Opportunities for Slovenia in the EO Envelope Programme (EOEP5)

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EOEP5 Proposed Content

Block 1: Future Missions

ID#1	Mission Preparation and Instrument Pre-Development

Block 2: Mission Development

ID#2	EE-7 (Biomass)
ID#3	EE-8 (FLEX)
ID#4	EE-9
ID#5	CSC Evolution – Instrument Models
ID#6	SAOCOM-CS

Block 3: Mission Management

ID#7	PhE2 Management, L2 Products and Generic PDGS Development

Block 4: EO Science for Society

ID#8	Scientific Data Exploitation
ID#9	EO Exploitation Platforms
ID#10	EO for Sustainable Development

ESA 5th Earth Observation Envelope Program

EOEP-5, 2017-2021

EOEP-5 Block 4: "EO Science for Society"

❖ Foster scientific excellence ❖ Pioneer new EO applications ❖ Stimulate downstream industry growth ❖ Support international responses to global societal challenges ❖

Scientific Exploitation

EO Application Platforms

EO for Sustainable Development

3 unifying principles

| Forster **easier access and utilisation of satellite data**, accelerated by emerging ICT |
| Respond to needs from **authoritative user communities** and downstream industries |
| Complement, seed, **cross-fertalise activities** from ESA MSs, H2020 and Copernicus |

Science Exploitation Element Objectives

- Strengthen the leadership of European EO research community
- Enable the science community to address new scientific research
- Maximise the scientific return of ESA and European Missions in terms of novel methods, new products and innovative science results
- Ensure ESA and ESA data contributes to major international scientific efforts
- Ensure exploitation results contribute to stimulate future mission concepts
- Communicate ESA scientific results to the general public and international media

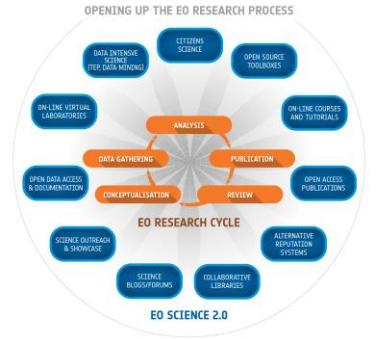
Science Exploitation Element: Types of Project

- **Open call:** A continuous open call scheme for 10% of the overall budget. Focus on fast results (max 12th months) feasibility studies;
- **Feasibility Studies:** (max of 24th months)
- **Science/R&D Projects:** (max of 36th months)
- **Collaborative R&D 2.0 projects:** highly collaborative approach to scientific activities involving parallel studies coordinated by ESA
- **Large Community Projects:** (max 36th months)
- **Living Planet Fellowship:** (for a fixed period of 24th month)

Science Exploitation Element Action Lines

Engaging international Science community	Organising and contributing to a series of regular international **thematic workshops** for consulting scientists and gathering feedback
Developing Open Science Practices-Tools	**Developing Open Science 2.0 activities and practices** using latest tools and techniques
Advancing EO methods and Techniques	Launching state-of-the-art **R&D studies** for maximizing scientific exploitation of EO missions in terms of new methods and products;
Advancing Earth System Science	Addressing major **open questions in Earth system science** in close collaboration with major international science efforts.
Translating Exploitation Results into Novel Mission concepts	Reinforcing the role of exploitation results as a driver for **future missions**

Developing Open Science Practices & Tools: 1st year plan



1. Implement the recommendations of EO open science consultations in the following domains: Citizen Science, Scientific APPs, Visualisation Tools, Virtual Lab for R&D, training and e learning, etc.

2. Develop and maintain next generation scientific toolboxes in imaging instruments, altimetry, atmosphere, and polarimetry and deploy a portal for managing open source approach

3. Propose a series of ESA MOOCs targeted to the scientific EO community at large and deploy an education portal for hosting these courses

4. Prepare Science Blogs dedicated to specific domain of ESA EO missions scientific exploitation

5. Develop Open virtual Research Lab in key domain of global EO research (Ocean, Atmosphere, Land etc..) for multi-sensor/data exploitation

Advancing EO Methods and Techniques: Operational Missions - Priorities EOEP-5





1. **Maximise the scientific return of the Sentinel and other operational missions** (National missions and TPM)
2. **Develop** further new **methodology in Polarimetry, Polinsar, Tomography** (at P-band, C-band, L-band)
3. **Research** on **fully polarimetric bistatic SAR** at L-band and applications in preparation for SAOCOM-CS
4. Develop innovative scientific **exploitation for the Sentinel-1 mission dual polarisation** capability
5. Continue research on **advanced oceanography products for Sentinel-1**
6. Develop innovative scientific **exploitation for the Sentinel-2 mission** (Coastal zones , Coral reefs, new Atmospheric corrections)
7. Develop innovative scientific **exploitation for the Sentinel-3 mission:**
   - Implement **CLEO recommendations in R&D for Ocean Color**
   - **Research** on advanced **processing** for **new generation SAR altimeter over various surface types** (Open Ocean, costal zones, River &Lakes)
8. Maximise **Scientific Exploitation of S5p and S6**
9. **Prepare** for the **Scientific exploitation of Sentinel-4 and -5**
10. **Launch** innovative **constellation studies** for **enhanced exploitation (e.g. S1A-B/S2A-B and S3A-B)**

Advancing EO Methods and Techniques: Scientific Missions - Priorities EOEP-5

1. **Maximize scientific return of ADM:**
   - **a. Novel cloud & aerosols** products;
   - b. Explore **novel products**: vertical winds (turbulences), surface winds, oceans **Earth science processes**: Arctic gyre, Tropical circulation, gravity waves,…

2. **Maximize the scientific return of CryoSat:**
   - a. Novel methods to infer **sea-ice over Antarctica and complex sea ice**;
   - b. Explore the potential of **SARIn over coastal areas**
   - c. Enhance **full basin river-flow estimates** merging SAR measurements (e.g., S3) over main streams with CryoSat SARIn over small riparian rivers;
   - d. Expand the use of swath processing over **Mountain glaciers;**

3. **Maximize the scientific return of Swarm:**
   - a. Explore **interactions of the ionosphere & magnetosphere with climate**;
   - **b. Deep Earth** processes;
   - c. Fully **develop successful feasibilities** (i.e., Swarm+ initial activities);
   - d. Lithosphere Heat Fluxes (e.g., **Antarctica**);

4. **Maximize the scientific return of SMOS:**
   - **a. Novel salinity products** in high latitudes, Mediterranean, Baltic, Black Sea;
   - b. Capitalise on the datset (8 years in 2017) for **Earth system science**
   - **c. Novel products**: droughts, flash floods, global inundation;

Advancing Earth System Science Priorities EOEP-5

- **Water Cycle Research:** 1) Global water cycle **synthesis exercise**, 2) Ocean Water Cycle, 3) Ocean-Land Tele-connections, 4) Extremes and impact in regional and global water cycle;

- **Carbon Cycle Research:** 1) Ensemble global and regional land fluxes, 2) data-driven CO2 flux product (contribution to RECCAP), 3) Ocean Acidification (collaboration with SOLAS), 4) Impact of extremes in carbon fluxes, Addressing key gaps in EO-base information;

- **Arctic and Polar research (EC-RTD collaboration):** 1) support the Year of Polar prediction (2017-2019), 2) Arctic Fresh Water Flux Budget, 3) Arctic Ocean (Arctic ocean Spin-up, Ocean-atmosphere heat flux and the Artic energy budget, Ocean-atmosphere gas exchanges, ocean-sea ice interactions), 4) Expand successful EOEP-4 Arctic+ feasibilities;

- **3DEarth:** 1) Enlarging the EOEP-4 3DEarth Initiative to the deeper Earth (core and deep mantle) (1MEuro), 2) Integrate 3DEarth and 3DEarth-Deep earth in a single model, 3) Advance towards a community 4DEarth model accounting for dynamic processes;

- **Sea-Air Interactions:** 1) Upwelling Areas, sea-spray-cloud-aerosols-precipitation interactions, 2) sea-air gas transfer (expanding OceanFlux), 3) Ocean Acidification (Collaboration with GCP & SOLAS), 4) impact of extreme storms on sea-air fluxes;

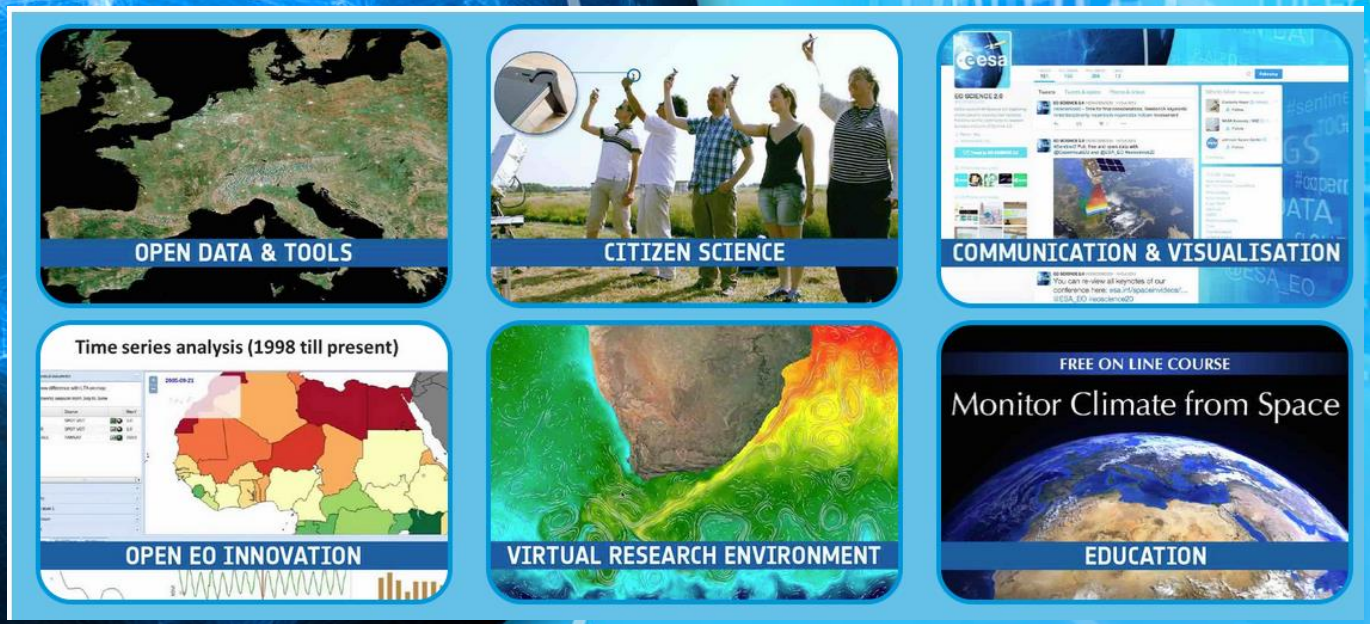
- **Regional science initiatives:** e.g., support of Baltic Earth scientific priorities, Black Sea Science and Applications Workshop;

- **Exploring novel areas for collaboration:** CLIVAR (e.g., global energy cycle), IGAC (atmospheric science). Future Earth.

EARTH OBSERVATION OPEN SCIENCE 2016 CONFERENCE

12 – 14 September 2016

ESRIN



ESA 5th Earth Observation Envelope Program

EOEP-5, 2017-2021

EOEP-5 Block 4: "EO Science for Society"

❖ Foster scientific excellence ❖ Pioneer new EO applications ❖ Stimulate downstream industry growth ❖ Support international responses to global societal challenges ❖

Scientific Exploitation

EO For Sustainable Development

EO Application Platforms

3 unifying principles

| Forster **easier access and utilisation of satellite data**, accelerated by emerging ICT |
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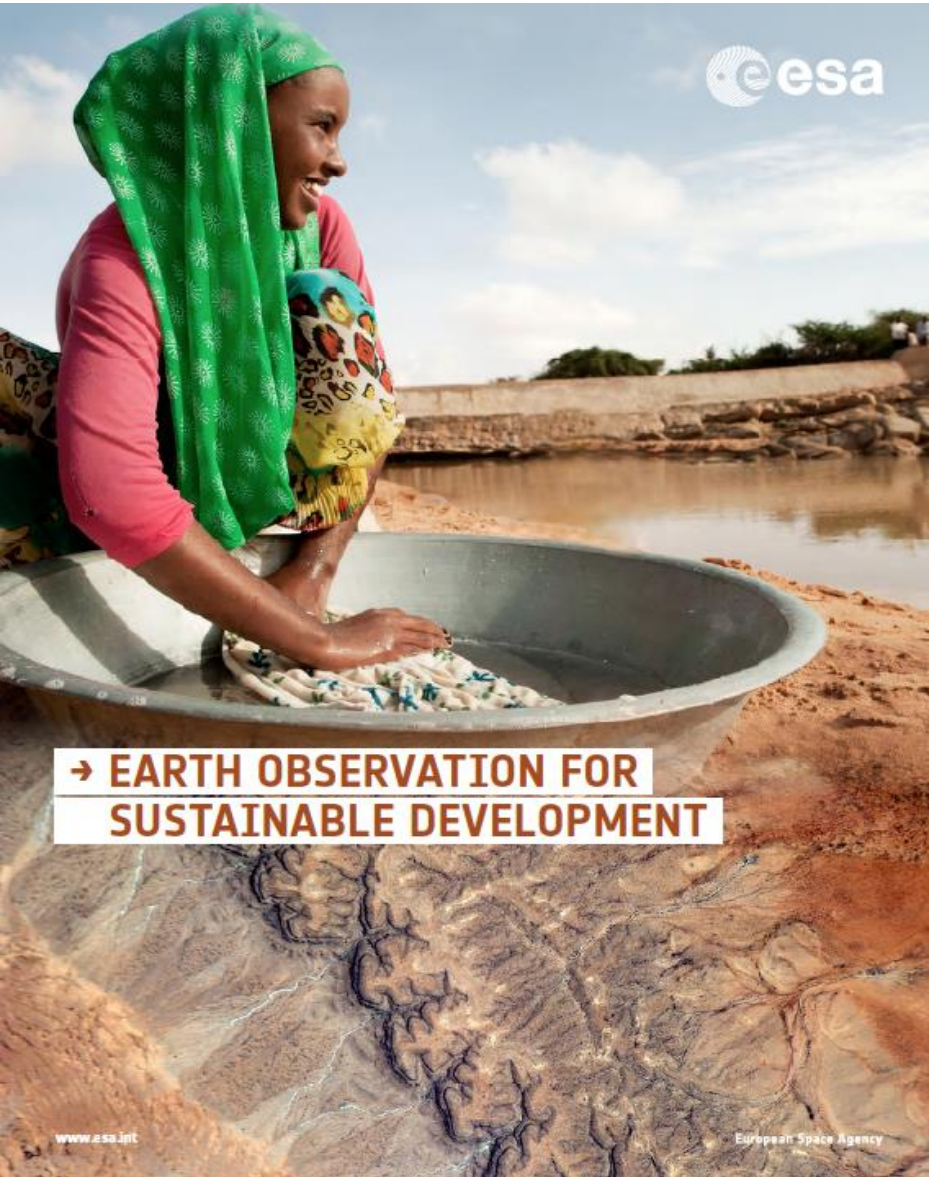
Longer-Term Vision



- **Mainstream & Transfer EO** into operational working processes of Official Development Assistance (ODA) – in partnership with main Multi-lateral Development Banks (MDBs),
- **EO As 'best-practice' source of environmental information** in Environmental Impact Assessment (EIA), Monitoring & Evaluation (M&E) methodologies, **planned-in** financing of project preparation & implementation,
- **Priority thematic areas :** on-going discussion with IFIs and GEF.

Global Sustainable Development

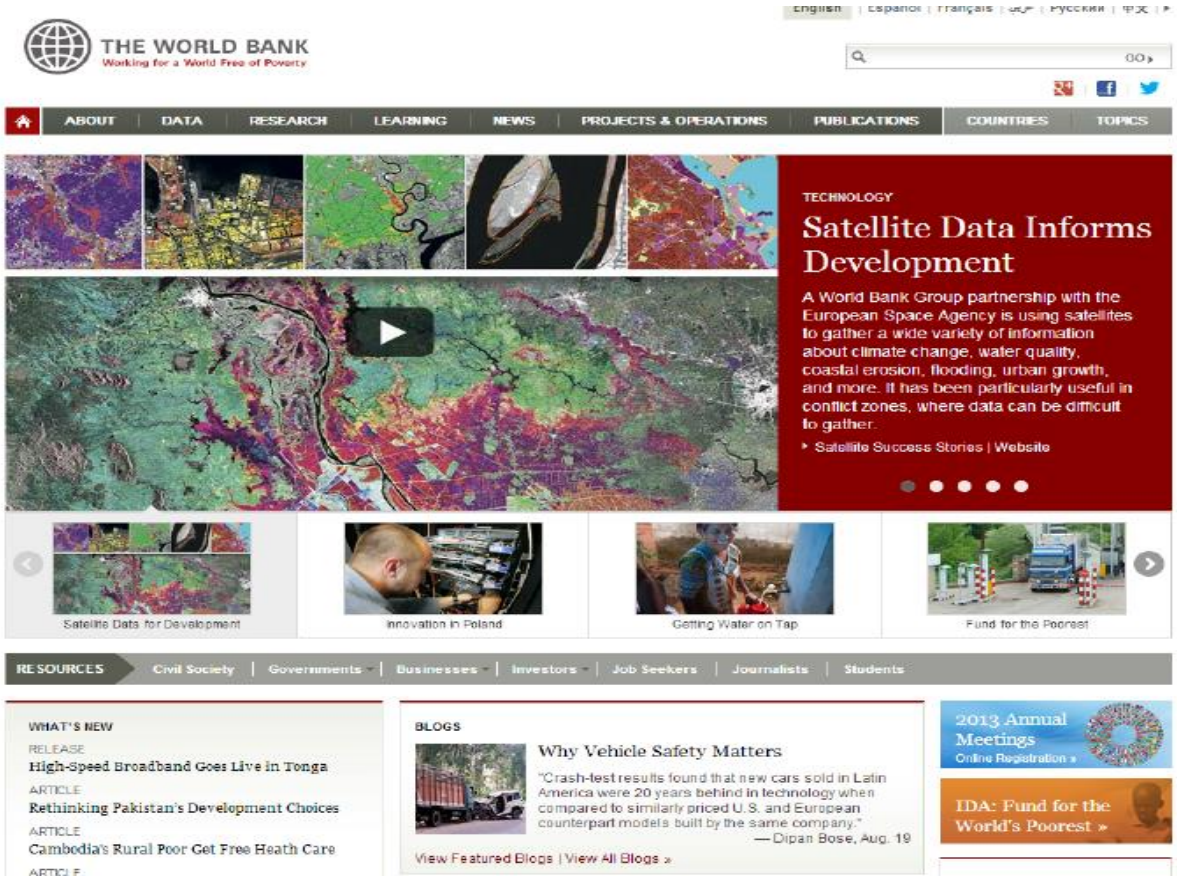
Role of Earth Observation information

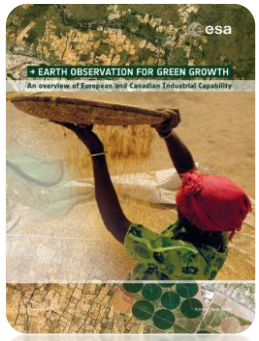
Sept 2015 : New 17 SDGs with 169 targets + indicators

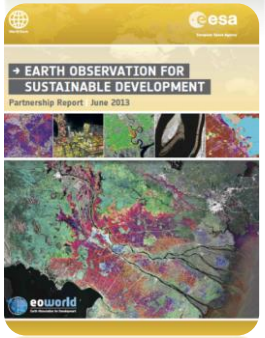
Make development increasingly measurable

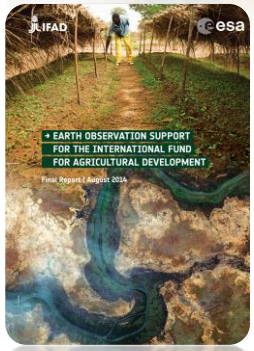
Official Development Assistance (ODA):
An opportunity EO as 'best-practice' environmental information

- Small-scale demonstrations of EO services in support of International Financing Institution (IFI) projects since 2008,









THE WORLD BANK

IFAD

European Investment Bank

ADB

European Bank for Reconstruction and Development

e Agency

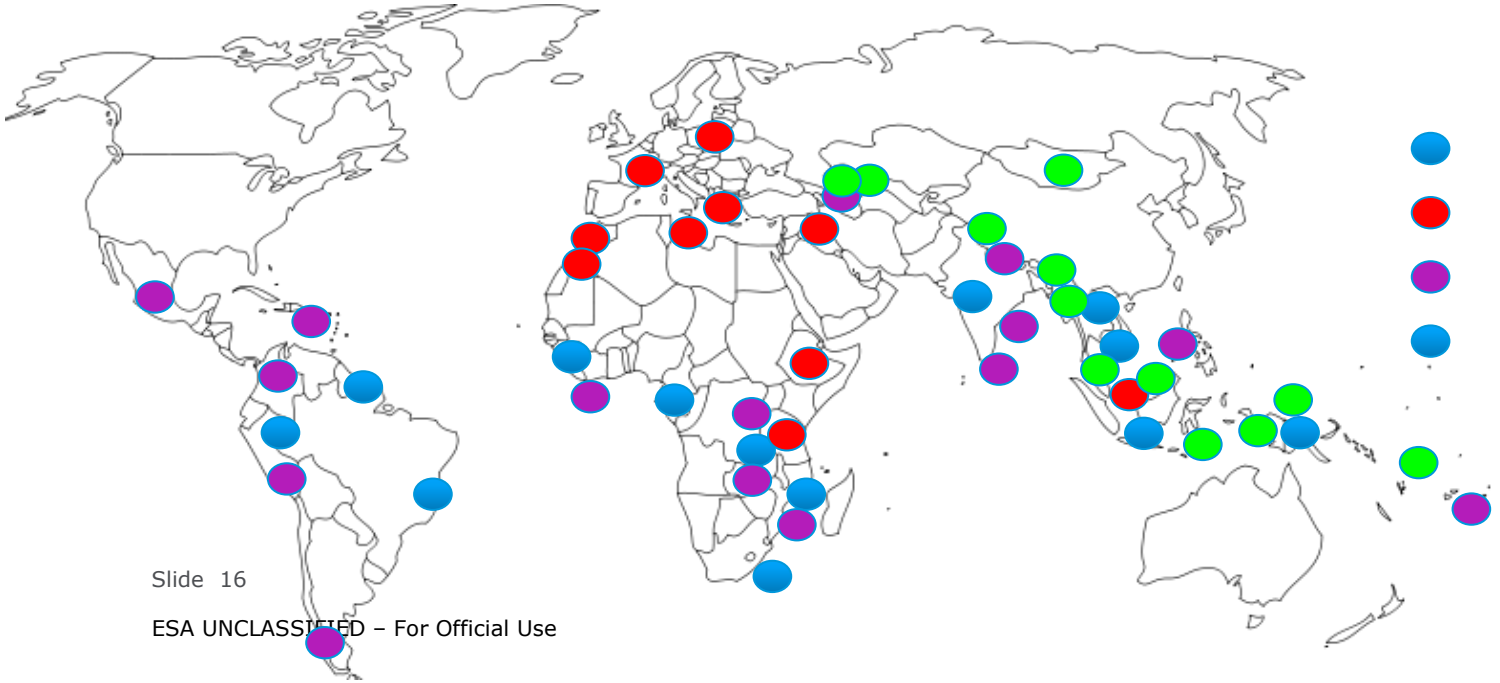
ESA cooperation with International Development Banks

Sets of customized demonstration projects executed with WB Group, ADB and EIB since 2010:

- EOWorld 1 2010-2012
- EOEuropa 2011 – 2013
- EOWorld 2 2014 - 2015
- EOTAP (ADB) 2014 - 2015

2015 – initiate scaling up activity

- 3 priority sectors (urban, water, agriculture/rural development
- Another 7 sectors addressed in 2016/17
- Address wider range of information requirements
- Include capacity buildling efforts



EOEP-5 Block 4
EO Science for Society

- ***EO for Sustainable Development***
  - Maximum of 7 Large-Scale Activities in remaining high-priority thematic domains (each contract 2-2.5 M€, 3 years, all starting in 2017)
    - ***Marine***
    - ***Risk Management,***
    - ***Energy,***
    - ***Forest,***
    - ***Ecosystems,***
    - ***Fragile States,***
    - ***Climate Resilience & Proofing.***
  - 'EO Walk-in Clinic' for rapid-response, small-scale exploratory uses of EO information in Bank projects/activities - pre-qualified EO information suppliers, 'rotating, fair-chance' scheme of service provision
  - EO for Environmental Safeguards policies, Monitoring & Evaluation Methodologies, Environmental Impact Assessment
  - Open Call for industry proposals (10 contracts/year, 2-3 years)

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The ESA EO Ground Segment evolution strategy

EO Ground Segment evolution strategy [ESA/PB-EO(2015)34, Sept. 2015]

Heritage missions	data valorisation & discoverability
ESA missions	**ESA Core Ground Segment**
Sentinel missions	**Copernicus Core Ground Segment**
National missions	**Core Ground Segments** ASI, CNES, DLR, UKSA, CSA
Industry missions	**Core Ground Segment industry**
Meteo missions	**Core Ground Segment Eumetsat**

EO-Innovation Europe

- ***EO enabling element = Technical & economical interoperability***
- ***EO stimulating element = Remote sensing expertise***
- ***EO outreach element = Thematic value-adding***

The ESA EO Ground Segment evolution strategy

EO Ground Segment evolution strategy [ESA/PB-EO(2015)34, Sept. 2015]

The most known part of the EO Ground Segment evolution strategy, around the paradigm :

"moving user (activities) to the data"

creating a ***network of virtual open and collaborative platforms*** (the ***exploitation platforms***, or application platforms)

bringing together:
- data centre (EO and non-EO data)
- computing resources and hosted processing
- collaborative tools (processing tools, user tools, …)
- application shops and market place functionalities
- communication tools (social network) and documentation
- accounting tools to manage resource utilisation

EO-Innovation Europe

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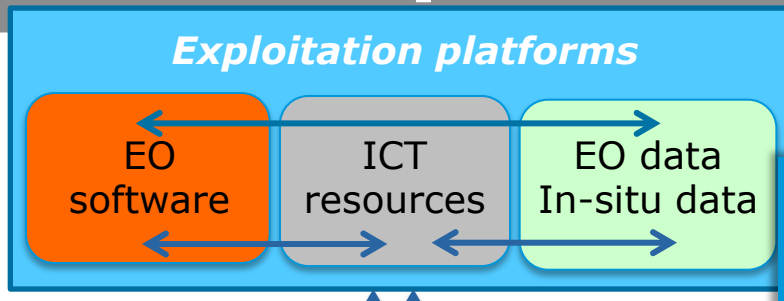
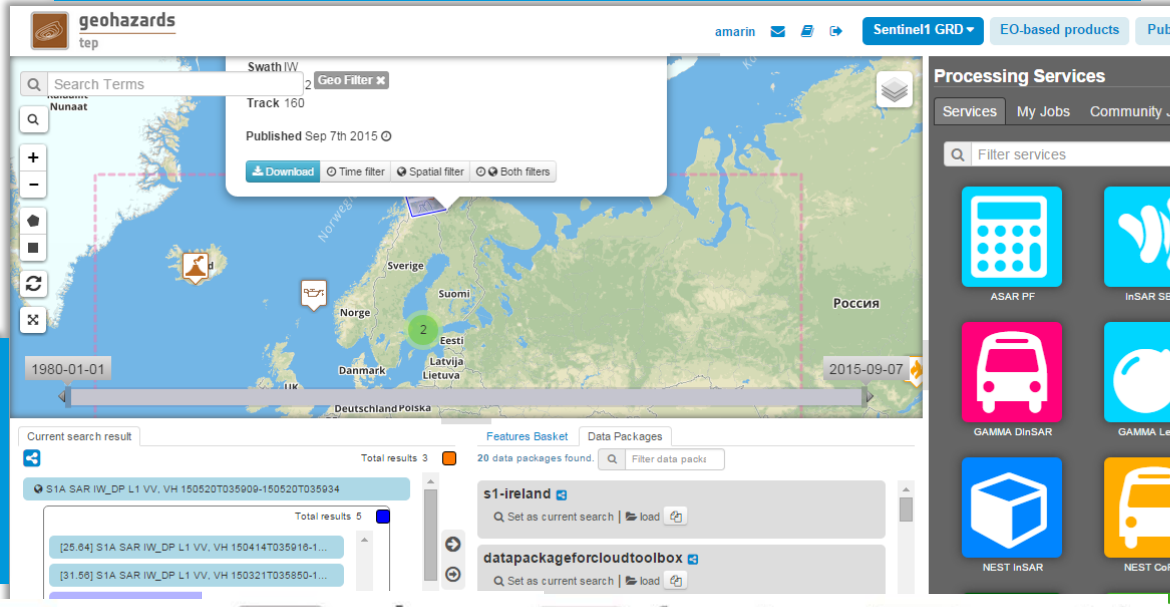
Exploitation Platforms Concept



Users access a virtual, open and collaborative work environment containing the data and resources required, as opposed to downloading and replicating the data 'at home'.

EO and non-EO data, computing resources, collaborative tools (processing tools, data mining tools, user tools…), dev environment, test bench functions, app stores and market place functionalities, communication tools (social network) and documentation, accounting tools to manage resource utilisation …

Three canonical use scenarios:
- EO data exploitation
- New Service
- New product (including massive processing)



geohazards tep | hydrology tep | polar tep | urban tep | forestry tep | coastal tep

Types of Exploitation Platforms

Thematic* exploitation platform (TEP) → *Focusing on a geophysical theme (e.g. forestry)

Current ESA Thematic Exploitation Platforms (TEPs):

- **Geohazards**
- **Hydrology**
- **Urban**
- **Coastal environment**
- **Polar**
- **Forestry**

Under development (2015-2017) with ESA EOEP funds
Not intended to be operated by ESA

***Regional* (multi-thematic) exploitation platform**:

→ ***Focusing on a regional theme*** (e.g. West Africa)

Could be developed with ESA funds (no plans yet)
Not intended to be operated by ESA

Technological exploitation platform :

→ ***To assess new technologies to be rolled out to the exploitation platforms***

Could be developed and operated with ESA funds,
Could be shared with national space agencies

***Mission/Sensor* exploitation platform (MEP)**:

→ ***Tailored* to a particular mission/sensor community (e.g. an Earth Explorer user community)**

e.g. → **BIOMASS mission community (exploitation) platform**
Proba-V mission exploitation platform

To be developed with ESA EOEP funds,
To be operated with ESA EOEP funds (as part of mission operations)

Many similar activities also outside ESA

EO Exploitation Platforms EOEP-5 Prog. Element Target

Also:

"Establish an open, non-monolithic network of EO Exploitation Capabilities, fuelled with European EO assets, in coordination with all European stakeholders (EC, Member States, Industry). The network includes data management and service provisioning capabilities, sensor, scientific and applications expertise, within an open collaborative framework and good governance principles."

EO Innovation Europe

→ *a network of exploitation platforms*

The best worldwide EO data asset

Europe EO

- *Operational public EO data (Sentinel, Meteo)*
- *Heritage EO data (e.g. Spot-1, Envisat)*
- *R&D EO data (e.g. Earth Explorers, SWOT)*
- *Commercial EO data (e.g. Pleiades, TerraSAR-X)*
- *Airborne & in-situ data*

Increasing data volume & diversity

Evolving user expectations

"traditional" data access (pull/push)

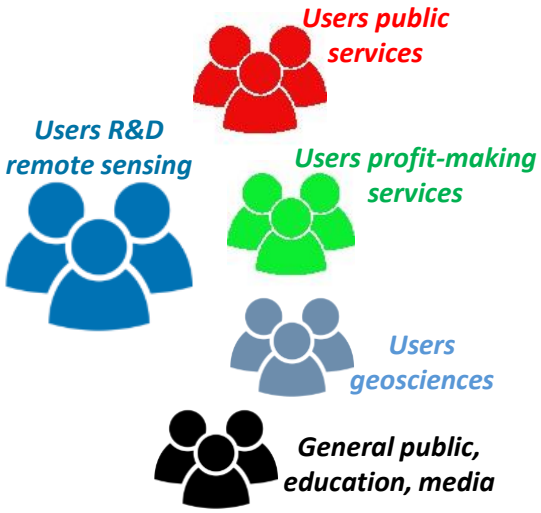
Network of exploitation platforms

"EO Innovation Europe"

"Big Data"

Vivid global user communities

5 interconnected user groups



Objectives of the network concept:

- ✓ ***Enabling large scale exploitation of EO data***
- ✓ ***Stimulating the innovation with EO data***
- ✓ ***Maximising impact of European EO assets and preserving European independence***

How:

- ✓ ***Interoperable/interconnected platforms around a core enabling element***
- ✓ ***Open to multi-source funding initiatives***
- ✓ ***Common governance rules***

EO Exploitation Platforms Action Lines

Enabling Public Sector Benefits	Support responses to societal challenges
Enabling Industry Growth	Foster growth in commercial EO information industry
Common Architecture and Technology	Establish reference architecture for Network of Platforms; agreed standards, open source suite
Platform Services for ESA Projects	Provide the platform resources needed by ESA projects
Implementing Network of EO Platforms	Build network of platforms through the continuing integration of relevant European capabilities supporting EO data exploitation, both public and commercial
Evolving Shared Technical Capabilities	Provide enabling technical capabilities supporting the evolution of the platform ecosystem

Enabling Public Sector Benefits & Industry growth

- Enabling Opportunity
  - Expand uptake by stakeholders who are not specialist data scientists
  - Intercomparable information sets
  - Ensure access to massive datasets and associated processing resources for small innovative SMEs
- Change in development approach
  - New way of doing projects (less mucking around)
  - Enable leading edge data mining, fusion etc
- New possibilities
  - Global and regional products with faster update and lower unit cost
  - Enable new activities and relation to network of platforms / teps
  - Unlock commercial potential of very large (and increasing) data holdings
  - Connect to complementary initiatives by stakeholder communities (they are not waiting for us)

EOEP5 Block 4
Enabling Public Sector Benefits

Development of innovative user-driven EO data products, methods and tools to support international community responses to global societal challenges, capitalizing on ESA's international reach.

GLOBAL

Development of global EO-based approaches and datasets to support major collaborative international initiatives.

- Int. Env. agreements
- GEO Initiatives
- Global Environment Programs

REGIONAL

Enhance and integrate EO within existing regional monitoring and assessment systems in cooperation with regional/ national authorities.

- In Europe and neighbouring countries.
- Atlantic, Baltic, Black Sea, Mediterranean, Alps.

NATIONAL

Foster new EO capacities within existing national environmental & natural resource monitoring and assessment networks.

- In countries without EO national programs.
- In new and small ESA Member States

Best use of "collaborative platforms" adapted to serve user communities

***Primary Users**: international organisations, inter-governmental bodies, national governments and agencies, civil society and NGOs.*

Atmosphere | Marine | Terrestrial

EOEP-5 Block 4

*Expanding **Global** Public Sector Benefits*

Supporting international collaborative responses to global societal challenges

Global Multi-lateral Environmental Agreements

- United Nations Framework Convention on Climate Change (**UNFCCC**)
- United National Convention to Combat Desertification (**UNCCD**)
- Convention on Biological Diversity (**CBD**)
- **Ramsar** Conventions on wetlands

GEO initiatives

- Global Forest Observations Initiatives (**GFOI**)
- GEO Global Agricultural Monitoring Initiative (**GEOGLAM**)
- GEO Biodiversity Observation Network (**GEO BON**)
- Global **Water** Sustainability
- Global **Urban** Observation and Information

Global Environmental projects and programmes

- Sustainable Development Goals (**SDG**s)
- Global Environmental Assessments: **IPCC**, **IPBES**
- UN agencies and mechanisms: **UNEP**, **FAO**, **WFP**, **IFAD**, **UN Habitat**, **UN Water,** etc.
- International Associations and Initiatives: **IPA, ICRI, CGIAR, CIFOR, ICLEI,** etc.

mainly under CEOS coordination

Global approaches to sustainability

- Significant strengthening of the **overall political framework** which underpins global sustainability.
- High emphasis on the needs for **international cooperation** to collaboratively face big societal challenges

Enabling Public Sector Benefits
Regional Exploitation Platforms

- Addressing issues with regional relevance
  - Regional environment and climate issues
  - Security issues with a Regional dimension
  - Infrastructure and other developments impacting regionally
  - Regional collaboration on issues of pan-national interest
- Stakeholder organizations structured around regional cooperation fora
  - Common environmental and climate change monitoring and assessment (eg natural capital, ecosystem services)
  - Data exchange and cooperation agreements (eg maritime data, fine scale meteo etc)
  - Regional Earth Science cooperation fora
- Geographically structured datasets:
  - National and regional Collaborative Ground Segment Initiatives
  - Regional consistent (and intercalibrated) earth science data

EOEP5 Block 4
Enabling Industry Growth

Organised along 3 main directions :

- ***Expand Demand***
  - For user sectors where requirements are well-known through previous work, but that offer significant potential to grow the use of EO enabled by taking advantage of enhanced ICT capabilities (Apps Platforms concept).
- ***New Opportunities & Actors***
  - Stimulate entrepreneurship/innovation/disruptive ideas,
  - Via the involvement of new players, new (non-EO) disciplines,
- ***Consolidate Best-practices***
  - For user sectors initial use of EO has been made, but comprehensive understanding of the EO potential needs to be established, and where there are industrial champions ready to enlarge the use of EO within the sector through trade associations/organizations.

EOEP5 Block 4
Common Architecture and Technology

Establish a reference architecture for the Network of Platforms, including agreed common standards and protocols and implement an open source suite that can be reused by participants to the network of platforms

ICT / GS Activities aimed at providing, *inter alia:*

- Federated Identity Management solutions
- Processing and chaining platform functions
- Information extraction and visualization platform functions
- Data provisioning, management, accounting platform functions
- Security and IPR protection

Other

- Engineering Management Support

EOEP5 Block 4
Platform Services for ESA Projects

Provide the platform resources needed by ESA projects (Enable Public Sector Benefits & Industry Growth, + EC ERA-Planet projects) – though other projects will be served if resources permit

Activities:

- Upgrade / evolve capabilities of existing Exploitation Platforms
- TEP operations support
- TEP community animation
- Help Desk and technical support to ESA projects
- ICT resources for ESA projects

EOEP5 Block 4
Implementing the Network of Platform

Build the network of platforms through the continuing integration of relevant European capabilities supporting EO data exploitation, both public and commercial, into a common European network, including:

- Full-fledged Thematic, Regional, or Mission Exploitation Platforms
- Data access (DaaS), software and tools (SaaS), collaborative platform capabilities (PaaS), high level information services (InfoaaS), as well as infrastructure such as storage, network, and processing capabilities (IaaS)
- Managed user services

Activities, largely ICT

- Technical integration, verification, and validation
- Evolution of third-party capabilities (Open Call)
- Engineering Management Support

EOEP5 Block 4
Evolving shared technological capabilities

Provide the enabling *cross-cutting* technical capabilities supporting the evolution of the platform ecosystem including data, infrastructure and other capabilities.

Partly n technology programmes **GSP->TRP->GSTP-> (and more mature in EOEP)** – driven by

- short-to-medium term applicability <- User needs
- Trailblazing disruptive technologies / push the envelope <- Technology push
- Strategic tech., lower financial risk <- Member states, industry, EC

⇒ Implement traditional participative technology planning process, but also much more reactive and rapid development cycles for disruptive technologies, innovation, trailblazing

- Technology Pathfinders, skunkworks, plus Open Call
- Technology transfer activities, plus Open Call
- Next generation(s) e-infrastructures – TEPs, REPs, MEPs,


Thank you
Earth Observation
A Necessity