolution of the Level 2 products during Phase E/F, including Level 2 reprocessing.

This element also funds the Earth Explorers validation activities including:

- Validation campaigns, e.g. airborne campaigns
- Development and maintenance of validation equipment, e.g. ground-based instrumentation for match-ups with satellite data (e.g. spectrometers, radiometers, etc)
- Validation data analysis (e.g. databases of in-situ measurements for match-ups)

During the EOEP-4 period, this element will be used for:

- The evolution of the L2 needs for Swarm, CryoSat, SMOS and GOCE as well as ADM-Aeolus once launched,
- The development of the L2 products for EarthCARE and for EE7.

Summary of main opportunities for Mission operations and ground segment development

2013	2014	2015	2016

- Sensor Performance, Product and Algorithms Maintenance and Operations (2013 Q3)
- Support to Cal/Val activities, in particular for Earth Explorers
- EO User Exploitation Platforms
- Development/upgrading of elements of generic PDGS, e.g. end-to-end monitoring
- Development of EE7 PDGS
- Support to PDGS operations