ESA Earth Observation Programmes towards C-MIN 2012

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Directorate of ESA Earth Observation Programmes

BE Industry Info Day, Brussels

25 June 2012
At C-MIN 12, a series of Earth Observation Programmes will be tabled for subscription:

1. EOEP-4
3. GSC-3

Additionally Earthnet and Long-Term Data Preservation programmes will be tabled as part of the LoR, as described in C(Min)2008.

Additionally PROBA-V phase Exploitation will be open for subscription, together with on-going ESA programmes.
The Earth Observation Programmes in ESA

Overview
The ESA Earth Observation “fleet”
1. Four EO missions in operation
   a. Five more currently operated by Eumetsat
2. Several thousand data user projects worldwide—increasing further
3. More than 100 Terabytes/yr of data
4. 30 partner missions for which data disseminated to European users
ENVISAT mission: 10 years

First images
- Global air pollution
- B-15A iceberg
- Bam earthquake
- Hurricane Katrina

Launch
- Mar 02

Envisat Symposium
- Salzburg (A) - Sep 04
- Montreux (CH) - Apr 07

Living Planet Symposium
- Bergen (N) - Jun 10
- Montreux (CH) - Apr 07

and many workshops dedicated to specific Envisat user communities

Serving
- 4000 scientific projects
- many operational users

CO2 map
- Arctic 2007
- L’Aquila 2009
- Ozone hole 2005
- B-15A iceberg
- Hurricane Katrina

Iceland 2010
- Japan 2011
- Arctic 2007
- L’Aquila 2009
- Ozone hole 2005
- B-15A iceberg
- Hurricane Katrina

Prestige tanker oil slick
- Mar 12

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Results of the Explorer Missions

**GOCE**: most accurate Geoid ever, with unprecedented detail

**SMOS**: first global ocean salinity and soil moisture maps (key variables in the water cycle)

**CryoSat**: first Arctic sea ice thickness map
ESA mission synergies

Altimetry map (Envisat, Jason)

High precision Geoid (GOCE)

CryoSat Data of Ice/Water surface

Ocean currents (GOCE)

Ocean Dynamic Topography

The Gulf Stream
Objectives:

- Maintain Europe at leading edge of sciences
- Increase use of Earth Observation in formulation, implementation and monitoring of public policies and in the provision of public services
- Foster the development of commercial services using Earth Observation

Implementation:

- EARTH EXPLORER SATELLITES for science and technology demonstration
- EARTH WATCH SATELLITES for long-term operational monitoring
- Operational ACCESS TO DATA,
- Support to EXPLOITATION: Science, reference data sets, development of services
**Earthnet**: European access to non-ESA missions:
Landsat, SeaWifs, NOAA, JERS, MODIS, ALOS, Proba, Bird, Scisat...

**Earth Explorers**
- ERS-1, -2
- ENVISAT

**METEOSAT**
- M-1, 2, 3, 4, 5, 6, 7

**METEOSAT Second Generation**
- MSG-1, -2, -3

**METOP**
- 1, -2, -3

**GOCE**
(Gravity and Ocean Circulation Explorer)

**SMOS**
(Soil Moisture and Ocean Salinity)

**Cryosat2**
(Polar Ice Monitoring)

**ADM/Aeolus**
(Atmospheric Dynamics Mission)

**SWARM**
(Magnetic Mission)

**EarthCare**
(Clouds, Aerosols & Radiation Mission)

**Earthnet**: European access to non-ESA missions: Landsat, SeaWifs, NOAA, JERS, MODIS, ALOS, Proba, Bird, Scisat...

**European users**

**Meteo**
MTG/MetOp-SG
In cooperation with EUMETSAT

**Science**
To better understand the Earth System

**Applications Services**
To initiate long term monitoring systems and services

**GMES in cooperation with EC**

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For Official Use
Earth Observation Envelope Programme 4th Period (EOEP-4)
EOEP is the backbone of ESA EO strategy. It provides room for:

- Scientific Earth Explorer Missions
- Preparation of Operational Programmes
  - Eumetsat missions
  - GMES Space Component (GSC)
  - Climate Change Initiative (CCI)
- Technology Development
- Set up of an operational G/S infrastructure
- Mission continuity, data exploitation

<table>
<thead>
<tr>
<th>EOEP-1</th>
<th>EOEP-2</th>
<th>EOEP-3</th>
<th>EOEP-4</th>
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</table>
The scientific merits of the EOEP

In 2011, a successful scientific and programmatic review of the Earth Observation Envelope Programme (EOEP) was held.

The review team of external science experts concluded that the EOEP

• “has evolved very successfully during the past decade in developing, launching and operating state-of-the-art space-based EO satellites”
• “has emerged as a sustained technology programme at very high innovation level” and produced
• “substantial scientific output with significant impact on our understanding” of Earth.
EOEP has been conceived as an ‘envelope’ program:

1. It provides a continuous long-term planning mechanism with successive periods of nominally 5 years.
2. It enables a flexible and responsive definition of program content
3. It offers recurrent opportunities in terms of proposed new calls for missions/activities
4. It ensures a balance across the programme objectives from technology development, mission development to operations, science and exploitation
5. It empowers the program participants in the direction of the program content via selection procedure for Earth Explorer missions and approval of yearly work-plans

**EOEP-4 will span the period 2013-2016, with commitments up to 2020. (4 years + 6 months for operations)**
The program assumptions are:
- a balance between new missions and exploitation activities
- a minimum of order 60% of funding in mission development, including ongoing development and new opportunities
- significant new space segment opportunities within the period

A balanced program proposal with a financial envelope of 1600 M Euro (2012 e.c.)

This funding level will allow:
- Development of next generation Explorer missions (EE-7, EE-8, EE-9, EE-10 (Phase A)); collaborative payloads and missions, in close cooperation with MS, e.g. EE-X; an improved level of technical preparation of missions, in line with the orientations of the Code of Conduct (final selection only after phase B1; increased activities on instrument pre-development, as per lessons learnt from GOCE/Aeolus, coordinated with MS).
- Science exploitation of the EO data (including Sentinel missions)
- Continuity of missions (e.g. Explorers) beyond currently approved lifetime
- Innovative G/S solutions for an ‘open and operational’ access to EO data by different users communities
- (Pre) development of future EO services; provision of prototype reference data sets
- Preparation of future EO operational systems
Status of the EE-7 mission candidates
Biomass, CoReH2O, PREMIER
AN ESA EARTH EXPLORER CANDIDATE TO MEASURE THE BIOMASS OF THE EARTH’S FORESTS

BIOMASS aims to observe forests biomass and height globally for a better understanding of the carbon cycle to

1. Improve current estimates of forest carbon stocks
2. Reduce uncertainty in deforestation emissions to a level comparable to uncertainty in net ocean flux
3. Improve estimates of terrestrial carbon sinks from regrowth and reforestation
Biomass ‘first’ : P-band SAR from space

Instrument:
P-band SAR
Operating in interleaved stripmap mode

Flight Operation Centre

Satellite Mass: ~ 1200 kg
Satellite Power Gen.: ~ 1.5 kW (EOL)

X-Band Receiving Station
S-Band TT&C Station

Processing Centre

Orbit:
Sun Synchronous
LTAN: 18:00
Altitude: ~640 km
Repeat cycle: 25 days Nominal Phase,
4 days for Tomographic Phase
AN ESA EARTH EXPLORER CANDIDATE TO OBSERVE SNOW AND ICE

Measurements of Snow Water Equivalent (SWE) and Snow Extent (SNEX) globally, with high resolution, high accuracy and temporal revisit.

Objectives:

- Quantify fresh water in terrestrial and glacier snow
- Evaluate and reduce uncertainty of snow water storage and budgets
- Validate and improve hydrological processes in NWP models
- Validate snow and ice processes in global climate models
CoReH2O ‘first’: X/Ku-band simultaneous SAR observations

Satellite concept A

<table>
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<tr>
<th>Mass</th>
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<tr>
<td>Power</td>
<td>~3.5 kW</td>
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<tr>
<td>Peak Power</td>
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<tr>
<td>Size</td>
<td>4.2-4.3 m by 1.8 m reflector</td>
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</table>

Mission profile: Snow & Sea Ice areas coverage with wide swath (100 km); highly repeatable and automated mission

- Phase 1 (year 1 & 2): 3 days revisit (~666 km altitude)
- Phase 2 (year 3+): 15 days revisit (~645 km altitude)
AN ESA EARTH EXPLORER CANDIDATE TO OBSERVE ATMOSPHERIC COMPOSITION

PREMIER will be the first mission to observe upper troposphere / lower stratosphere (UTLS) trace-gas 3D fields at high resolution to improve the understanding of:

1. UTLS structure and its impact on surface climate and dynamical coupling
2. Trace gas exchange between troposphere and stratosphere
3. Impact of convection, pyro-convection and their outflow on the UTLS
4. Processes linking the UTLS to the lower troposphere

Data products

mandatory:
H₂O, O₃, T, HNO₃, NO₂, CH₄, CFC-11, CO, HCN, PAN, extinction coeff.

additional:
ClONO₂, CH₂O, NH₃, H₂O, NO₂, CFC-12, HCFC-22, N₂O, SF₆, HDO, CH₃Cl, CH₃Br, CH₃CN, CH₃OH, H₂O₂, CH₂O, C₂H₆, N₂O₅, SO₂, OCS, ClO, ClONO₂, BrONO₂, C₂H₅, acetone, Isoprene, HCOOH
PREMIER observation concept

- PREMIER will observe 3D atmospheric composition fields through the use of Infra-Red limb imaging spectrometry (IRL). Millimetre-wave limb sounding will provide 2D data in presence of cirrus clouds and complementary chemical species.

- PREMIER data will be extended to the surface through the synergy with nadir observations from MetOp instruments, improving estimates of bioaenic, pyrogenic and anthropogenic emissions.

- Infra-Red (IRLS) and mm-wave (STEAMR) limb sounding.
- Loose formation with MetOp to ensure synergy with MetOp nadir-looking observations.

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European Space Agency

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Status of the EE-8 mission candidates
Carbonsat, FLEX
CarbonSat: to quantify and monitor the distribution of carbon dioxide and methane => better understanding of the sources and sinks of these two gases and how they are linked to climate change.
• A single nadir-pointing satellite carrying a single instrument: The Green House Gases Imaging Spectrometer (GHGIS), operating in pushbroom mode archiving longitudinal coverage pole wards of 40° within 12 days with a pixel size of 2 x 2 km²
• GHGIS records data in three spectral bands: NIR (747-773 nm) with a resolution of 0.1 nm; SWIR1 (1559 - 1675 nm) with a resolution of 0.30 nm; SWIR2 (1905 - 2095 nm) with a resolution of 0.5 nm
• GHGIS: based on single-slit dispersive concept using immersed or transmission gratings, with detectors and SWIR2 spectrometer elements passively cooled to 150-180 K and 250 K, respectively, and a set of calibration units (e.g. sun-illuminated diffuser) in front of the spectrometer
• Role of the Cloud and Aerosol Imager (CAI), proposed in the ‘goal configuration’, is fulfilled intrinsically by the imaging spectrometer
• Platform with pointing capability for sun-glint over the ocean and snow- and ice-covered high latitude areas (pitch only) as well as sun-pointing for radiometric calibration
• Satellite compatible with the Vega launcher
• Mission duration of three years, with a goal of five years
FLEX: to provide global maps of vegetation fluorescence, which can be converted into an indicator of photosynthetic activity ➞ better understanding of how much carbon is stored in plants and their role in the carbon and water cycles
FLEX

- A single three-axis stabilized satellite flying in tandem with Sentinel-3, observations between FLEX and Sentinel-3 instruments acquired within 6 to 15 s from each other.

- A FLuORescence Imaging Spectrometer (FLORIS) acquiring images in the spectral range 500-780 nm, with a sampling of 0.1 nm in the oxygen bands (O$_2$-A [755-780 nm] and O$_2$-B [677-697 nm]) and 0.5 to 2 nm elsewhere.

- FLORIS operates in pushbroom mode with a swath of 100 to 150 km (contained within one of the Sentinel-3 OLCI camera swath) and a pixel size of 0.3 x 0.3 km$^2$. For radiometric calibration it relies on both cross-calibration with the equivalent bands of OLCI and dedicated on-board calibration device.

- OLCI and the SLSTR on Sentinel-3 provide complementary information to measure fluorescence signal - FLEX and Sentinel-3 images are co-registered by on-ground processing through correlation algorithms.
EE – X is the acronym for a ‘small’ Earth Explorer mission, to be selected and implemented under EOEP-4.

This small mission is either a mission ‘in full’ or an instrument using a flight opportunity.

Cooperation with national EO programmes will be encouraged (e.g. In-Kind Contributions).
EOEP – Potential Belgian Role

• At this early point of definition of EE-7, E-8 and EE-X missions (a fortiori selection), it is difficult to map any meaningful Belgian industrial involvement.

• Still, Belgian industry and institutions have so far been active and successful in participating in all the programme lines (techno, mission implementation, exploitation).

• The cumulative Belgian ‘geo-return’ on EOEP is well above 110%, as a token of the potential for Belgian actors to be involved in the programme.

• Besides direct ‘geo-return’, EOEP offers an environment nurturing the further creativity of the Belgian actors: technology for future missions, access to data, access to processing toolkits, co-location events, access to service ‘end users’, etc.

• In general, performance of Belgian Industry in Earth Explorers satellite’s development activities has been satisfactory.
EOEP – Belgium’s participation in EOEP up to date

- **Aeolus**
  - CSL - Vacuum Mechanical Test Fac
  - AMOS - Thermal Shrouds & MGSE Support
  - Euro Heat Pipes S.A- Laser Cooling System
  - Sonaca - Optical Bench

- **EarthCARE**
  - Thales Alenia Space (ETCA)- DC/DC Convertor of S-Band transponder
  - Euro Heat Pipes S.A- Laser Cooling System
  - INST ROYAL METEOROLOGIQUE- Level 2
  - Xenics- Detectors
  - Spacebel- Mass Memory & Formatting Unit (MMFU) ASV
  - CSL – Potential candidate for test facilities
EOEP – Belgium’s participation in EOEP up to date

- **Swarm**
  - Thales Alenia Space (ETCA)- DC/DC Convertor of S-Band transponder

- **GOCE**
  - Nexans- Harness

- **CRYOSAT**
  - Thales Alenia Space (ETCA)- SIRAL EPC and DC/DC converter

- **General**
  - Engineering and Administration Support from RHEA
potential items of interests in the space segment

- Mechanical Test Facilities
- Thermal Shrouds, MGSE, OGSE
- Laser Cooling System
- DC/DC Convertor
- Optical Bench
- Infra-red Detectors
- On-Board Software Systems & System Validation Facilities
- Harness
- Engineering Services
- Ground segment and definition of operations
Overview of EOEP-4 proposal : Main elements

• Scale-up EO Services for International Development Banks :
  • World Bank : priority areas : Oceans, Urban, Forestry, Disaster Risk Reduction,
  • European Investment Bank and European Bank of Reconstruction & Development : in support of infrastructure developments,
  • UN-IFAD : in support of agricultural developments.
  • Asian Development Bank : areas TBD following first discussions 2012.

• Develop Civil Security Sector :
  • European and international Law enforcement agencies : Monitoring / surveillance/Intelligence services; making use of NRT/VH-res European EO missions.

• Expand Corporate Industry Markets :
  • Re/Insurance : Index-linked schemes for Floods & Crops, Risk assessment,
  • Oil & Gas : Environmental Impact, Health & Safety, Arctic Explorations,
  • Renewable Energy : Resources assessment (solar, wind, hydro, bio-fuels),
  • Green Business : Corporate sustainable development, Eco-Systems services.
Overview of Belgian participation

**EO Value-Adding Companies:**
- Land Cover, Crop Monitoring
- Urban mapping
- Environmental Impact Assessment
- Crop Yield estimation
- Atmospheric monitoring

**Industrial Users:**
- Geo-marketing research / consultancy
- Renewable Energy: Hydro-Power
- Certification Organic Crops
- Sugar Beet Production (world leader)

**International Development Banks:**
- Support to World Bank (urban vulnerability)
- Support to European Investment Bank (motorway construction, environmental protection)
- Environmental impact of Hydro-Power operations
- Improving Sugar Beet production
- Certification of organic crops
- Population & infrastructure for geo-marketing
- Atmospheric monitoring of ship emissions

12 Projects (since 2002), including:
- Support to World Bank (urban vulnerability),
- Support to European Investment Bank (motorway construction, environmental protection),
- Environmental impact of Hydro-Power operations,
- Improving Sugar Beet production,
- Certification of organic crops,
- Population & infrastructure for geo-marketing,
- Atmospheric monitoring of ship emissions,
Data User Element: Belgium in EOEP-3

GlobCorine

- U.C. Louvain
- BIRA-IASB
- VITO
- I-MAGE Consult
- KEYOBS S.A.
- MUMM
- Eurosense

* Globcover for EOEP-2
GMES Programme and GSC-3 Proposal for C-Min
Global Monitoring for Environment and Security

European independence in data sources for environment and security monitoring

Global, timely and easily accessible information in domains such as Land, Marine, Emergency response, Atmosphere, Security and Climate Change
GMES dedicated missions: 
Sentinels

**Sentinel 1 – SAR imaging**
All weather, day/night applications, interferometry

**Sentinel 2 – Multi-spectral imaging**
Land applications: urban, forest, agriculture,.. Continuity of Landsat, SPOT

**Sentinel 3 – Ocean and global land monitoring**
Wide-swath ocean color, vegetation, sea/land surface temperature, altimetry

**Sentinel 4 – Geostationary atmospheric**
Atmospheric composition monitoring, trans-boundary pollution

**Sentinel 5 – Low-orbit atmospheric**
Atmospheric composition monitoring (S5 Precursor launch in 2015)
Users need decade-long term perspectives

<table>
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<tr>
<th>GMES Space Component Long-Term Scenario</th>
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<td>2011-2013</td>
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<td>2014-2020</td>
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<td>2021 ==&gt;</td>
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<th>Access to Contributing Missions</th>
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<td>Sentinel-1 A/B/C</td>
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<td>Sentinel-1 A/B/C 2nd Gen</td>
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<td>Jason-CS A/B</td>
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<td>Jason -CS Follow-on A/B</td>
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<tr>
<td>GSC Evolution</td>
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</table>
FULL and OPEN*

* Joint Data Policy Principles
- adopted by ESA in ’09,
- EU legal act to be prepared in ’12

* free-of-charge licenses

* if not constrained by security or technical restrictions
GMES Space Component
(GSC-3)
GSC-3: proposal for C-MIN 2012

- **Sentinel 5**
  - ESA contribution of 163 M€ (2012 e.c.)
  - MetOp-SG passenger PL, GS integration into EPS-SG provided by EUM (TBC)
  - 3 units, first unit financed by ESA MS, recurrent units and operations by EU (according to LTS)

- **Jason-CS**
  - ESA contribution B2/C/D/E1 of 188 M€ (2012 e.c.), assuming launcher provided by US
  - 2 units, first unit financed by ESA MSs, second unit and operations by EU (according to LTS)
  - Launch 2018 (JCS-A) and 2023 (JCS-B)

- **GSC Coordination and Studies Activities**
  - ESA contribution ~23 M€ (2012 e.c.)
  - Programme coordination, GSC system architecture analysis, Threat and Vulnerability assessment, GSC evolution

- **PDGS Adaptation, mainly Sentinel-5P (15 M€)**

- **Sentinel data interfaces for national use 16 M€/8 years**

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</table>
GMES Space Component: Belgium results

- In GMES Segment-1/-2, Belgium has already achieved georeturn = 1.

- More precisely, Belgium has totaled contracts for ~31 M€ against an ideal target (when taking the recent CAC increase into account) of ~20.5 M€ (2012 ec) and a contribution of ~24 M€.

<table>
<thead>
<tr>
<th>GMES element</th>
<th>Procurement Item</th>
<th>ESA or FP7</th>
<th>Contractor selected</th>
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<td>FP7</td>
<td>ETCa</td>
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<td>Transm X-band Assembly (TXA)</td>
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<td>CSL</td>
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<td>AMOS</td>
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<td>PCDU - Power Control and Distribution Unit</td>
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</tr>
<tr>
<td>5A</td>
<td>OLCI Calibration Hardware</td>
<td>FP7</td>
<td>CSL</td>
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<tr>
<td>5A</td>
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<td>ESA</td>
<td>CSL</td>
</tr>
<tr>
<td>5A</td>
<td>OLCI Electronic Unit</td>
<td>ESA</td>
<td>ETCa</td>
</tr>
<tr>
<td>5A</td>
<td>OLCI OGSF ISOF tools</td>
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<tr>
<td>5A</td>
<td>OLCI Hemispherical measurements on the Spectral Dimsers</td>
<td>ESA</td>
<td>CSL</td>
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<tr>
<td>5A</td>
<td>Payload Electrical architecture support</td>
<td>ESA</td>
<td>Astor SE</td>
</tr>
<tr>
<td>5A</td>
<td>Satellite Meshes</td>
<td>ESA</td>
<td>various</td>
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<td>5B</td>
<td>Technical support for 5B mission implementation</td>
<td>ESA</td>
<td>RHEDA</td>
</tr>
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<td>5B</td>
<td>5B Land Synergy Products for SPOT VGT continuation</td>
<td>ESA</td>
<td>VTO</td>
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<tr>
<td>5B</td>
<td>Satellite MGREs</td>
<td>FP7</td>
<td>AMOS</td>
</tr>
<tr>
<td>5B</td>
<td>Platform ESOF Items - POWER SCOPE &amp; COTE</td>
<td>FP7</td>
<td>ETCa</td>
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<tr>
<td>5B</td>
<td>PCDU - Power Control and Distribution Unit</td>
<td>FP7</td>
<td>ETCa</td>
</tr>
<tr>
<td>5B</td>
<td>SBT - S-band Transponder</td>
<td>ESA</td>
<td>ETCa</td>
</tr>
<tr>
<td>5B</td>
<td>TX Assembly (TXA)</td>
<td>ESA</td>
<td>ETCa</td>
</tr>
<tr>
<td>5B</td>
<td>STR - Star Trackers</td>
<td>FP7</td>
<td>Cypres</td>
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<td>5B</td>
<td>SAKL RPU EPC RadC Band</td>
<td>ESA</td>
<td>ETCa</td>
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<tr>
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<td>OLCI Calibration Hardware</td>
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<tr>
<td>5B</td>
<td>OLCI Electronic Unit</td>
<td>ESA</td>
<td>ETCa</td>
</tr>
</tbody>
</table>
Potential role of Belgium industry on Segment-3 should build upon the good results achieved in Segment-1/-2.

Concerning geo-return, GSC-3 will follow the std ESA rules (Segment-3 is not a joint programme with EC, it is a traditional ESA optional programme). This means that we “re-start from scratch” (so to say).

A contribution at least in the order of GDP is expected. On the one side, it is fully justified by past performance; on the other side, it will still likely lead to an over-return.
MetOp Second Generation (MetOp-SG)
MetOp-SG Programme

- Collaborative programme with EUMETSAT.
- Designed to provide data continuity with, and to enhance the observations from, the existing first generation MetOp series (beyond 2020).
- Current MetOp satellites provide essential meteorological observations from polar orbit.
- ESA is responsible for the development of the prototype satellites and, on behalf of EUMETSAT, for the procurement of the recurrent satellites.
- EUMETSAT contributes to ESA development costs for the satellites and funds all the recurrent satellites.
- In addition, EUMETSAT develops the ground segment, procures the launch and LEOP services and performs the operations.
MetOp-SG for C-MIN 2012

- Overall programme size (ESA + EUM): > 3 Beuro.
- 2-satellite constellation – recurrent models (nominally 2 series of 3 satellites each).
- Inclusion of ICI instrument to be decided by EUMETSAT Council on 5-6 July 2012.
<table>
<thead>
<tr>
<th>Satellite</th>
<th>Instruments</th>
<th>Instrument Provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sat-A</td>
<td>METimage</td>
<td>DLR via EUMETSAT</td>
</tr>
<tr>
<td></td>
<td>IASI-NG</td>
<td>CNES via EUMETSAT</td>
</tr>
<tr>
<td></td>
<td>MWS</td>
<td>ESA – MetOp-SG</td>
</tr>
<tr>
<td></td>
<td>RO</td>
<td>ESA – MetOp-SG</td>
</tr>
<tr>
<td></td>
<td>3MI</td>
<td>ESA – MetOp-SG</td>
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<tr>
<td></td>
<td>Sentinel-5</td>
<td>ESA – GMES</td>
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<tr>
<td>Sat-B</td>
<td>SCA</td>
<td>ESA – MetOp-SG</td>
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<tr>
<td></td>
<td>MWI</td>
<td>ESA – MetOp-SG</td>
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<tr>
<td></td>
<td>RO</td>
<td>ESA – MetOp-SG</td>
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<tr>
<td></td>
<td>ICI (option)</td>
<td>ESA – MetOp-SG (option)</td>
</tr>
<tr>
<td></td>
<td>Argos-4</td>
<td>CNES via EUMETSAT</td>
</tr>
</tbody>
</table>
MetOp-SG – Potential Belgian Roles

• MetOp-SG is a large programme and offers several possible roles for Belgian industry, with a global potential well above GNP level.

• With the recurrent satellites, MetOp-SG provides security for long-term industrial activities and workload / employment.

• Belgium is a EUMETSAT Member State and will contribute to the mandatory EUMETSAT EPS Second Generation programme at GNP level (2.6% in EUMETSAT framework).
Other Elements in General Budget
Two other elements will be tabled in C-MIN 12, namely Earthnet and Long-Term Data Preservation, as part of the Level of Resources.

Both critical elements are not exclusively related to ESA Earth Observation but cover the cooperation with and support to Member States, International Cooperation and elements common to different ESA directorates.
LoR Element - Earthnet

- Science Access to National and International missions, Coherent PI Projects data access to ESA and Third Party Missions

- Implementation of the International Charter for Space and Major Disasters

- International Presence: Cooperation with China, Russia, US, Africa and any European and International Organisations

- Outreach, education, training

- Of the order of 22M/year

**Relevance for Belgium:**
- Guaranteed access to Third party mission EO data
- International agenda (Africa – Tiger and Charter)
- Proba-1 operations
LoR Element - Long-Term Data Preservation

- Assuring the long term data access (starting 5 years after the end of the mission lifetime)
- Relying on a distributed infrastructure with modern physical and virtual archives
- Evolution of processing and data access systems to allow ‘use/exploitation of the data’
- Approach shared
  - with other national EO space systems in Europe (see agreed LTDP guidelines)
  - with SRE/HSO in ESA
- Assumption: 17M (2012 ec) annually in average for EO part

**Relevance for Belgium:**
- Guaranteed access to EO data (unique long-time series back to 1990’s)
- Proba-1 data
- Industry involvement in data preservation/mining/reprocessing tools
PROBA-V

Phase-E
**PROBA Vegetation (PROBA-V)** is the third mission of ESA D/TEC for the In-Orbit Demonstration (IOD) of technologies. It ensure the generation of “Vegetation” products data in continuity of the CNES SPOT/Vegetation missions. It will bridge the gap between SPOT/Vegetation decommissioning and the availability of the Sentinel 3A and -3B constellation between 2013 and 2015. To be launched end of 2012.

The new **PROBA-VEGETATION** payload consists of three aligned wide-field pushbroom radiometers (blue/red/NIR/SWIR) with a ground sampling distance of 100/350m for all bands, except SWIR 200/700m.

Quasi-daily acquisition of all land masses, along a repetitive seasonal pattern.

**Flight Operations**

Spacecraft and payload control and monitoring from REDU ESA Ground Station(B).

Payload data downlink via TBD Northern latitude station(s)

**Payload Data Processing**

User Segment in Mol (B) at the VITO.
PROBA-VE is a new element of the Earth Watch Programme, to be subscribed at the time of C/M 12, covering:
- the operations of PROBA-VE for the 2.5 years of ‘nominal’ ops phase, plus possibly 2.5 years extension,
- and the preservation of the archives for another 5 years.

Operations include mission management, data acquisition, processing and distribution of a pre-determined list of products, promotion of the use of PROBA-VEGETATION data.

<table>
<thead>
<tr>
<th>Category</th>
<th>Indicative description</th>
<th>Spatial resolution</th>
<th>Title</th>
<th>Indicative access timeliness</th>
</tr>
</thead>
<tbody>
<tr>
<td>P-Products</td>
<td>Level 1C = Level 1B further radiometrically corrected at pixel level (unprojected TOA reflectance).</td>
<td>Kilometric</td>
<td>P</td>
<td>72 hours</td>
</tr>
<tr>
<td>S-Products</td>
<td>Level 3 composite product of atmospherically corrected L2A data, projected onto a uniform space grid, corrected for cloud, ice/snow artefacts.</td>
<td>Kilometric</td>
<td>S1 TOA</td>
<td>72 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S1 TOC</td>
<td>72 hours</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>S10 TOC</td>
<td>(10 days) + 72 hours</td>
</tr>
</tbody>
</table>
PROBA-VE – potential Belgian role

• Valorisation of past investments/experience in both the Vegetation monitoring area and PROBA, through the re-use of facilities/capacities in ESA Redu and VITO.

• Continuity of the support to the VGT user community, especially until commissioning of Sentinel-3a/b.

• Synergy with Vegetation national programme: possibility for the programme participants to design and to offer additional products (e.g. higher geometric resolution) and services (e.g. NRT time delivery).