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## EXCELSIOR Project

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Project acronym:	<b>EXCELSIOR</b>
Work Package:	<b>WP8 ECoE Digital Innovation Hub in EMMENA</b>
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## EXECUTIVE SUMMARY

This report aims to overview the possibility of the establishment of a Regional Exploitation platform that would provide the technical means to foster the use of purposive inflows and outflows of knowledge that can be used to accelerate internal innovation and expand the markets for external use of innovation.

The main objective of this deliverable is to provide an overview of the EO platforms market, identify the current needs of remote sensing users and developers and examine how ECoE's EO services can be implemented. An important aspect of this report and deliverable is to examine how a Digital Innovation Hub can benefit from developing a regional exploitation platform. Based on this extensive overview provided in this deliverable, there are a plethora of the existing EO online platforms in the market. The need to establish a new platform similar to other available platforms will be examined as the EXCELSIOR project evolves. Therefore, an efficient method to fully exploit the potential of ECoE's research fields and serve the remote sensing community and the public in general would be to make it available through such a platform. The detection of existing or even future needs in remote sensing society, the integration of ECoE's services to the EO market and the effective use of ECoE's products in existing online platforms for research, institutional or even governmental activities are of primary importance for ECoE's further development and recognition. The evolution of EO online platforms continued to further improve data management and ease user access and exploitation capacities. During the next few years, ECoE will continuously examine the capabilities of these platforms in order to take full advantage of the technological advances in the industry of creating or using such platforms.



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## Abbreviations and Acronyms

ADAM	Advanced geospatial Data Management platform
AI	Artificial Intelligence
CAMA	Computer Assisted Mass Appraisal
CLEOS	Cloud Earth Observation Services
CODE-DE	Copernicus Data and Exploitation Platform-Germany
CUT	Cyprus University of Technology
DEM	Digital Elevation Model
DLR	German Aerospace Centre
ECMWF	European Centre for Medium-Range Weather Forecasts
ECoE	ERATOSTHENES Centre of Excellence
EMMENA	East Mediterranean/Middle East/North Africa
EO	Earth Observation
EOSC	European Open Science Cloud
EP	Exploitation Platform
ESA	European Space Agency
GEO	Group on Earth Observation
GIC	Geo Information Centre
GIS	Geographic Information System
ICT	Information and Communications Technology
LCMS	Land cover Monitoring System
LPIS	Land Parcel Identification System
ML	Machine learning
MQS	Metadata Query Service
NFS	Network File System
NOA	National Observatory of Athens
TEP	Thematic Exploitation Platforms
VHR	Very High Resolution
VM	Virtual Machine



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## 1. INTRODUCTION

The Report on Regional Exploitation platform is included in the WP8 “**ECoE Digital Innovation Hub in EMMENA**”, whose objective is to investigate the potential of ECoE’s expertise and remote sensing services towards efficient exploitation of new or existing online EO platforms and web services. The development of a new EMMENA Exploitation Platform or the use of existing EO platforms and the addition of innovative services will be of great importance for the benefit of EO users and the further development of ECoE services and products.

This specific report puts emphasis on the characteristics and structure of available EO products and services, which are already provided online by numerous platforms. Type, cost, conditions, users, prerequisites and availability of the remote sensing products and services are investigated and evaluated. This report provides an extensive overview of operational online platforms that provide EO and remote sensing products and services. During the last decade, the vast expansion of satellite data raised the need for more extensive storage and better computational resources and as a result, many cloud services were developed to fill the gap between EO data and EO users. Nowadays, there is a plethora of EO services available online, the majority of which are commercial with an exception of some free-of-charge services, providing mostly visualization tools. Summarising the most important characteristics of these platforms, their primary products are geoinformatics services; cloud services and infrastructure. Some services aim to address the needs of specialized users, while other platforms are oriented to serve ministries, governments and non-profit institutions. Several platforms provide similar services, most oriented towards natural disasters, agricultural monitoring, real estate, cloud and infrastructure services.

This report will follow the following structure:

- **Chapter 1** performs an introduction on existing EO platforms and ECoE’s strategic plan to benefit from existing operational platforms and provide additional, state-of-the-art and innovative services to EO users and developers.
- **Chapter 2** presents ECoE’s strategy in exploiting existing services and benefits from the use of the platforms analysed in the sections to follow.
- **Chapter 3** focuses on existing online EO platforms. ESA’s, Copernicus and other fully operational EO platforms are analysed.
- **Chapter 4** concludes with some observations about the operability and functionality that the existing EO platforms offer. In addition, the ECoE’s capacity in fulfilling the EO market’s gaps and needs is discussed.

The Annex provides the Table A1 with an analysis of DIAS platforms and Table A2 summarises the main features of existing EO platforms.



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## 2. ECOE REGIONAL EXPLOITATION PLATFORM

In this report, an extensive overview of existing EO platforms is provided, towards the optimal exploitation of ECOE's services and products. It is critical for ECOE to identify the EMMENA needs in terms of data and services, understand the current market, realise which are the gaps and offer to the community one Regional Exploitation Platform organised and ready to be used by all interested parties. NOA, as an advanced partner, is responsible for developing such a platform for ECOE to provide ECOE's data for access to end-users.

State-of-the-art remote sensing services that have been developed and are operating through ECOE can be made available to the public and scientific community. Critical questions such as ECOE's expertise, scientific uniqueness, capacity in terms of storage and infrastructure emerged, and require careful handling. Therefore, a strategic plan is prepared to analyze all steps that ECOE has to follow and actions that have to take, to upgrade its services and products make them accessible to the public.

Considering the large amount of EO platforms, ECOE should **identify EMMENA needs** that are not yet addressed and focus on providing unique, state-of-the-art, and affordable solutions. The type of services and products differ based on the type of users. Investigation of the level of ECOE's services is crucial for targeting the suitable group of EO users and identifying their needs.

A major restriction in creating and operating an EO platform is capacity. ECOE needs to evaluate all future specifications and restrictions that may apply to cloud services, as well as the infrastructure, storage and computational efficiency that are some aspects that are required for such platforms. This report provides an overview of the services and platforms available.

The strategy that ECOE needs to follow for evaluation is described within this report (figure 1). First, based on the overview of available online platforms, ECOE **analyses the specifications of all the existing platforms** (Chapter 3). Following, an **overview of ECOE's services** will be acquired by the different departments through the Demonstration Actions (WP6). A comparison between the EMMENA needs and ECOE services with the offerings of the existing platforms will lead to a **gap analysis**. Using such information, a **decision** needs to be made as to whether a new platform should be developed or if an existing platform will be selected that could be used as a host for ECOE's services/products. Depending on the decision, it will be necessary to communicate with the optimal platforms to clarify the requirements and setting of an appropriate economic plan. Finally, **all necessary work and modifications** to ECOE's services will need to be performed to meet the specifications of the hosting platform and facilitate the quality and novelty of the offered services and products.



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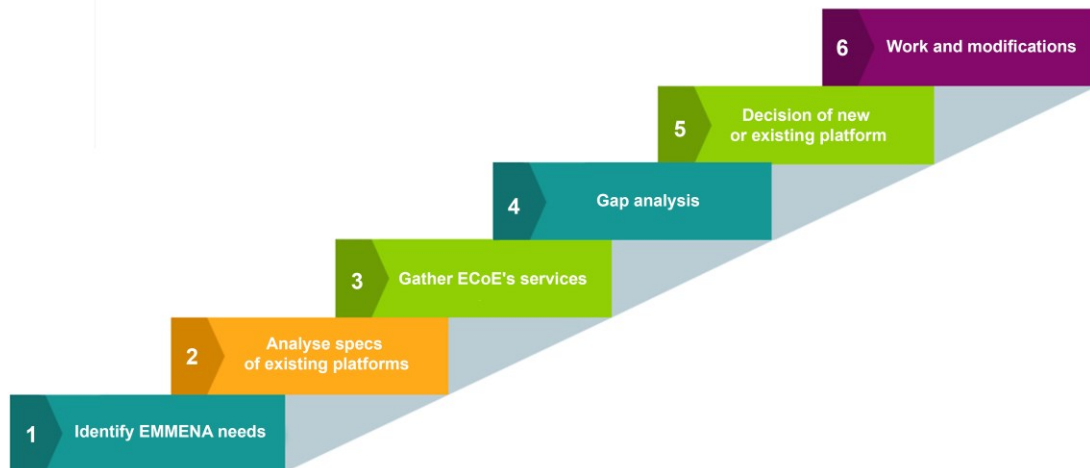


Figure 1: ECoE strategy regarding Regional Exploitation Platform



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### 3. EXISTING PLATFORMS

An important aspect of the remote sensing field is the development and operation of EO services to serve academic, institutional, governmental users. An increasing and competitive market of EO products and services exists, which aims to employ remote sensing techniques and geoinformatics to fully exploit significant satellite data volumes. An overview of existing and operational online platforms that provide EO products and cloud services is provided.

#### 3.1 ESA Online Platforms

In the framework of big satellite data exploitation and the limited resources of EO users, ESA developed Thematic Exploitation Platforms (TEPs), covering the domains of coastal monitoring, forestry, hydrology, geohazards, polar monitoring, urban planning and food security. Also, openEO platform was designed to provide all necessary programming libraries (R, Python, JavaScript and other clients) that enable the processing of big Earth Observation data volumes. A short description of the available TEPs and openEO, is added.

##### 3.1.1 ESA Thematic Exploitation Platforms (ESA TEPs)

The concept of building a Regional Exploitation Platform is borrowed from European Space Agency's (ESA) Thematic Exploitation Platforms (TEP), in this case, positioned for serving EMMENA Earth Observation (EO) needs. This chapter analyses the theory behind the ESA's TEPs.

The Thematic Earth Observation Exploitation Platforms were created with the purpose of allowing data, infrastructure, tools, algorithms and knowledge owners to share their assets, allowing users to easily get access to satellite data and extract information from them without the need to download any dataset. The vast expansion of satellite missions and the continuously increasing amounts of EO data that require high capacity in computing and storage raised the need for online services. The primary objective of TEPs is to allow the users to fully exploit these vast amounts of EO data.

This availability of all the necessary elements in a shared collaboration environment represents a unique opportunity for science and applications but also poses a significant challenge in realizing its full potential in terms of data exploitation. In this context, ESA began the EO Exploitation Platforms initiative with the aim to create an ecosystem of interconnected TEPs on European footing, addressing seven main themes:

- [Coastal](#)
- [Forestry](#)
- [Hydrology](#)
- [Geohazards](#)
- [Polar](#)
- [Urban](#)
- [Food Security](#)



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In short, an Earth Observation (EO) Exploitation Platform (EP) is a virtual, open and collaborative environment which brings together EO and non-EO data, computing resources, tools to support data exploitation (processing, data mining, data analytics), algorithm development, collaboration and communication (e.g. social networks, fora), and market place functionalities. This environment provides the ground for different types of stakeholders to perform a wide variety of tasks and achieve their objectives:

- Researchers: developing their scientific research based on EO data, sharing proven algorithms for the benefit of the community
- Software Vendors: offering toolboxes that support the exploitation of EO data
- Service Providers: offering scalable operational services to the community
- Infrastructure Providers: offering the computing resources needed for the data exploitation
- Data Owners: providing input data products (EO or non-EO) to the platform
- Thematic knowledge owners: sharing their expertise with the community
- End Users: consuming resources available on the platform, deriving higher-level information, eventually sharing the derived information on the platform, therefore earning revenue or recognition.

The fundamental principle of the Exploitation Platforms operations concept is to move the user to the data and tools. Users can access a collaborative work environment that provides the expertise, algorithms, data, tools and resources needed, as opposed to downloading, replicating, and exploiting data 'at home'. Not only does this accelerate the "time to market" for science results and application demonstrations, but it also allows to perform activities at an unprecedented scale. The user community is present and visible in the platform, involved in its governance and invited (and enabled) to share and collaborate. This virtual workplace typically provides access to:

- Relevant EO and non-EO data
- Discussion fora to share experience and knowledge
- Scalable network, computing resources and hosted processing (Infrastructure as a Service – IaaS)
- A platform environment (Platform as a Service – PaaS), allowing users to integrate, test, run, and manage applications (i.e., processors) without the complexity of building and maintaining their infrastructure
- Standard platform services and functions include collaborative tools, data mining and visualization applications, the most relevant development tools (such as Python, IDL etc.), documentation, accounting and reporting tools to manage resource utilization.
- Application repositories or stores (Software as a Service, SaaS) providing access to relevant advanced processing applications (for example InSAR processors and the Sentinel Toolboxes).



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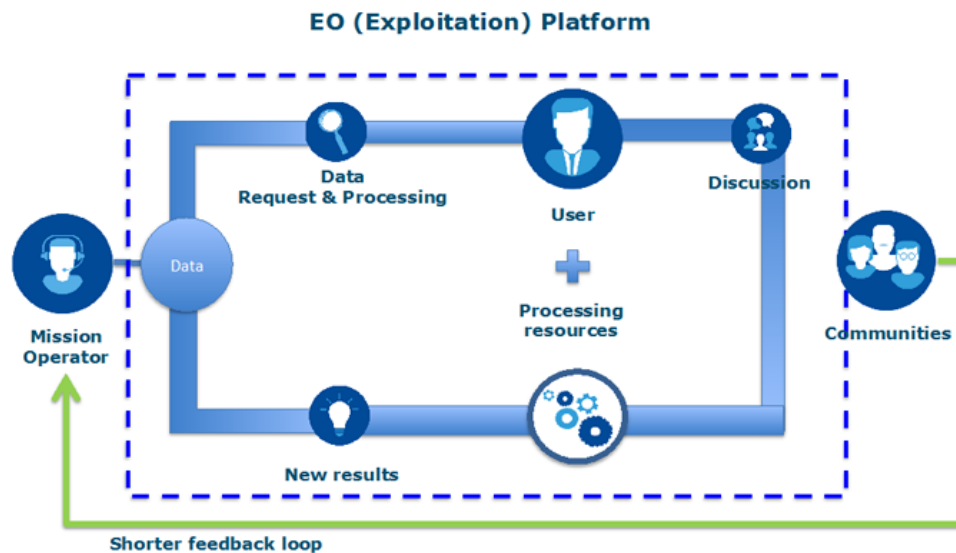


Figure 2: Earth Observation Platform

The ESA TEPs have been implemented according to the following principles:

- Develop and employ open-source and freeware to the maximum extent possible – to ensure reuse, avoid vendor lock-in, contain costs, and ensure openness
- Implement standards– to ensure interoperability
- Implement infrastructure independence– to ensure cost-effective infrastructure sourcing, avoid vendor lock-in, and allow reuse of public and commercially available ICT
- Implement pay-per-use– to avoid capital investment, contain costs, and allow for cost-sharing
- Cater also to commercial providers – to allow (affordable) access to commercial software, data and infrastructure when required
- Secure IPR– to ensure that users retain their intellectual property rights
- Be Community and impact driven– to benefit from solid participation of the scientific and application communities, to ensure user buy-in
- Enable sustainability –to propose funding and revenue models and sources to maximize the probability of economic sustainability of the platforms in their operations phase.
- Facilitate knowledge sharing – to offer, via the provision of collaborative tools, the possibility to share data, and algorithms and experiment with other users of the platform or publicly on the web.

### 3.1.2 openEO platform

openEO platform was also developed by ESA and is built upon openEO. It provides programming libraries (R, Python, JavaScript and other clients) and enables the processing of significant Earth Observation data volumes. To promote a smooth operation of the platform regardless of the size of



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the project (whether it is research or a large-scale project), the workload is distributed on multiple infrastructures.

The objective of this project, which began in September 2020, was to fully support and promote openEO to production. EODC (lead), EGI, EURAC, GEO, Sinergise, VITO, and WWU Münster, are the project partners. All partners contributed to the management and software development of EO cloud processing platforms, with VITO, Sinergise, and EODC having a pivotal role in developing the platforms.

The technologies integrated with openEO API to create openEO platform are summarised as follows:

- Terrascope, the Belgian processing infrastructure for Copernicus and PROBA-V data,
- Sentinel Hub, the most advanced on-the-fly satellite data processing engine handling more than one hundred million requests every month, and its future evolution,
- Data Cube Facility Services, and
- EODCs cloud infrastructure and HPC experience

OpenEO platform aims to compensate for the needs of all kinds of users, from remote sensing researchers to software developers. Front-end services along with back-end services are offered to the users with a variety of tools. JupyterLab is proposed for researchers, while R is available for R users and developers can employ their IDE. All necessary libraries (Python, R, JavaScript) are integrated to facilitate the use of the services provided. An overview of the openEO platform is provided in Figure 3

Following the rationale of most ESA's platforms, the user community is supported and user engagement is highly recommended. Actions such as sharing their open-source code, participating in the user forums, or placing user work on a marketplace, are promoted. Data fusion, including Earth observation datasets in raster format, along with data in other formats, is also available through the use of Machine learning (ML) and artificial intelligence (AI) methods. For this purpose, libraries such as Tensorflow will be integrated. In addition, Data Cubes will be upgraded to serve not only as a visualisation tool but to enable ad-hoc analysis of the products.

The openEO platform services are available upon request that demands approval. OpenEO platform services are free for early adopters (90 days trial) and for a 30 days trial to browse the services. For non-ESA projects, there is a limited funding of 5.000 euros, upon request.



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Figure 3: Overview of openEO platform

### 3.2 Copernicus platforms

The European Commission developed five platforms known as DIAS (Data and Information Access Services), to enable access to Copernicus data and information. Through these platforms, Copernicus Sentinel data, along with processing tools. In addition, another Copernicus project is C-SCALE which employs DIAS, the national Collaborative Ground Segments and EOSC, to create an open source Big (Copernicus) Data Analytics platform.

#### 3.2.1 DIAS analysis

This task also aims to investigate the deployment of the Regional Exploitation Platform to Copernicus Data Information Access Services (DIAS) providers. An analysis of the various DIAS providers has been conducted and is presented herein. The analysis includes each platform, Data Access, Infrastructure, Cloud Computing, Software and other Cloud Services.

DIAS (Data and Information access services) are cloud-based platforms developed to assist and standardise access to Copernicus data and information. The European Commission has launched an initiative to facilitate access to Copernicus data and information services. DIAS was designed to improve users’ ability to access as well as process Copernicus data and information by standardizing access to data through five cloud-based platforms:

- Sobloo: <https://sobloo.eu/>



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- ONDA: <https://www.onda-dias.eu/cms/>
- Mundi: <https://mundiwebseervices.com/>
- CREODIAS: <https://creodias.eu/>
- WEKEO: <https://www.wekeo.eu/>

The platforms provide access to entire Sentinel data archives and to Copernicus operational Services outputs, while they also host specific applications and tools. These systems provide open EO data from the Copernicus program through standard web services and protocols such as OpenSearch, WFS, WMS, WCS and CSW. Moreover, DIAS allows users to work with cloud computing infrastructure for on-demand processing to store and process EO datasets, as well as to directly access these datasets. (Gomes, et. al. 2020). Undoubtedly, DIAS provides an ideal development environment for third parties to generate higher level outputs and services, for commercial exploitation, as DIAS teams offer various degrees of support, access to additional data, shared business, etc. Only self-sustained DIAS will continue as fully commercial instances after 2021.

All five DIAS online platforms provide a cloud-based access point for all Copernicus satellite data and information from the six Copernicus services; as well, the platforms also give access to sophisticated processing tools and resources. Data is available through the web portals operated by the various Copernicus service lines:

- Land-related data: <https://land.copernicus.eu/>
- Atmosphere-related data: <https://atmosphere.copernicus.eu/>
- Marine-related data: <https://marine.copernicus.eu/>
- Emergency-related data: <https://emergency.copernicus.eu/>
- Climate change-related data: <https://climate.copernicus.eu/>
- Copernicus Security Service data: <http://copernicus.eu/main/security>

In regards to the technical capabilities that DIAS offer, it is worthwhile mentioning that DIAS provides an interface to find what is available on it, provides Object storage that accesses copies of the ESA's scihub archive, and provides the possibility to select and configure cloud resources for processing, contributes to configurable processing to run in "front end" or "backend", as well as provides technical support for IT infrastructure and EO specific issues. Regarding cloud computing resources, DIAS users can set up and configure virtual (or dedicated) machines to perform computing and access data via a web interface, OpenStack API, or with the technical support of the DIAS provider. DIAS users can get access to configurable CPU, RAM, disks, object storage, network setup, etc., can access machines via ssh, or configured Linux images with pre-installed required software tools, that all DIAS can provide.

Table A1 (Annex) is an endeavour to analyse the different current DIAS provisions by collecting information from each DIAS website, from the DIASs analysis created in August 2020 in the context of the e-shape H2020 project and the analysis created in September 2021 in the context of ENVISION H2020 project, in which NOA is a partner.



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### 3.2.1.1 CREODIAS<sup>1</sup>

Creodias started as a consortium of CloudFerro, Wroclaw Institute of Spatial Information and Artificial Intelligence (WIZIPISI), Geomatys, Eversis and Sinergise, aiming at serving and processing large amounts of EO data. The Creodias platform (Figure 4) serves currently more than 21 PB of Earth Observation data with daily ingestion of approximately 25 TB including all missions of Sentinels, Landsat 5, 7 and 8, Envisat and others such as DEM, Jason-3 and Copernicus Services, whereas at the same time it provides a big-data enabled OpenStack cloud platform for processing this massive amount of data. Therefore, users have the potential to build their services from scratch by exploiting the instant access to the data via a series of interfaces such as S3 object interface.

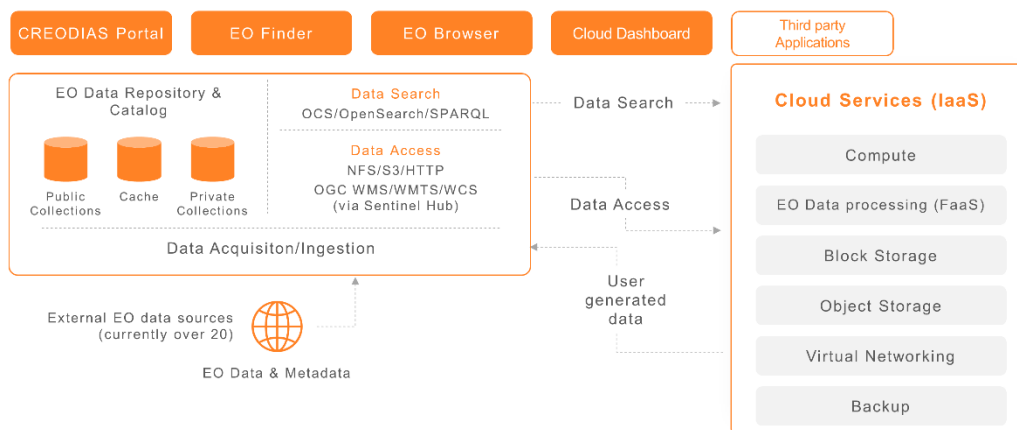


Figure 4: CREODIAS platform

In terms of processing, CREODIAS offers several types of machines, such as VMs, Dedicated Server VMs and Bare Metal Dedicated Server Machines. Users can define different parameters and characteristics, including machine type (physical or virtual), RAM, CPU (vCores), storage quantity and type, operating System, middleware components, Virtual Networks connected to the machine. These combinations are provided by the available flavours. For example, the flavour eo2a.5xlarge comes with 64 virtual cores, 256 GB or RAM and 1024 GB of SSD network storage. There are also machines equipped with GPU (GeForce RTX 2080TI). In addition, network access, administrative permissions, live back functionality, possibility to start, stop, reboot, pause, suspend and snapshot the machine are provided to the users. Moreover, a dedicated dashboard is available so the users set up the provided infrastructure. Sen4CAP software also comes as a ready to use solution on CREODIAS and is available as an easy-to-run image. CREODIAS provides a wide range of data, by which applications related to multiple sectors such as marine, epidemiology, geology, weather and smart cities can be developed. Furthermore, as CREODIAS provided all collections of products from Copernicus Services,

<sup>1</sup> <https://creodias.eu/>



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it may also be used for the development of services for monitoring water resources or land and agriculture monitoring.

### 3.2.1.2 Mundi DIAS<sup>2</sup>

Mundi consortium consists of ATOS, T-System, ThalesAlenia Space, DLR, e-geos, EOX, GAFAG, Synergise and Spacemetric. Mundi is considered a cloud-based one-stop shop for designing and deploying EO services. It provides a scalable computing and storage environment (Figure 5), while it allows third parties to offer advanced value-adding services. Regarding the data offering, Mundi provides a three-tier layer for object storage; standard object storage for ongoing analyses, a cold one for cost-efficient long-term archiving and a warm one, between both – optimal for data that is regularly processed, but not very often. These layers are offered either in block level storage capacities (Elastic Volume Service -EVS) or Object Storage Service. Data collection includes Sentinel 1,2,3 and 5P data, Landsat 7-8, Copernicus services data and non-EO data such as IoT (via internet and satellite), DEM and weather data. Moving to the computation capabilities, Mundi can provide suitable flavours for the respective task such as high-performance flavours or GPU flavours leading to parallelization and distribution of tasks and workload. The basic flavour is the Elastic Cloud Servers with the most powerful of them having 32 vCPUS and 256 GB RAM. One additional asset for Mundi is the capability of displaying the developed service in a repository called Marketplace. The Mundi Marketplace acts as a showroom bringing to light the services and a potential increment of them via the access to Atos and Mundi go-to-market capabilities. Sentinel Hub, EO4Agri, Urban Green, Datacube Analytics by Rasdaman are among the services deployed in the Marketplace. Finally, Mundi aims to add Atos HPC-as-a-Service feature to the cloud.

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<sup>2</sup> <https://mundiwebservices.com/>



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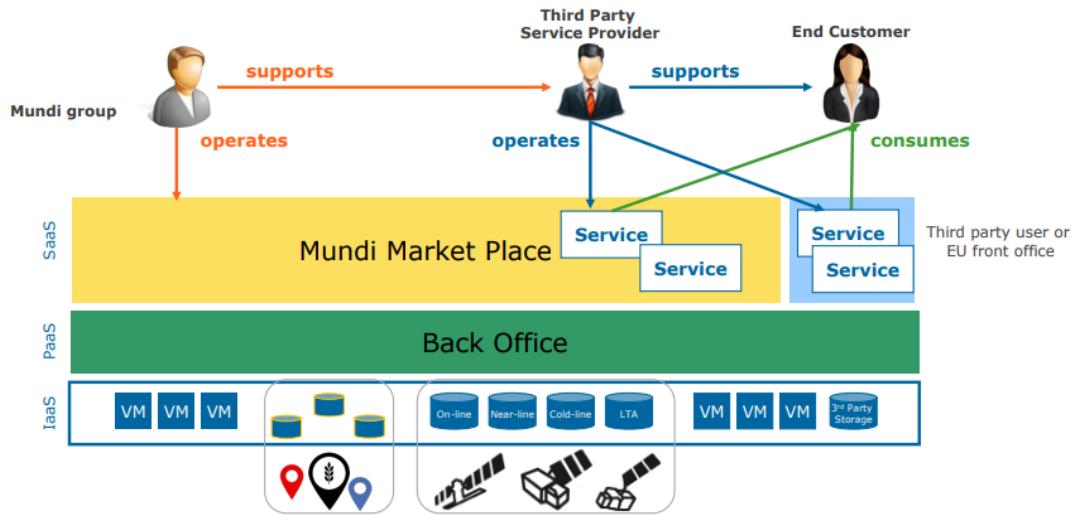


Figure 5: Mundi platform

### 3.2.1.3 WEKEO DIAS3

The most recent among the DIASs is WEKEO, implemented by EUMETSAT, ECMWF and MERCATOR OCEAN. The idea behind WEKEO is a collaborative platform between the three centres and the users. The main advantage of the WEKEO is the distributed technology regarding the data and the infrastructure (5). Three centres linked together reduce not only the costs, but also the consuming energy for the infrastructure. Moreover, this federative approach yields direct access to the most up-to-date data downloaded via a high-speed fibre without delay. Each new federated partner, such as National (e.g. CODE DE) or commercial entities benefit from WEKEO services, while all WEKEO users will also benefit from this addition as new data and service will be ingested. Except for Copernicus data, WEKEO also offers a large variety of state-of-the-art environmental data contributing to any environmental research. WEKEO provides virtual processing environments named with T-shirt sizes. For example, the strongest environment is L, which provides 128 vCPUs, 4 TB RAM and 2 GPUs. Currently, WEKEO successfully collaborates with European Environment Agency (EEA) providing certain services such as snow service or allowing access to CLMS data without duplication (VITO and EEA are connected to it). WEKEO supports and enhances the development of applications related to Maritime, Land Administration, Natural resources, Agriculture, Environment and Natural disasters.

<sup>3</sup> wekeo.eu



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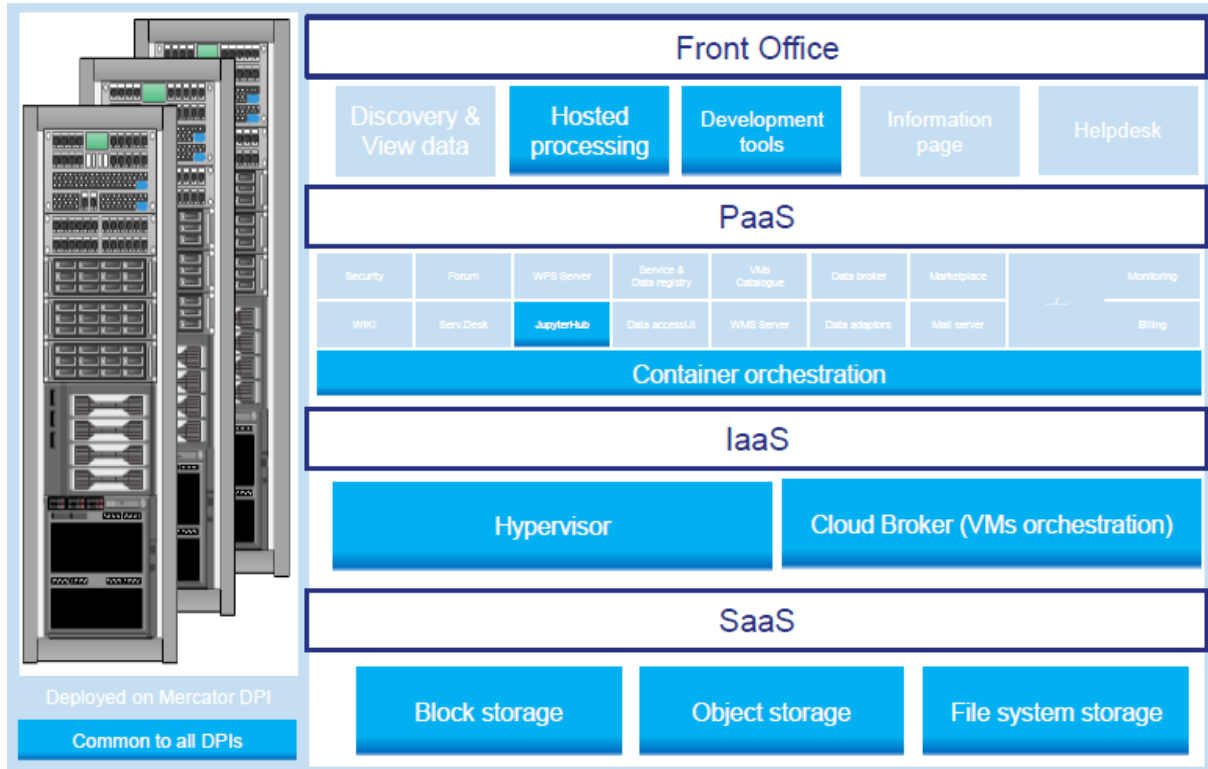


Figure 6: WEKEO platform

### 3.2.1.4 Sobloo<sup>4</sup>

Sobloo is run by Airbus, together with Orange (number one in France in cloud infrastructure), Capgemini, CLS and VITO. It provides virtual infrastructure with à la carte offerings, along with managed services by Sobloo teams including databases, operating systems and applications so to simplify the exploitation of the platform from the users. The architecture of Sobloo cloud platform is based on Flex Engine of which the services are depicted in Figure 7. Regarding data offer, Sobloo makes room for all Sentinel missions’ products, Copernicus services data, Muscate cloud masks (using MAJA) and data from Pleiades A/B and SPOT 6/7. The majority of data is stored online for nine months. Storage takes place in multiple ways; object storage, block storage, scalable file service and local storage. At the same time, Sobloo provides mobile data in the form of statistical indicators of attendance, origin and movement via Flux Vision of Orange's mobile network. In addition, soCAP, another thematic product hosted in Sobloo Market Place, delivers detailed satellite-derived crop analytics. Computing in Sobloo is based on various types of Elastic Cloud Servers from tiny flavours to Big-Data, GPU and high-performance flavours. For example, big data flavours are equipped with up to 48 vCPUs, 440 GB or RAM and 24x1.8 TB of temporary high-performance storage. Each of these machines can be scaled in terms of more powerful flavours and of numbers of VMs. In addition,

<sup>4</sup> <https://sobloo.eu/>



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Image Management Service give the potential for the creation of personalised images in order to easily deploy application and launch VMs from them. Sobloo also provides the capability of deploying pre-configured services such as Kubernetes, MapReduce, Kafka and Redis. All the aforementioned data and services can be offered either for a fixed period or by the hour.

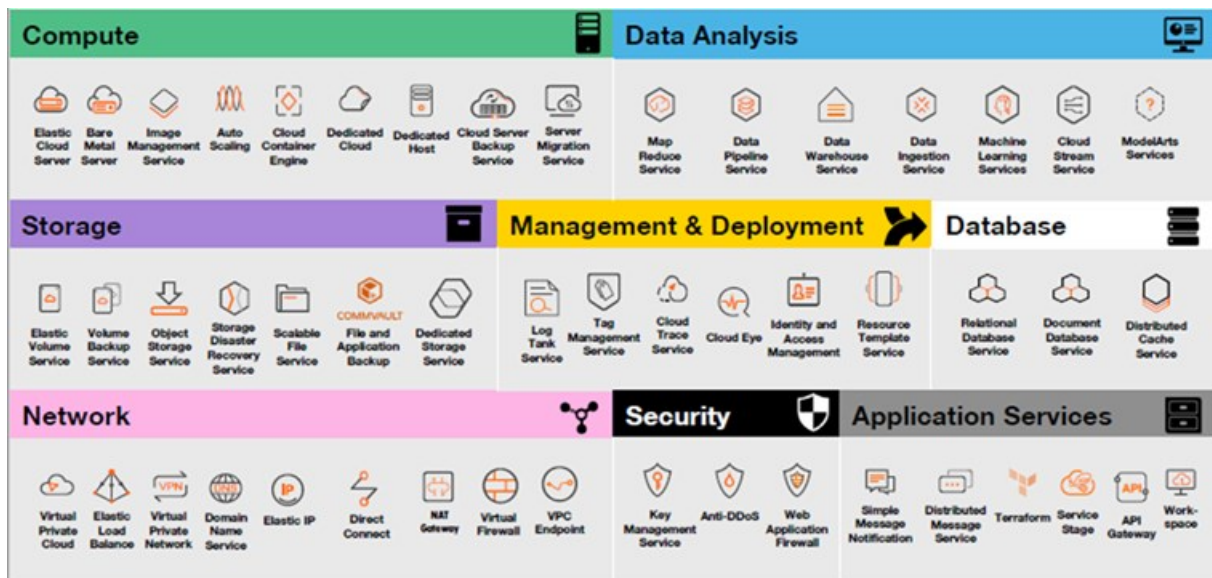


Figure 7: Flex Engine Services

### 3.2.1.5 ONDA DIAS<sup>5</sup>

ONDA (On Data) is the cloud platform developed by Serco Italia, OVH, Gael Systems and Sinergise, which enables users to have instant access to EO Data and build cloud applications. Currently, ONDA hosts more than 31 PB of EO data. This data includes all the Sentinel missions, Envisat, Landsat 8 and the CMEMS, CLMS and CAMS Copernicus Services, without any charge. In addition, the users can request commercial Very High Resolution (VHR) imagery. Data access can be achieved in two ways; the OData API and the Advanced API through Elastic Node Service. The first one is used to search and download products, whereas the second one is based on Network File System (NFS) access protocol and accessed only via ONDA VMs enabling the direct access of products without the need for a full download. ONDA provides several options for computing resources, from standard machines to high performance platforms and GPU solutions. Three storage volumes are provided; Classic, High Performance and Snapshot. ONDA also comes with ready-to-use EO tools such as Sen2cor, SNAP, QGIS, GDAL and Orfeo toolbox. Moreover, users can benefit from the ONDA Services. Among them, the Managed ONDA Storage (**MOST**) service, an archive as a service solution, offers private storage for accessing the massive amount of data in the ONDA Archive (Object Storage and/or Cloud Archive). Finally, a showcase section is available, on which users can advertise for free any service developed on the ONDA platform.

<sup>5</sup> <https://www.onda-dias.eu/cms/>



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### 3.2.2 Copernicus- EOSC Analytics Engine (C-SCALE)

C-SCALE is a Copernicus project, which aims to facilitate the use of Copernicus data by researchers, institutions and initiatives. All products and services are available on the cloud, enabling the integration of C-SCALE solutions with other European Open Science Cloud (EOSC) research. European data and infrastructure will be provided by Copernicus. EOSC services will be updated to ensure the operability of the platform with the new services provided.

The primary objective of C-SCALE (Figure 8) is to make Copernicus data and services available to a larger community through a more easily accessible environment for all types of users. The platform will enable a variable of services including not only data browsing but also the tools to process EO data. To successfully implement this project, Copernicus employed DIAS services, the national Collaborative Ground Segments and EOSC. Pan-European e-Infrastructures and existing project initiatives will be exploited to create an open-source Big (Copernicus) Data Analytics platform. Three dedicated services are offered to the users. First and foremost, access to a large archive of C-SCALE EO data. Second, processing services of EO data. Lastly, analytics are deployed on top of EO data and services.



Figure 8: C-SCALE’s principal concepts

Along with access to Copernicus EO data, infrastructure including HPC, cloud computing and storage is provided to the users.

Some supportive services that facilitate using the three principal services (data access, processing, analytics) will be mentioned.

- **Data Lookup Service – Metadata Query Service**

This service enables the user to have a quick look at the vast Copernicus data archive and an easy selection of the desired data, depending on the working project.

Also, the Metadata Query Service (MQS) implements a STAC API manage STAC-compliant queries for product availability. This service takes into consideration special characteristics of the products, e.g. geographical area, acquiring and retention policy, and product type, to correctly redirect queries only to sites that match the user’s searching criteria

- **Services and infrastructure**

As already mentioned, the C-SCALE project offers the users various services and infrastructure, including cloud resources, HPC/HTC systems. Access is granted based on membership of users to one



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of the supported communities, authentication and authorisation. The Principal Investigator (PI) is responsible for the members of his community and the use of C-SCALE services.

- **On demand seasonal drought forecast**

Seasonal drought forecast for a river basin is a service offered by C-SCLAE. The service includes access to data (ERA5 reanalysis and SEAS5 seasonal forecast). Processing of the data with the use of WFLOW hydrological model. Generation of a 50-member ensemble forecast. Visualization of the results in an interactive Jupyter Notebook. The service will be deployed on C-SCALE's HTC infrastructure.

### 3.3 Other Platforms

TEP and DIAS are two fully operational platforms developed by ESA and Copernicus. Along with these two platforms, numerous projects have been successfully implemented, providing the users (e.g. research, industry, and public users) with a variety of EO products and tools. The most complete, regarding the content of products and services and operational, will be analysed herein.

#### 3.3.1 CloudFerro

CloudFerro is a European company and a member of the European Open Science Cloud, which provides cloud services dedicated to research space activities. As a member of Copernicus Relays and with expertise in storing and processing big satellite data, the main objective of cloudFerro is to promote the Copernicus EO program. The available cloud solutions and services are customized based on the users' needs. Technical support is also provided to the users by experts in the field. Space Agencies and scientific institutions like the European Space Agency (ESA), the European Centre for Medium-Range Weather Forecasts (ECMWF), Mercator Ocean International, German Aerospace Centre (DLR), and the [EGI](#) are indicative clients of cloudFerro, along with numerous European universities.

CloudFerro's public clouds include computing resources, storage and technical support. However, private clouds are also offered, which provide higher security and independence compared to a public cloud option. Private clouds instead of the CloudFerro's data centres can often be set up to the client's preferred location, with the provision of equally technical and administrative support, by CloudFerro.

**CloudFerro EO services** are summarized as follows:

- **EO cloud services**

Two Copernicus DIAS platforms, CREODIAS and WEKEO DIAS operate on CloudFerro cloud. Also, CODE-DE (Copernicus Data and Exploitation Platform-Germany), the German Copernicus collaborative hub exploits CloudFerro services.

- **Data processing**



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CloudFerro provides four data processing options. Users can process EO data in a virtual machine or run their codes in a shared environment, where all necessary libraries are added. GIS users can benefit from the Sentinel Hub capabilities and access EO data through web coverage services. Finally, the option of processing in a computing cluster is available, where the user has the ability to process a large amount of EO data, saving time and resources. The installation of new processing algorithms by the users is also available.

- **Storage services**

EO data are stored in repositories. EO data from the Copernicus program and VHR (Very High Resolution) satellite data from China and Kazakhstan are stored in cloud.

### 3.3.2 SINERGISE

Sinergise provides cloud GIS services focused on agriculture and land administration, primarily in Europe and Africa. Annually, there is a large number of users that benefit from Sinergise's cloud services and the economic impact of the provided services in managing property and transactions is noticeable.

Sinergise's services are summarized as follows:

- **Remote Sensing and Machine Learning**

Access to EO data and processing via a cloud-based environment is available on the Sentinel Hub application. Land cover Monitoring System (LCMS) enables land cover and crop type classifications and change detection at a national scale using ML techniques. CAP Area Monitoring Marker Service provides agricultural markers like Similarity, Homogeneity, Bare Soil, Mowing and Harvesting, Land Cover, Crop Type, Minimum Agricultural Activity, Segmentation.

- **Agriculture related systems**

Farm Registry, Land Parcel Identification System (LPIS), on-the-spot controls, best agricultural policy (Giselle Farm Management tool), land consolidation, meliorations, disease outbreak, forestry are some services included in the agricultural related applications that Sinergise provides.

- **Real-estate management**

Sinergise provided a real estate management tool for the Surveying and Mapping Authority of the Republic of Slovenia, through a computer assisted mass appraisal software (CAMA).

- **Geopedia (a cloud-based crowd-sourcing GIS tool)**

Geopedia is a web-based application for searching, viewing, and editing geographical data, with services available to many clients simultaneously.

- **2D and 3D mapping engine**

Sinergise's clients are in the majority government institutions. The company was initially developed in Slovenia and recently expanded in Central and Western Europe and Africa. The company's services are provided in a long-term collaboration framework.



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### 3.3.3 SISTEMA-ADAM

The Advanced geospatial Data Management platform (ADAM) is a platform that provides access to an extensive archive of global environmental data. Visualization of daily updated data, along with API services to obtain global and local data are provided. AI tools are included for facilitating the processing of large data volumes. An overview of ADAM’s products is provided in Figure 9.

Name	Start	End
Air Temperature	1950-02-01	2100-12-31
Sea Level Anomalies	1993-02-15	2016-01-15
Sea Surface Temperature	1991-10-01	2011-01-31
Precipitation - Rain	2000-07-01	2021-02-21
Precipitation - Snow	2000-07-01	2021-02-21
True color images	2015-09-07	2021-04-02
Land Surface Temperature	2000-04-05	2021-02-17
Vegetation assessment	2000-02-01	2021-02-01
NO2 concentration	2018-05-30	2021-04-02

Figure 9: An overview of ADAM’s products

Apart from the rich environmental data archive, the platform offers on-the-fly processing in a Jupyter notebook environment. Depending on the client’s status (private users, public administrations, and insurance companies), micro-services focused on the client’s needs are provided. The products related to these services can be delivered via API’s or e-mail. The cost of the micro-service varies based on the project’s characteristics (no data, processing). Air quality monitoring service, vegetation status monitoring service and environmental parameters provision for critical infrastructures management is some indicative micro-services that ADAM platform offers.

### 3.3.4 e-GEOS

e-GEOS is one of the most advanced EO company that offers geospatial solutions in various sectors, including defence and intelligence, agriculture, emergency management, land and infrastructure monitoring, maritime and land surveillance services. In the above-mentioned fields e-GEOS, provides services accessible online, through dedicated platforms.

- SEonSE is the platform for maritime surveillance, oil spill and ship tracking services
- Braint provides defence and intelligence IMINT products
- AWARE focus on infrastructure monitoring and operation
- AgriGeo for agricultural and forestry services
- mapcy for natural disaster mapping
- GIC (Geo Information Centre) for geospatial analysis, based on existing e-GEOS platforms



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- CLEOS (Cloud Earth Observation Services) is the digital platform that enables the digital transformation of e-GEOS. e-GEOS is the official land exclusive distributor for the COSMO-SkyMed satellite data. e-GEOS services can be summarized as follows:
  - Radar and Optical data processing,
  - Orthoimage and GIS solutions,
  - SAR Interferometry
  - Analysis, Ground segment solutions for EO satellite missions
  - Geodesy
  - Cartography

The services offered by e-GEOS are available through CLEOS, a digital infrastructure that permits the clients to use the services and developers to develop their workflow and make use of advanced AI techniques to extract the necessary information. This approach favoured the development of the GeoHUB service, which combines Earth Observation and technological advancements.

### 3.3.5 VANTAGE

VANTAGE differs from other platforms as it provides a unique cloud service. It offers the ability to analyse videos from EO data in a cloud environment and extract valuable insights for their research or business projects. Access to Earth-i Vivid-X2, Sentinel and Landsat satellite data is offered to the users, along with the tools to process the videos. Services provided include the generation of 3D models and object detection. The philosophy of Vantage is based on the extreme value of a high-resolution, full-colour EO video to change detection activities. There are many advantages of EO videos compared to EO imagery. Object detection is enhanced with the use of AI and ML techniques. 3D models can be more accessible and more accurately generated. Cloud presence can be mitigated. A free demonstration of the platform is available to the users to have an overview of the services provided. VANTAGE has a partnership with Earth-i, [CGI](#) and ESA. Earth-i is a geospatial company that employs advanced AI techniques and Earth Observation data to produce advanced analytics. CGI is a company that provides EO services.

### 3.3.6 ELLIP

ELLIP is TERRADUE's cloud platform, where users can integrate and test scalable processing chains. The clients of ELLIP belong to industry, institutions and universities. ALTAMIRA, IAASARS, ESA, DLR, ECMWF, University of Valencia, INGV are some indicative users. The cost of the services varies depending on the client's use. The first billing plan for developers who aim to create an online application. The second plan is for clients who prefer to develop and deliver cloud applications. The third plan is dedicated to data producers, who access and run cloud applications. Terradue provides an Open-Source Center, with a large variety of software repositories, which are updated on GitHub, to build EO applications. The Open-Source Center includes:

- Shell, CSS, R, C# Repos
- Java Repos
- Javascript Repos
- Ruby Repos



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- Python Repos

Finally, the platform offers extensive documentation and a large community through the «Discuss@Terradue» discussion board for users’ support. ELLIP’s services are presented in Figure 10.

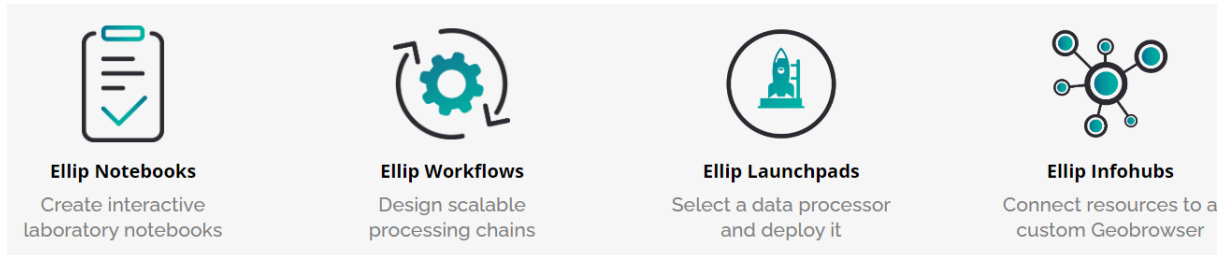


Figure 10: ELLIP’s services summary

### 3.3.7 Google Earth Engine

Google Earth Engine is a platform that enables geospatial analysis of EO datasets, dedicated to academic, business and governmental projects. A rich archive of satellite imagery in combination with geospatial datasets, provides a unique opportunity for researchers to monitor the Earth’s surface, detect changes and identify trends. Google Earth engine is commercial, except for academic and research use. Figure 11 briefly presents the imitative of this platform.

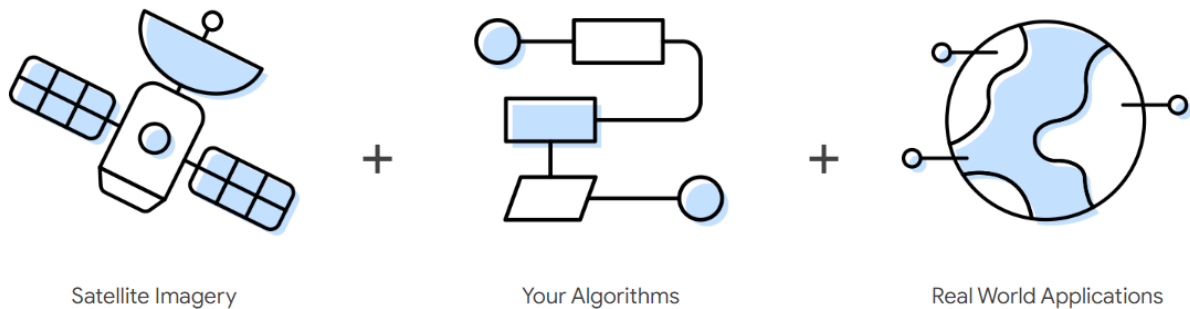


Figure 11: Google Earth Engine rationale. Source: <https://earthengine.google.com/>

Although Earth Engine provides a very rich archive of EO data and has similarities with Google Earth, the main difference lies in the ability to analyse geospatial data and extract valuable insights into how Earth’s surface evolves across time in terms of forest, water and land coverage, as well as data on the health of agricultural fields.

Among satellite imagery provided, Landsat and Sentinel-2 collections are available to Google Cloud Storage as part of the Google Cloud public data program. Data availability includes EROS (USGS/NASA) Landsat catalogue, numerous MODIS datasets, Sentinel-1 data, NAIP data, precipitation data, sea surface temperature data, CHIRPS climate data, and elevation data. The users can make a request for additional data.



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An important feature of the platform is the compatibility of the platform with various datasets. The user can import third-party data in raster or vector format, perform analysis and download the results locally to employ them with other third-party tools.

The Earth Engine platform is free of charge for non-commercial use; there is a pricing policy for commercial and operational applications. Technical support from other Earth Engine users and developers is provided. For commercial users advanced technical support is provided. Commercial cloud services are also provided to start-ups who are interested to use Earth Engine. Finally, Earth Engine training courses are provided to the users, who are notified via the Developers email list.



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Table 1: EO Platforms overview of the main features

#	STName	Registration	Usage	Potential users	Challenges	Costs
1	<a href="#">Geohazards TEP</a>	Same registration to all TEP platforms. Visitor Plan (browse public EO data collections, discover public processing jobs, access public community publications)	RS services for landslides, earthquakes, active fires, glacier analysis, Surface Temperature Mapping, DEM	Academic users Industry	The eo4alps-landslides project  Account upgrade -> candidate application for a member user or as a Stakeholder	Data processing services via Service Packs Three packages (Basic users 1200/year, Essentials 3000/year, Advanced 6000/year)
2	<a href="#">Urban TEP</a>	Sign in via ESA EO account	EO imagery and existing auxiliary data to measure and assess key properties of the urban environment and monitor the past and future spatiotemporal development of settlements.  Urban TEP communities  Development of your own processors	Academic users Industry Public users	Registration and sign-in page not working (error messages)  user interface not very responsive  not a user-friendly environment	Free of charge
3	<a href="#">Hydrology TEP</a>	Same registration to all TEP platforms	Access, process, upload, visualise, manipulate and compare hydrology data. Create flood frequency maps Create water level time series of small lakes and rivers. Generate water masks within your area of interest. Monitor key water quality parameters in high temporal and spatial resolution.  Gain insights into ecological status, dynamics and trends of inland and marine	For scientific users, river basin organisations and service providers	TBC	Free account to test the Geobrowser and discover public data collections and shared job results on Hydrology TEP. Self-managed processing, Customised processing, Additional Advanced Services and User Support for Monthly Subscriptions monthly charged



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#	STName	Registration	Usage	Potential users	Challenges	Costs
4	<a href="#">Coastal TEP</a>	Registration form	Data access service to improve data-intensive research into dynamic coastal areas.	Maritime research and industry sectors users	Process and manage large volumes of coastal data. Available over 20 years EO data, near real time EO data non-space data and multi-sensor processing tools. Extract temporal and spatial information and perform statistical analysis.	Free and premium subscription packages with different levels of service based on user's processing needs.
5	<a href="#">Forestry TEP</a>	Subscriptions are managed on a monthly basis and renewed automatically.	A platform to improve forest management while ensuring sustainability and carbon sequestration.	Commercial, research and public sector users	Work with satellite data online, share outputs and collaborate. Users can reach new customers globally. Gain benefit from the community-developed tools and access timely information to support forest management, reporting and decision-making.	Basic, Standard and Premium packages. 30 days free trial. Discount of 5% on 12 month contracts, 10% on 24 month contracts. Additional 10% discount for academic users.
6	<a href="#">Polar TEP</a>	Simple registration form	Developing tools to model, understand and monitor climate changes, to better predict and mitigate the resulting global economic and environmental consequences.	Research scientists, industry, operational service providers, regional authorities.	Complete working environment for users to access algorithms and data remotely. Providing computing resources and tools to manage large volumes of data. Machine Learning Environment, Processor Development Environment, Processor Execution Environment, Application Hosting Environment, Polar Data Management Support Service, Processor Integration Support Service, Additional Data Storage	Different economic plans based on the type of use and the required resources.
7	<a href="#">Food Security TEP</a>	Simple registration form	Increase efficiency of agricultural production on farm level in Europe and Africa.	Small-scale farmers, agricultural	Three pilot programs 1. Crop monitoring, derivation of advanced biophysical parameters, yield	General Platform Services  Platform User



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#	STName	Registration	Usage	Potential users	Challenges	Costs
				industry, public science, finance and insurance sector, local and national administration, international agencies	<p>predictions (Europe, Africa)</p> <p>2. Improvement of financial services for farmers in Africa</p> <p>3. Developing satellite EO aquaculture applications for the coastal region of Tanzania, Africa.</p>	<p>Subscriptions</p> <p>Algorithm Integration Services</p>
8	<a href="#">Google Earth Engine (GEE)</a>	Login with a Google Account that's been enabled for Earth Engine access	A computing platform that allows users to run geospatial analysis on Google's infrastructure	Academic users Industry	<p>Climate and Weather. Surface Temperature. Climate. Atmospheric. Weather. Imagery (Landsat, Sentinel, MODIS, High-resolution Imagery). Geophysical (Terrain, Land-cover, Cropland, Other geophysical data)</p> <p>GEE will be available to a limited set of Google Cloud customers and use cases while in Preview. GEE enables businesses around the world to easily access, compute and visualize open earth and geospatial data at scale, which can help your organization tackle unique business challenges.</p>	Academic and research use remains free.
9	<a href="#">SISTEMA - ADAM platform</a>	Simple registration form	Climatelynx, Air Quality Monitoring, Land Use / Land Cover, Forest Monitoring and Modeling, Landslides and Floodings with SAR, Fire Detection, Solar Irradiance Monitoring Service, DataCube, Climate screening of developing projects	Whoever needs data for climate screening, Developers, Academic users, Institutions	Landslides and Floodings with SAR (Page not found error) fonts are faint (make it difficult for users to distinguish categories and services) Also other services do not have sufficient information and we pages	free



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#	STName	Registration	Usage	Potential users	Challenges	Costs
			World bank uses the data from SISTEMA at the moment			
10	<a href="#">ELLIP</a>	Same registration to all TEP platforms	Build, deploy and monitor data processing pipelines	Academic users Industry	some webpages not working	Three plans specifically purposed for value co-creation, plus a plan for tailor-made operating level agreements with providers
11	<a href="#">Cloudferro</a>	contact form	CREODIAS (Public cloud with an integrated repository of satellite images from Copernicus program.) cloud computing services with a focus on big data sets.	Academic users Industry	Our major environments are hybrid solutions combining the advantages of private and public clouds. We readily take part in projects funded by external programs, such as H2020, Horizon Europe, business incubators, ESA programs, and others.	Flexible billing models (long-term cooperation), Discounts for science, External fundings
12	<a href="#">E-GEOS</a> <a href="#">CLEOS</a> <a href="#">Digital market place</a>	registration with VAT information	Processing services: Radar Multi-Temporal Coherence (MTC), Radar Geocoding, Radar Pre-processing	Academic users Industry	not user friendly	cost per product
			Data: Copernicus Land - HRL Forest, HRL Grassland, HRL Imperviousness, Natura2000, Riparian Zones, Urban Atlas, Land Cover, Surface Water, CORINE Land Cover, EUDEM, SRTM30, HRL Water/Wetness			
13	<a href="#">SYNERGISE</a>		GIS company building large turn-key geospatial systems in the fields of cloud GIS, agriculture and real-estate administration. Remote sensing and Machine Learning, Agriculture, Real-estate, GIS tools	Governmental institutions Non-government organizations Private companies	Cooperation with several research projects focused on automatic satellite imagery processing, change detection, agriculture monitoring, disaster response and more. GIS tools which can either run	



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#	STName	Registration	Usage	Potential users	Challenges	Costs
				Individual users	as standalone products or can be integrated into larger projects. They range from processor intensive procedures such as image processing to web-based GIS clients capable of crowdsourcing.	
14	<a href="#">VANTAGE</a>	Log in via Google mail	A cloud-based online environment where users can analyse videos acquired from EO satellites, and extract value. It offers an archive of videos acquired from satellites, including Earth-i Vivid-X2, Sentinel and Landsat. Rich repository of tools to process these videos and extract value.	Academia Industry	EO Video provides several advantages over still imagery, for example: It enables faster and more accurate object recognition using AI and machine learning; It enables 3D models to be created to much higher precision than from a single stereo pair; It provides more contextual information to analysts and researchers, by capturing movement	Free open products and commercial
15	<a href="#">OpenEO platform</a>	Currently, openEO Platform is only open for Early Adopters or within a free 30-day trial period. Approval is required	Data cubes, Editor, JavaScript, Jupyter Lab, Python, R	Academia Industry	openEO platform provides intuitive programming libraries to process a wide variety of earth observation datasets.	Free trial or become an early adopter for running larger use cases.
16	<a href="#">EoSC Analytics engine</a>	Access is controlled via authentication and authorisation solutions compatible with the EOSC AAI. Access is granted based on membership of users to one of the	The project offers access to compute and storage resources hosting Copernicus data, compute platform services supporting Earth Observation data analytics, data management services and related user support and training.	Academia	The purpose of the open call is to facilitate co-designing the C-SCALE federation with the scientific community, to ensure that the e-infrastructure implementation is aligned with end-user needs. C-SCALE aims to offer access to infrastructure and platform services, dedicated user support and training.	



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#	STName	Registration	Usage	Potential users	Challenges	Costs
		supported communities.			Selected use cases will collaborate with the C-SCALE platform providers to deploy their applications, thereby helping us to identify the needs and requirements of the end-users to improve and refine aspects of the overall C-SCALE service portfolio.	
17	<a href="#">Sobloo DIAS</a>	Simple registration form	Harmonised data access, cloud infrastructure and expert user support	All type of users		Commercial offer of dedicated virtual machines or request the pay-per-use plan that fits best.
18	<a href="#">WEKEO DIAS</a>	Simple registration form	Harmonised data access, cloud infrastructure and expert user support, Environmental data, virtual processing environments and skilled user support.	All type of users	User friendly. Data browsing similar to the GEP platform	Free to access and transform data Commercial offer of dedicated virtual machines or request the pay-per-use plan
19	<a href="#">CreoDIAS</a>	Two steps registration process. Personal information and client type: business or individual. Additional billing information such as company name, VAT ID, address etc. – depending on the type of user you selected.	A seamless environment that brings processing to EO data. Mundi contains most of Sentinel data and Services, Envisat and ESA/Landsat data and other EODATA. Its design allows Third Party Users to prototype and build their own value-added services and products.	Academic users Industry	Computing services, Storage, Data related services, Virtual networking services, Security services	Free trial Costs Per usage (per hour) prepaid mode where services are billed according to every hour used. Fixed term (long term), Revenue sharing mode Discount policy



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#	STName	Registration	Usage	Potential users	Challenges	Costs
20	<a href="#">ONDA DIAS</a>	Simple registration form	ONDA is a platform enabling users to host data and to build their applications in the Cloud, by fostering exploitation of freely available EO satellites Data and geospatial Information and by providing Access to Services for the development of new solutions.	Academia	Could Resources, Data-Access, Managed-Services, Tools	We provide open and free access to a huge volume of geospatial products and information
21	<a href="#">Mundi DIAS</a>	Simple registration form	Mundi integrates a large scope of earth observation and non-EO data.	Academic users Industry	The collection is regularly enriched to offer all material to build and operate your service.	Free access to full Sentinel and Landsat data. As a data provider, someone can add their own data collection to Mundi, and monetize it.



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## 4. CONCLUSIONS

This report aimed to collect all available information about existing and operating platforms and create an extensive summary, to provide valuable insights and guidelines for the exploitation of ECOE's products and services. The analysis of available remote sensing services led to a rich archive of useful knowledge and research innovations, web services and infrastructure, detected limitations, malfunctions, research gaps, and future needs. All of the information is extremely valuable as it assists ECoE in carefully evaluating its services in terms of innovation, capacity, scientific soundness and computational efficiency. The identification of ECoE's noticeable advantage compared to other platforms, but also its deficiencies, will help ECoE to evolve and improve its products.

The development or use of an online platform will be useful for the creation of a EMMENA Exploitation Platform. ECoE's research activities cover a wide range remote sensing application, including natural hazards, agricultural monitoring etc. Moreover, ECoE's infrastructure will be able to support efficient handling of big earth observation data.

Considering the abundance of EO platforms, there will likely be an overlap of the provided services and products by ECoE, with the existing services and products on the market. The main and primary objective of ECoE is to offer to the users, services tailored to the region and that are innovative or additional to existing EO services. ECoE could offer services that will be valuable to research institutes, governments or end-users for EO visualization. Also, the cost of such platform development, juxtaposed with the provided EO services and products, is another important parameter to be considered.

Based on the detailed analysis performed on existing online platforms and on the steps ECoE should follow for efficient management and promotion of its products and services, we recommend the following actions:

Through the analysis of the existing platforms above, a first selection of the platforms that could serve the objectives of ECoE, was performed. [Geohazards TEP](#) is the primary platform that follows ECoE's research interests and some services, such as P-PSI, fire risk prediction and landslides risk assessment, could be deployed. [Food Security TEP](#) could also be used for deploying algorithms from ECoE's agricultural managing sector. Also, cloud services like openEO, DIAS and Google Earth Engine could also be used by ECoE. Taking into serious consideration the challenges of creating and operating an online platform for cloud processing, the creation of an online EO platform where ECoE's products will be available for visualization and advanced services will be offered to dedicated users, upon contact and a form of contract is a possible suitable option, to present ECoE's work to the public, the research community and institutions.

**If existing platforms will be used**, ECoE should perform an extensive analysis on the products and services its domain has to offer and follow **the actions below**:

- Select those platforms that are offered to developers and institutions to deploy their own services and through those platforms make their services available to the public
- Make a careful plan of the` costs
- Contact the platforms that meet ECOE's criteria



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- Deploy those services that are unique and serve the needs and gaps of the research community
- Create a collaboration plan with the selected platforms
- Plan the upgrade of the provided services
- Decide the terms of use and the type of users
- Decide the time period of the provided services

Through the availability of such platforms, during the next few years ECoE will be able to examine the possibility to use or develop different components of the EO platform as a means to access EO data in the EMMENA region. The market evolution of such information access services can aid significantly in the development of ECoE's regional exploitation platform.



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## ANNEX I

Table 2: DIAS Analysis

	ONDA	WEKEO	Sobloo	CreoDIAS	Mundi
<b>URL</b>	<a href="https://www.onda-dias.eu/">https://www.onda-dias.eu/</a>	<a href="https://www.wekeo.eu/">https://www.wekeo.eu/</a>	<a href="https://sobloo.eu/">https://sobloo.eu/</a>	<a href="https://creodias.eu/">https://creodias.eu/</a>	<a href="https://mundiwebservices.com/">https://mundiwebservices.com/</a>
<b>Partners</b>	OVH cloud, GAEL Systems, Sinergise	Eumetsat, ECMWF, Mercator Ocean	Airbus, Orange, Capgemini, CLS, Vito	CloudFerro, WIZIPISI, Geomatys, Eversis and Sinergise	ATOS, Thales Alenia Space, TSystems, DLR, egeos, EOX, GAFAG, Sinergise, Space
<b>Data Repositories</b>	Landsat 8, ENVISAT, KOMSAT, Deimos-2, VHR Optical, Sentinel-1 (Data older than 3 month is on the archive except All SLC products over Europe are available for immediate download), 2 (Data older than 3 month is on the Onda archive), 3 (Data older than 3 month is on the Onda archive) and 5-P (Full Archive)	ERA5, Sentinel-1, 2, 3 and 5-P with processing L1 to L4	Muscate (Land Monitoring), SPOT 6/7, Pleiades A and B (VHR), Sentinel-1, 2, 3 and 5-P (Previous 9 months Global coverage in local storage. Older data in the catalogue)	Sentinel-1, 2, 3 and 5-P (Most Sentinel products available in full archive), Landsat 5, 7, 8, Envisat, RapidEye, Planet Score, SMOS, SRTM, Jason-3, VHRR, DEM	Landsat 7 and 8, Sentinel-1 (dedicated ONLINE availability and coverage), 2 (complete collection), 3 (complete collection, with ONLINE data on-demand only) and 5-P (three types of timeliness: near real time, Offline and reprocessed)



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	ONDA	WEKEO	Sobloo	CreoDIAS	Mundi
<b>Copernicus Services/EO Applications</b>	CMEMS, CLMS, CAMS, Marketplace for users to promote their solutions	CMEMS, CLMS, CAMS, C3S, CEMS, EO Workbench for interactive applications like SNAP, Panoply and non-interactive like NDVI and RGB generation	CMEMS, CLMS, CEMS, CAMS, C3S, change detection algorithms, GeoRice, GeoFire, CNES LAI	CMEMS, CLMS, CEMS, CAMS, EO Finder, EO Browser Sentinel-Hub, SPARQL Interface	CLMS, CEMS, CAMS, CMEMS, C3S, Geosigweb Land Consumption, Grassland Monitoting Egeos, Keystone Copernicus Data Hub, Eo4WildLife etc.
<b>Services for developers/ Data Access Service/ Web services and APIs</b>	<p>OData – Open Data Protocol to query directly in the catalogue for data search, view, download</p> <p>Advanced API accessing any low level component of the product through Elastic Node Server</p> <p>OGC (WMS, WCS, WPS)</p>	<p>Discovery API (OpenSearch), Harmonised Data Access UI &amp; API, EO PaaS, Jupyter Hub, self-provisioning of IaaS, PaaS from SDN, SDS, VMs, Docker, K8S.</p>	<p>OpenSearch, API offer to OGC compatible Web Services (WMS, WFS, WMST, WCS, CSW) Access to more than 150 pre-packaged apps: ETCD, Redis, Kafka, RabbitMQ, ELK, etc., S3 (AWS, GCS Standard)</p>	<p>Discovery API, OpenSearch, OGC C-SW web service (WMS, WMS Time, WMTS, WFS, WCS), INSPIRE Compliance, S3 (AWS, GCS Standard)</p>	<p>Jupyter Note Book, Discovery API, Geodata Access UI, Open search API, OGCSW API, Download API, S3 Protocol, Reload Manager, INSPIRE Compliance, OGC (WMS, WMTS, WCS, WPS)</p>



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	ONDA	WEKEO	Sobloo	CreoDIAS	Mundi
<b>Basic Software: Client framework and EO Processing Tools</b>	GDAL, SNAP, Orfeo Libraries, QGIS, GCC, ESA Toolboxes, Anaconda/Jupyter, Jupyter Notebook, Ubuntu, Debian, CentOS, Open Source software tools in pre-configured virtual environments for data processing, software development, dissemination of value added products and administration of front-end service.	GDAL, SNAP, Orfeo Toolbox, QGIS Panoply, Monteverdi, s3rgb, Jupyter Hub, Jupyter Notebook, Ubuntu, Openstack, CntOS	GDAL, ESA Snap, BRAT, OTB, Sen2Cor, Orfeo Toolbox, GIS solution: QGIS, Eclipse Neon with C, C++, Java, Python, scilab, GNU Octave, Snaphu, Jupyter Notebook, Rstudio, Kubernetes	GDAL, Snap, sen2cor, Orfeo Toolbox, QGIS, Geoserver, Kubernetes, ArcGIS, QGIS, FWTools, MapServer, Python with GDAL, Mapnik, Geoserver, Batch Processing System, Jupyter Hub, Linux, Ubuntu	GDAL, SNAP Toolbox, Orfeo Toolbox (OTB), Jupyter Notebook, Linux



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	ONDA	WEKEO	Sobloo	CreoDIAS	Mundi
<b>Types of commercial offers</b>	<ul style="list-style-type: none"> <li>Pay-per-use (hourly)</li> <li>Subscription (monthly)</li> </ul>	<ul style="list-style-type: none"> <li>Pay-per-use</li> <li>Package offer based on T-Shirt sizes for project sizes (XS, D, S, M, L).</li> </ul> <p>Free offer for data discovery, Jupyter Notebooks and support.</p> <p>7 progressive Packages to add PAAS Services from 66 Euros/month</p>	<ul style="list-style-type: none"> <li>Pay-per-use</li> <li>Package offer</li> </ul>	<ul style="list-style-type: none"> <li>Pay-per-use</li> <li>Fixed term pricing billing models</li> <li>Revenue sharing mode</li> </ul> <p>Pricing based on : VM flavor units and storage space (In/Out operations and traffic are free of charge)</p>	<ul style="list-style-type: none"> <li>Pay-per-use - Applicable to VM (VCPU, NVGPU), all storage component, network and services</li> <li>Package offer - From 30 to 60% off from 12 to 36 months subscription</li> </ul> <p>Free offer for Discovery: Free data, Sandbox, Free Tools, Mundi Helpdesk</p> <p>Customized pricing: Free Data + Data collection from partners, Cloud IaaS; Free Tools + Advanced Tools (PaaS); Mundi Helpdesk + Marketplace Biz Accelerator + Extended support</p>