Wouldn’t it be nice if …

✓ ... all my data, tools, and resources were available in one place?
✓ ... I didn’t spend 50% of my project resources trying to access (EO) data?
✓ ... ICT (storage, compute, and network) was completely free?
✓ ... my funding scheme fit pay-per-use (instead of capital investment)?
✓ ... most of my tools were available as open source?
✓ ... I could make my stuff available to others while retaining IPR?
✓ ... access to data or resources didn’t depend on my nationality, affiliation, or participation in a particular project?
✓ ... I could have access to people and their knowledge in a collaborative setting?
✓ ... I didn’t need to be an ICT wizard or instrument expert to integrate stuff into my research or application?
✓ ... I could collaborate easily with colleagues, also in other disciplines?
✓ ... I could rapidly test out a new idea? With my peers? And publish the result?
✓ ... I could get fast, crowd-sourced validation of my results?
✓ ... I could use my own data and tools with everything else?
ESA EO Ground Segment Evolution
Action on Thematic Exploitation Platforms

A presentation to CEOS WGISS-42
Frascati, September 22, 2016

Overview

Background, Concept, Planning Overview

Where we are

Where we’re going
Background

Data on the state of the planet growing in volume, velocity, variety, and value

Disruptive technologies advancing at breakneck speed

- Sharp change in scenarios for data exploitation – **new challenges, new opportunities**
- ESA Ground Segment Evolution Strategy: develop **complementary operations concepts, including exploitation platforms**
One-stop community access
- To data & toolboxes ->
- GEO Geohazards Supersites

Processing on demand, managed user services
- GPOD & RSS
- Sandboxes, tools and data

Cloud models, Embryonic Virtual Workplaces
- Helix Nebula
- SSEP (Helix Nebula Flagship), EP4SM

Exploitation Platforms
- Refined scenarios
- Pre-operational use
- TEPs (REPs, MEPs...)

So: From distributing data and tools to providing access to all data and the resources required to exploit them, where they are used
- Each step depends on the previous
- What is required to implement changes as concept evolves (technology, partnerships, programmatics, funding and business models etc.)
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)
Types of Exploitation Platforms

Examples at ESA of different types of Exploitation Platforms:

- **Thematic Exploitation Platform (TEP)** → *Focusing on a geophysical theme* (e.g., forestry)
  - Under development (2015-2017) with ESA EOEP-4 funds

- **Regional (multi-thematic) exploitation platform**: → *Focusing on a regional theme* (e.g., TBC Baltic, Back Sea, Alpine ...)
  - Planned to be developed with ESA EOEP-5 funds

- **Technological exploitation platform**: → *To assess new technologies to be rolled out to the exploitation platforms*
  - Planned to be developed and operated with ESA funds, Could also 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
  - Planned to be developed and operated with ESA EOEP-5 funds

- **Plethora of Exploitation platforms developed outside ESA context by Member States, Int’l Organisations, Industry, etc**
Based on Previous Technology Trailblazing in ESA EOP
In step with the emergence of cloud computing, virtualization, hosted processing – GPOD, Frascati Declaration and GSNL -> SSEP ...

And subsequent stakeholder consultations
- Q4 2013, Request for Information – 48 Responses from mixed thematic/ICT/Ground segment consortia – proposing themes, services, ICT capabilities, objectives
- Q1 2014 industry consultation,

Following TEPs ITT
- Q2 2014 open ITT

And Projects
- Q1 2015, start of 5 TEPs projects + geohazards Q3
- Analysis, design, development of platforms
- Implementation of a set of thematic Pilot Projects
- Pre-operational use from ~Q4 2016 (but varies), for minimum 6 months
- Real-world users; real-world use scenarios
(Some) Specific Objectives

Short term objectives – addressed in the TEP R&D projects

Step change in capabilities in EO data exploitation

- Enable what was previously impossible (or at least very difficult)

Engagement

- Of user communities, institutional stakeholders, industry

Capability Building

- In user communities – collaborative ICT work environments in exploitation scenarios
- In industry – development, operations, service delivery on exploitation platforms

Sustainability

- Persistent, predictable, significant, sustainable capabilities for the long term

Technology

- Advance previous activities – SSEP etc: GSP-> TRP-> GSTP -> EOEP
- Evolve ground segment technology and services for new EO data exploitation
- TRLs and SRLs advanced as required for the platforms
- Open source architectures and components facilitating future dev.

Start of longer term activities with wider, longer term European objectives, to unlock strategic/commercial value of EO data on European footing
Exploitation Platforms offer multiple advantages as they enable:

- **Rapid data access** – processing the data directly without downloading
- **Full focus on exploitation** – avoid spending time on ICT and data sourcing
- **Synergistic use of data** – different EO data sources available in one virtual environment
- **Community building** – fostering a spirit of resource- and knowledge sharing
- **Rapid prototyping**, benchmarking, and deployment of algorithms – PaaS
- **Automated data processing framework** – allowing generation of products also for less technically sophisticated users
- **Replicability of scientific results**; traceability of workflow and processes – trail-blazing the new generation of scientific publications
- **Cost-effective approach to scalable ICT resources** – capitalizing on economy of scale through infrastructure pooling
- **Development of new business/funding models** – i.e. “data rental”, pay-per-use
Background, Concept, Planning Overview

Where we are

Where we’re going
Where we are – Step Changes enabled

- Some real step enablers under development for now based on enhanced processing
  - Coastal TEP – High resolution WQ parameters on a weekly basis (S2-S3 Fusion)
  - Geohazards TEP – Integration of parallel InSAR processing chains and InSAR data
- No developments as yet linked to multi-sensor fusion or other capabilities
Several TEPs have concrete engagement with large stakeholder communities:

- Coastal TEP – Future Earth Coasts, IMBER
- Geohazards TEP – National Geological Surveys
- Polar TEP – International Ice Patrol, Sustained Arctic Observing Network (SAON)

Several TEPs already well connected to complementary projects (eg H2020) involving key stakeholders:

- Coastal TEP - SAFI (H2020)
- Geohazard TEP - EPOS (H2020)
- Polar TEP – Ice Sheets ECV (ESA CCI), EU PolarNet (H2020)
Where we are – Technology, System & Service

Technology capabilities
- GSP-> TRP-> GSTP -> EOEP
- Reference model and architecture
- Standardization
- Interoperability
- Reusable open source components
- Advanced Technology and Service ‘Readiness Levels’ on various topics e.g. integrated accounting
- Federated identity management

System and Service
- Tangible results materializing
- GEP in pre-operations with 30+ users; others
Adoption: Examples of GEP Early Adopters, Validation Phase started in March 2015 (1)

<table>
<thead>
<tr>
<th>User organisation</th>
<th>Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ecole Normale Supérieure de Paris (France)</td>
<td>Etna, Italy and Corinth Rift, Greece</td>
</tr>
<tr>
<td>DLR IMF (Germany)</td>
<td>European tectonic mask</td>
</tr>
<tr>
<td>Altamira Information (Spain)</td>
<td>Test sites on landslides and earthquakes</td>
</tr>
<tr>
<td>ISTerre / Institut de Physique du Globe de Paris (France)</td>
<td>Subduction zones of Latin America, the NAFZ and Tibet.</td>
</tr>
<tr>
<td>INGV Roma (Italy)</td>
<td>Alto Tiberina Fault and Fogo Cape Verde</td>
</tr>
<tr>
<td>INGV Roma (Italy)</td>
<td>Marmara, East sector of NAFS</td>
</tr>
<tr>
<td>INGV Roma (Italy)</td>
<td>Haiti and West Java</td>
</tr>
<tr>
<td>ETH (Switzerland)</td>
<td>Volcanoes</td>
</tr>
<tr>
<td>NOA (Greece)</td>
<td>Earthquakes</td>
</tr>
<tr>
<td>SATIM (Poland)</td>
<td>Landslides</td>
</tr>
<tr>
<td>CNR ISSIA (Italy)</td>
<td>Subsidence</td>
</tr>
<tr>
<td>IPGP (France)</td>
<td>Asia, N &amp; S America, Indian Ocean</td>
</tr>
<tr>
<td>Universidad de Concepcion (Chile)</td>
<td>Southern Andean zone</td>
</tr>
<tr>
<td>Laboratoire de Dynamique Terrestre et Planétaire (France)</td>
<td>South America active volcanoes and tectonics</td>
</tr>
<tr>
<td>BRGM (France)</td>
<td>French coast subsidence</td>
</tr>
<tr>
<td>AIM CEA (France)</td>
<td>La Réunion</td>
</tr>
<tr>
<td>National Cartographic Center (Iran)</td>
<td>Iran</td>
</tr>
<tr>
<td>Instituto Geologico y Minero de Espana (Spain)</td>
<td>SouthEast Spain</td>
</tr>
<tr>
<td>USGS (USA)</td>
<td>Latin America volcanoes</td>
</tr>
<tr>
<td>CVGHM (Indonesia)</td>
<td>Indonesian and Mexican volcanoes</td>
</tr>
</tbody>
</table>

- **32 users up to early September 2016**
- **5 of them being CEOS pilot users** (4 Seismic pilot users and 1 Volcano pilot)
- **Mainly European users**, but also **5 users from Asia** (Indonesia and Iran), **Africa** (Morocco), **South America** (Chile) and **North America** (USA).
Example: 2016 Ecuador Earthquake: Sentinel-1 GEP Interferogram & Displacement map by CNR IREA

INTERFEROGRAM AND DISPLACEMENT MAP GENERATED BY CNR-IREA, EXPLOITING COPERNICUS SENTINEL-1 ACQUISITIONS OF 12 AND 24 APRIL 2016.
Example of promotion of results on the GEP for the Central Italy Earthquake (1)

All products generated on GEP for the Central Italy earthquake were gathered under a link on the carousel of GEP’s homepage: direct access to results.
Example of promotion of results on the GEP for the Central Italy Earthquake (2)

A number of posts were published on the GEP Blog concerning CEOS data collections, first products generated by CEOS Seismic pilot team etc.
Overview

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Beyond the platforms

Towards the ‘Network of Exploitation platforms’ – EO Innovation Europe

Some relevant results

• EP reference model and common conceptual architecture; reusable open source components; early solutions for some lower-TRL elements (e.g. integrated accounting); federated identity management; recommendations for standardization; refined cloud-based operations concepts …

• Capability development in industry, and in user communities

• **Sustainability analysis and requirements**: embryonic partnership agreements with ICT and data providers

• **Recommendations and requirements for data and ICT partnerships**, funding models, and service levels

Platform concept widely adopted – but synergy is required, ICT & data access, partnerships …

From single platforms to harmonized approach to EO data exploitation – Network of Platforms/ EO Innovation Europe

Network of Exploitation Platforms

**EO Innovation Europe**
Where we’re going – Programmatic Context

Switching gears: Earth Observation Envelope Programme, Period 5 (EOEP-5, 2017-2021), Element EO Application Platforms - from objectives of a set of ESA R&D projects towards a wider European objective, in the context of EO Innovation Europe:

“Establish an open, non-monolithic network of EO Application Platforms, 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.”

- Massively enhance and democratize access and use of EO data
- Respond to needs of authoritative international user communities and downstream industries, consulted systematically and participate in design, implementation and assessment
- Activities designed to complement, seed, cross-fertilize and enrich relevant activities of ESA Member states’ national programmes, the European Union, and Copernicus.
**EO Innovation Europe**

→ *a network of exploitation platforms*

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**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:**

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

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**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, RapidEye)
  - Airborne & in-situ data

**Increasing data volume & diversity**

- “traditional” data delivery

**Evolving user expectations**

- Vivid global user communities
  - Users public services
  - Users R&D remote sensing
  - Users profit-making services
  - Users geosciences
  - General public, education, media

**Network of exploitation capabilities**

- “EO Innovation Europe”

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**Operational public EO data**

- Sentinel, Meteo

**Heritage EO data**

- Spot-1, Envisat

**R&D EO data**

- Earth Explorers, SWOT

**Commercial EO data**

- Pleiades, RapidEye

---

**Airborne & in-situ data**

- Increasing data volume & diversity
EO Innovation Europe

→ map of relevant current R&D pilot activities in ESA

**EO enabling element**
= “commodity layer”

**EO stimulating & outreach elements**
= “value-adding layers”

- Federated identity management
- Review of data licenses approach
- Standardisation planning with OGC
- Architecture study
- TEPs (common elements)
- Data Processing power
- Platform common elements
- ICT Testbed Pathfinder (Poland)
- Sentinel toolboxes
- EO Librarian (GSTP fund)
- VIRES Data visualisation (TRP fund)
- Proba-V Mission Exp. Platform

**Thematic Exp. Platforms**
- Technology Atm. Platform (GSTP fund)
- Research & Service Support (G-POD)
- Marketplace study (EARSC)

Further R&D activities under definition
Activities in element address, inter alia:

- Common Architecture and Technology
- Enabling Public Sector Benefits
- Enabling Industry Growth
- Developing Network of EO Platforms
- Evolving Technical Capabilities

Significant opportunities for data providers, information service providers, cloud and ICT developers and service providers, science, applications, research institutes, platform developers, platform service providers, EO digital marketplace brokers, users, value adders, SMEs ...
Conclusions

TEPs on track starting to see tangible results

Pre-ops starting (some now, some end-year)

TEPs provide necessary R&D, capabilities, and experience to address the expanded objectives of EOEP-5, in particular EO Innovation Europe and the Network of Platforms

Thanks!