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Abstract: This document presents the second version of the EarthSelf Service Portal related to the Deliverable 4.3 of WP4 EarthSelf Service Set Up.

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***** Nature of the Deliverable:***	*R= Report, DEM= Demonstrator, Pilot, Prototype, DEC= Websites, patent fillings, videos, etc., OTHER= Other, ETHICS= Ethics requirement, ORDP= Open Research Data Pilot, DATA= datasets, microdata, etc.*

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31/03/2021	1.3	2nd internal review	isardSAT, CERTH
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Glossary

CPU	Computing Power Unit
DoA	Description of Action
EO	Earth Observation
GA	Grant Agreement
GDPR	General Data Protection Regulation
IaaS	Infrastructure as a Service
KaaS	Kubernetes as a Service
KPI	Key Performance Indicator
RAM	Random Access Memory
SO	Smart Objective
SSO	Single Sign On
VM	Virtual Machine
Waas	Workflow as a Service
WP	Work Package

Executive Summary

This document presents the second version of the EarthSelf Service Portal related to the Deliverable 4.3 of WP4 EarthSelf Service Set Up.

EarthSelf service Portal is intended to any business or user to create Earth Observation (EO) value-added services. Via this web Portal, they can create and deploy their cluster toward their own cloud provider. The EarthSelf portal offers them also a set of services, such as a cloud benchmarking service to help them to choose the suitable cloud provider and the helpdesk service to help them in the creation and deployment of their EO value-added services.

In relation with the DoA, this document mainly shows the result of the task T4.2 – Helpdesk Portal Development, aiming to develop the support activities access portal, which is the service user[1] interface.

All the technical information about the developed technological components of the EarthSelf Service Portal or interfaces is already described in detail in the submitted deliverables D4.1 [1].

This version of the document represents an upgrade of D4.2 [2] which has been updated with the following improvements (see more details in section 5 Differences in EarthSelf V2 compared with EarthSelf V1):

- Architecture and component evolution
- ONDA DIAS support
- The WaaS (Workflow as a Service) support
- Suggest Engine database extensions
- Migration of the development platform to production platform
- Updates and bug corrections in the EarthSelf portal
- EarthSignature integration

Three annexes have also been added in V2:

- Annex 1 – Suggest Engine JSON Configuration File Example
- Annex 2 – Suggest Engine API
- Annex 3 – Suggest Engine Algorithm

[1] Service Creator

1. Introduction

1.1 Purpose of the Document

This document, entitled “EarthSelf service Portal V2”, shows the results of all the work carried out within the “T4.2 Helpdesk Portal Development” task, aiming of the development of the support activities access portal, which is the service user[2] interface.

The following Figure 1 “EarthSelf overall architecture” is a reminder of the EarthSelf service technological components which were developed. For more detail, please refer to the D4.1 [1] which details the technical solution elaborated accordingly to the SnapEarth platform interfaces.

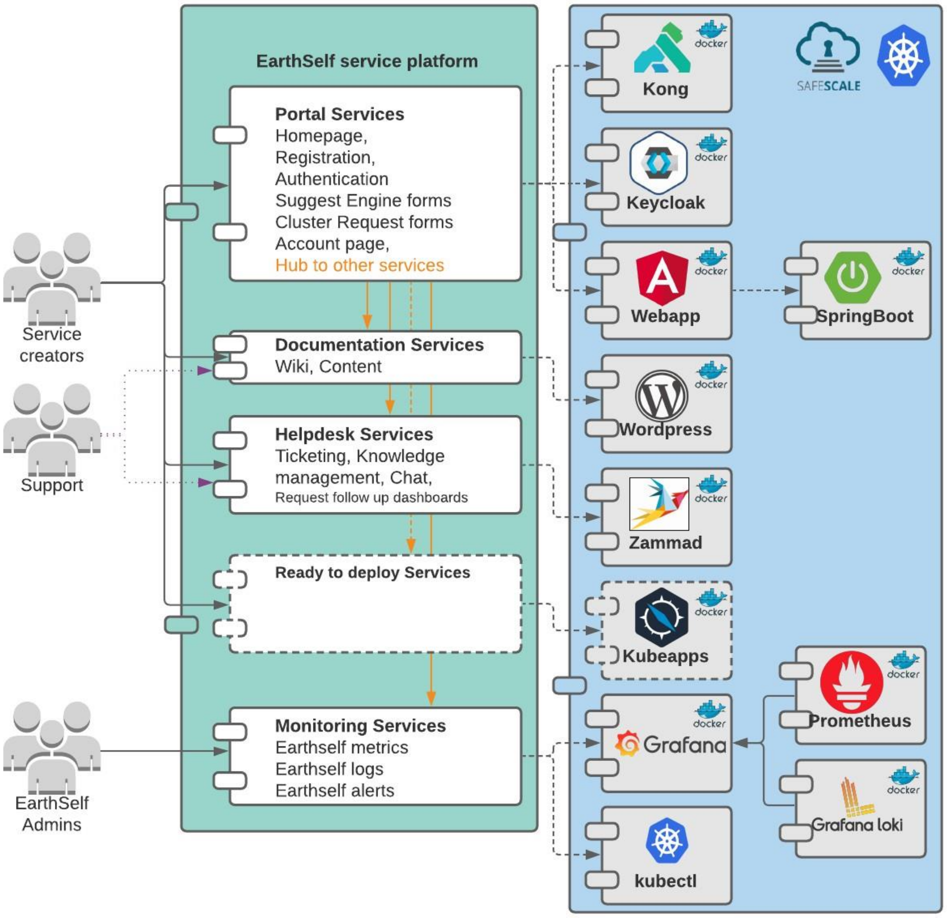


Figure 1 EarthSelf overall architecture

Based on this architecture, the status of the development in EarthSelf V2 compared to EarthSelf V1 is presented in section 5.1.

[2] Service Creator

To situate the EarthSelf service in relation to the other modules of the platform, please refer to Figure 2 SnapEarth platform architecture For more details please to refer to D3.1 [6] which describes all exposed interfaces.

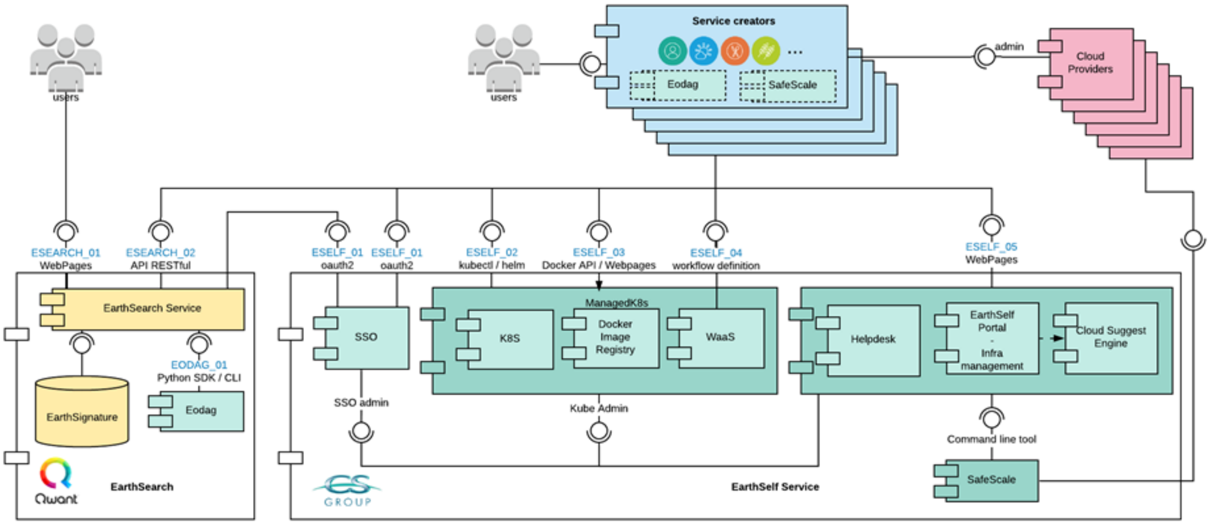


Figure 2 SnapEarth platform architecture

1.2 Link with the other deliverables

The following table explains how EarthSelf Service Portal is linked to the other deliverables.

Table 1: Link with the other deliverables

Deliverable	status	Explanation
D3.1 SnapEarth Design Dossier	Submitted	This document presents the definition of the hardware and software architecture of the platform that best meets the users' requirements. The document explains the design factors and architectural choices that have been made in the design to meet business and technical requirements. *The reader can refer to this deliverable to situate the EarthSelf service in relation to the other modules of the platform and all exposed interfaces.*

D3.6 SnapEarth Test Dossier V1	Submitted	The document represents the first version of SnapEarth Test Dossier. It defines test scenarios to run described from a “high-level perspective” (from the interface one). The document covers mainly how we intend to do it (process, tools, team setup) and what we are going to test. *The reader can refer to this deliverable to read more about the defined scenarios of the test and validation of the EarthSelf portal*
D3.7 SnapEarth Test Dossier V2	Submitted	The document represents the second version of SnapEarth Test Dossier. The test and validation campaigns defined in the D3.6 SnapEarth Test Dossier V1 will be updated and validated in the second version of this test dossier. *The reader can refer to this deliverable to have more information about the results of the test & validation campaigns of the EarthSelf portal*
D4.1 EarthSelf-Service Definition Document:	Submitted	The document describes the available services provided by EarthSelf platform. It details the technical solution developed by CS GROUP France and CS Romania elaborated accordingly to the interfaces detailed in [D3.1 SnapEarth Design Dossier] to meet business and technical requirements. *The reader can refer to this deliverable to have more information about the EarthSelf service technological components which were developed (or are ongoing).*

D4.4 EarthSelf-Service Tracking Tool V1	Submitted	The deliverable details the features of the set of tracking tools in its first version. It is a monitoring layer within the EarthSelf service platform which offers to service creator all the appropriate tooling to observe the whole system behavior and to conduct advance troubleshooting. *The reader can refer to this deliverable to have more information about the definition of the features of the set of tracking tools*
D4.5 EarthSelf-Service Tracking Tool V2	Pending M30	The deliverable details the implementation of the EarthSelf-Service Tracking Tool as defined in its first version in D4.4. *The reader can refer to this deliverable later to have more information about the implemented set of tracking tools and to see some metrics related to the pilot platforms in service*

1.3 Link with the KPI

The EarthSelf Service Portal is linked with the following KPIs:

Objective 1: Follow a user driven approach – WP2

The SnapEarth architecture and design were mainly carried out following the initial pilot's requirements consolidation.

As the users of the EarthSelf service are service creators, so first, the 4 Pilots were invited to use the EarthSelf service to deploy their service. Each of them was invited to complete a questionnaire with as much detail as possible to guide the design of the SnapEarth platform and, through the following link[3]. The Pilots' requirements consolidation feedbacks were used to design the EarthSelf architecture that met their requirements. The first version of the EarthSelf service D4.2 [2] took into account the results of the 4 pilot users.

[3] https://docs.google.com/forms/d/1nrmcPLl0oE7SBUZbs6SAkzlQyFvhdieF_mvNlsSbyhM/edit#responses

CS GROUP team has continued the campaign to collect external users’ needs. A pool of entities and people willing to be involved in an early adopter program has been identified. The requirements collected from the several events (1st SUG Workshop, 1st International Workshop and 17 one-to-one interviews) were analyzed further, aiming to extract specifications for the EarthSelf service. This second version of the EarthSelf service considers the results of the user need collection, in order to best meet their expectations. The results of this requirement collection are presented in D2.5 [3].

KPI	**Current target & Explanation**
SO 1 - KPI 1 At least 6 workshops organised by the project to collect user requirements, discuss SnapEarth specifications and present the project results.	The first SUG Workshop was set up at M10 to capture initial need of external user. The International Workshop 1 was set up at M23 to capture initial need of external user outside Europe.

<u>Objective 2: Build a self-service Cloud agnostic infrastructure management service – WP4</u>

KPI	**Current target & Explanation**
SO2-KPI 1 A SnapEarth service capable to manage resources on at least 3 Cloud providers (DIAS or public Cloud).	4 Cloud providers have been reached and integrated in EarthSelf. Two (2) cloud providers (**OVH** and **Creodias**) were initially reached at M18 and integrated thanks to SafeScale in EarthSelf platform and afterwards another cloud provider, **ONDA** DIAS, was reached and integrated as well at M27. To achieve more than the target, CS GROUP team was working at M30 to reach and integrate **Mundi** DIAS in EarthSelf and have more pilot infrastructure converging, regarding what is needed to be done from their perspective.
SO2-KPI 2 A SnapEarth service capable to serve at least 1000 concurrent users.	We can assume that 1000 users for a service can be reached. This target can be easily achieved by vertical scaling, with the assumption that not all users will work at the same time.

2. Working with the EarthSelf Portal

2.1 What is the EarthSelf Portal?

The EarthSelf Portal is an online system that Service Providers can use to manage their own EO value-added services using personal accounts. This tool enables them to submit customized requests based on their needs and to gain access to necessary information concerning cluster accessibility.

The Portal supports two areas:

- The public area with information about the EarthSelf Web Portal. Through this area users can manage their EarthSelf account and gain access to the authenticated area.
- The authenticated area which covers actions such as the management of personal account, the management of user's request forms (view, create, cancel, withdraw/close, get support, report incident, rate service), and inspection and monitoring of the status of all submitted requests.

2.2 Browser Requirements

The web portal can be accessed with a compatible web browser. We recommend using the following web browsers:

- Google Chrome (Latest)
- Firefox (Latest)
- Windows Edge (Latest)
- Opera (Latest)
- Internet Explorer (11)

For the best user experience, we recommend the latest version of web browsers.

2.3 Logging In/Out of the EarthSelf Portal

The EarthSelf Portal is accessible via http://snapearth.csgroup.space/portal/, and provides online forms to complete service deployment requests that, once submitted, can be assessed through the helpdesk service.

Note: Please review section 3.1 for more information on the account registration process.

This section describes how to:

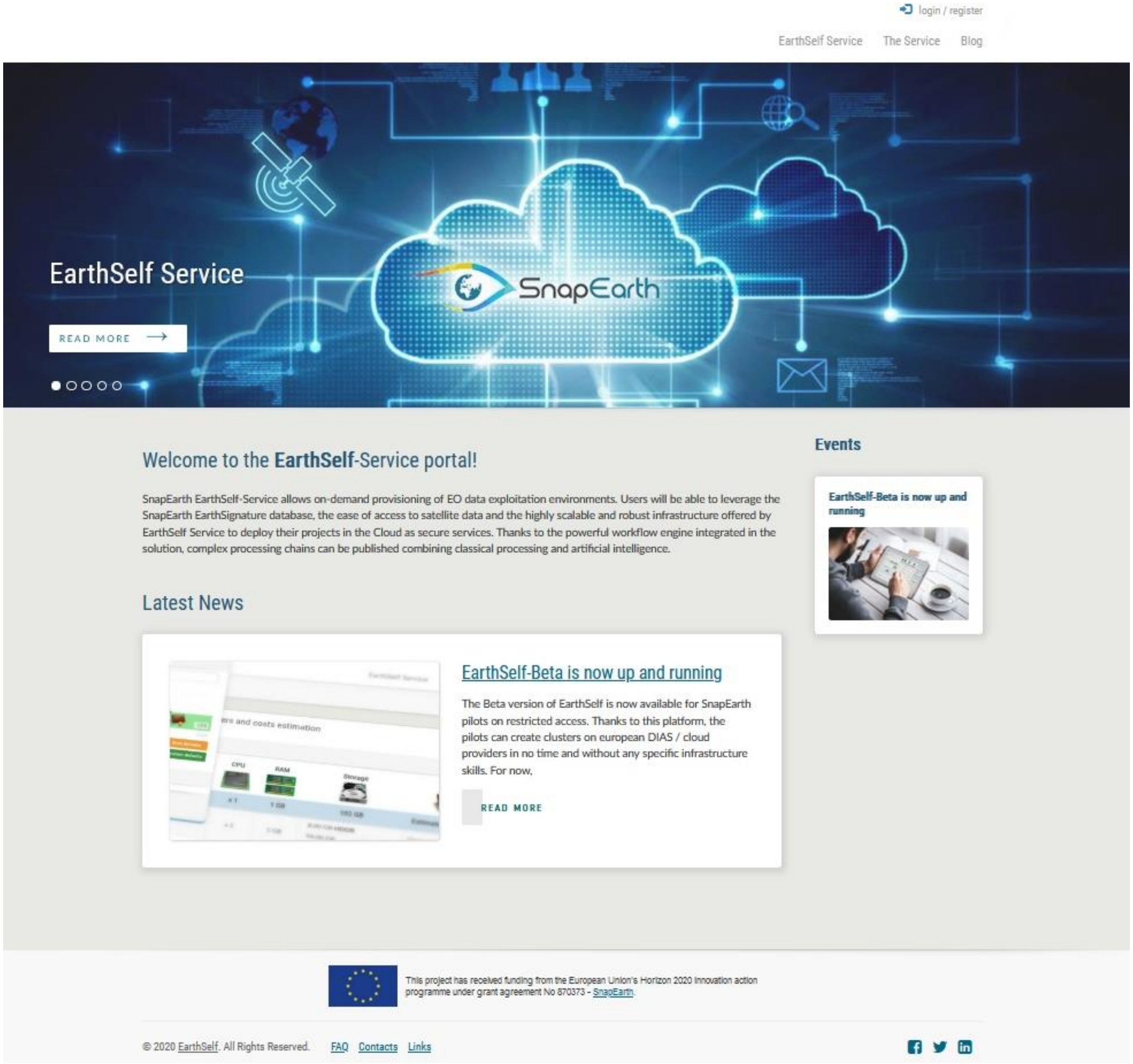
- Access the EarthSelf Portal
- Log out of the portal

Accessing the EarthSelf Portal

- Open a web browser and go to the EarthSelf Portal page using the following link:

  http://snapearth.csgroup.space/portal/

  Accessing the link, and if the user is not logged in, the main page of the portal is opened, and the user has the possibility to browse the information about the services offered by the portal, the latest news and events about the SnapEarth project but also to access some additional links for the Frequently Asked Questions (FAQ), contacts and also the SnapEarth project social media pages.



Welcome to the **EarthSelf**-Service portal!

SnapEarth EarthSelf-Service allows on-demand provisioning of EO data exploitation environments. Users will be able to leverage the SnapEarth EarthSignature database, the ease of access to satellite data and the highly scalable and robust infrastructure offered by EarthSelf Service to deploy their projects in the Cloud as secure services. Thanks to the powerful workflow engine integrated in the solution, complex processing chains can be published combining classical processing and artificial intelligence.

Latest News

EarthSelf-Beta is now up and running

The Beta version of EarthSelf is now available for SnapEarth pilots on restricted access. Thanks to this platform, the pilots can create clusters on european DIAS / cloud providers in no time and without any specific infrastructure skills. For now,

READ MORE

Events

EarthSelf-Beta is now up and running

This project has received funding from the European Union's Horizon 2020 innovation action programme under grant agreement No 870373 - SnapEarth

© 2020 EarthSelf. All Rights Reserved. FAQ Contacts Links

Figure 3 EarthSelf portal main page

- To log into the authenticated area of the EarthSelf Portal, the “login / register” link located at the top-right corner of the portal must be accessed.

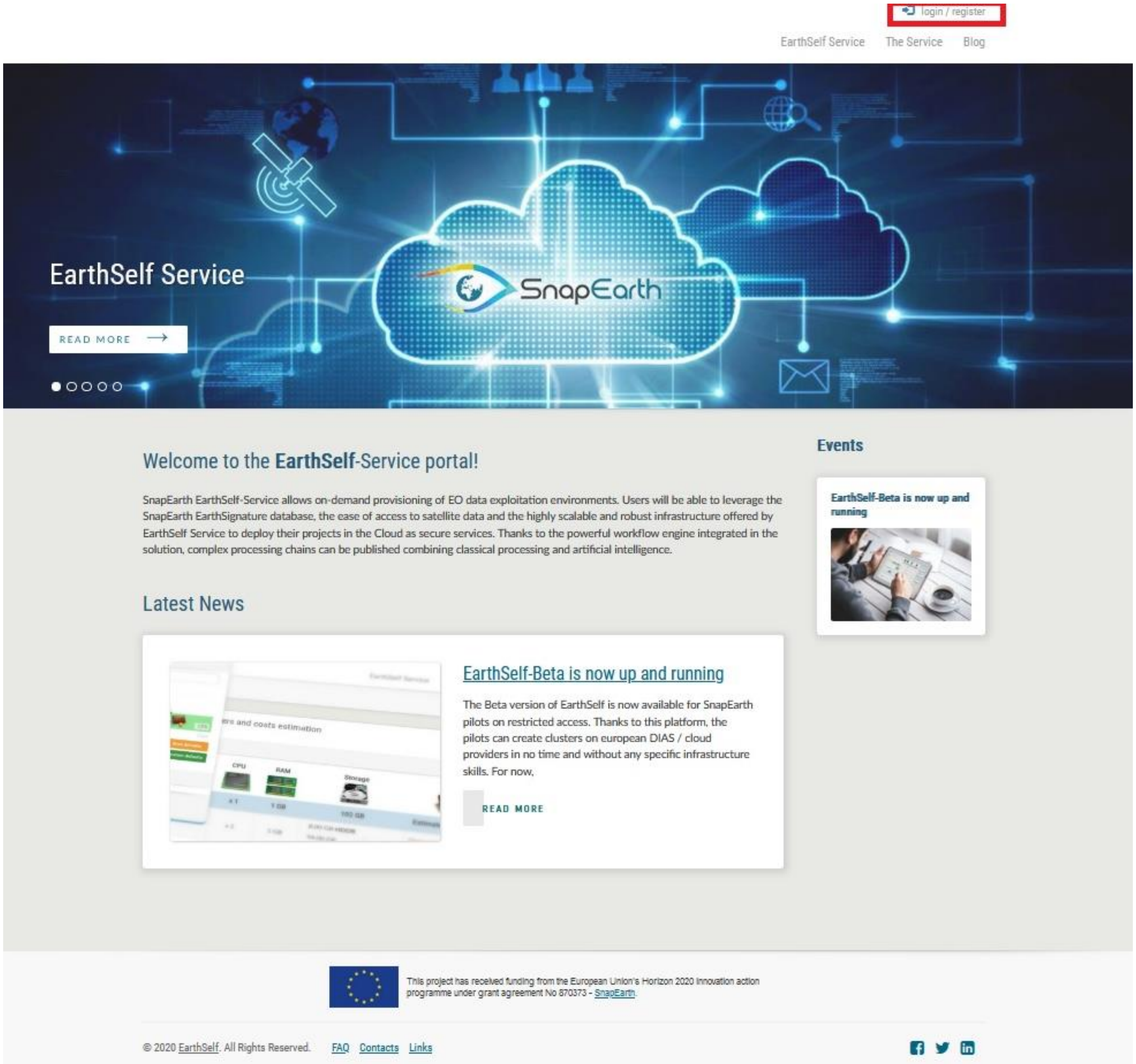


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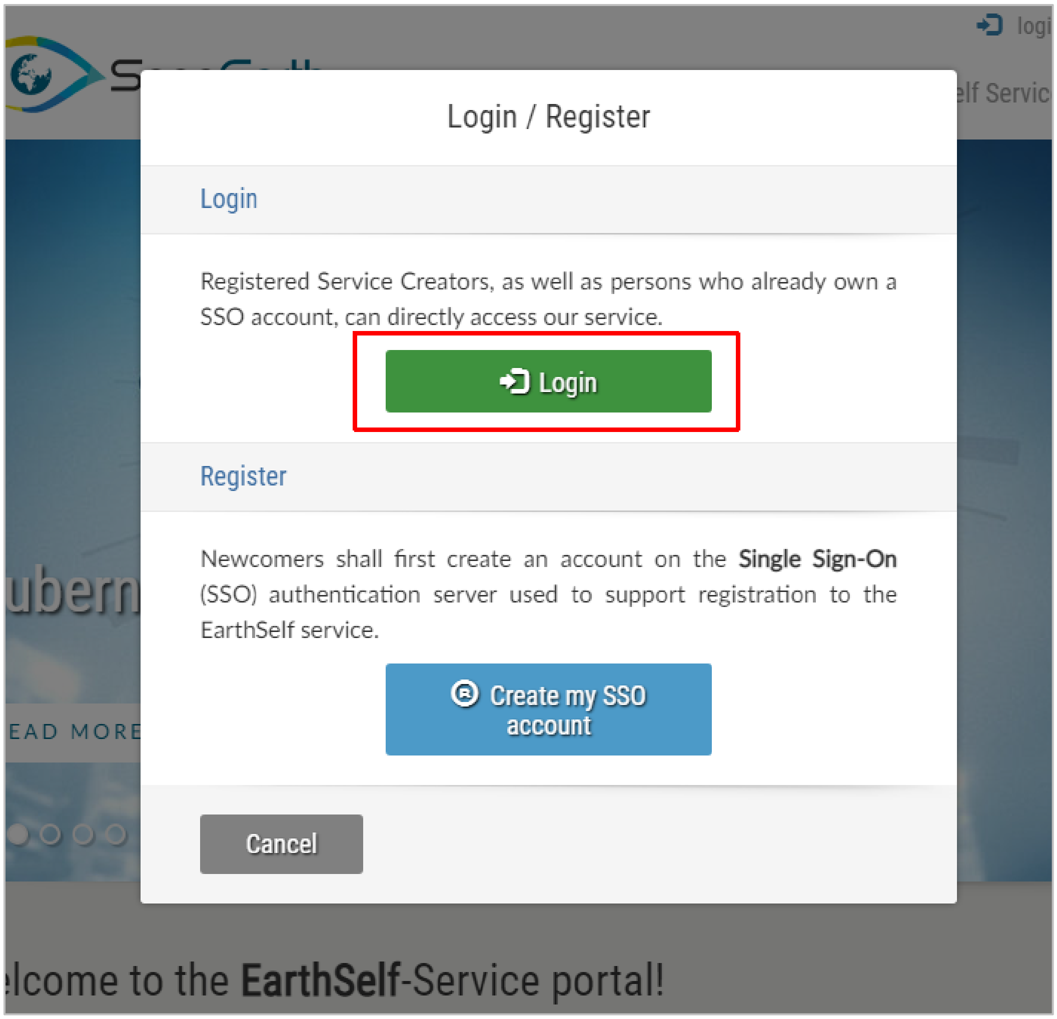
Figure 4: Login / register link

- the Login / Register page will pop-up and user can choose between logging in and registering for a new account.



Login / Register

Login

Registered Service Creators, as well as persons who already own a SSO account, can directly access our service.

Register

Newcomers shall first create an account on the **Single Sign-On** (SSO) authentication server used to support registration to the EarthSelf service.

Figure 5: Login page

If already registered, the "Login" button will redirect the user to the single sign on page.

- The application will ask for credentials. The username/email and password that the user has provided during the registration process must be filled in for the login procedure to finish successfully.

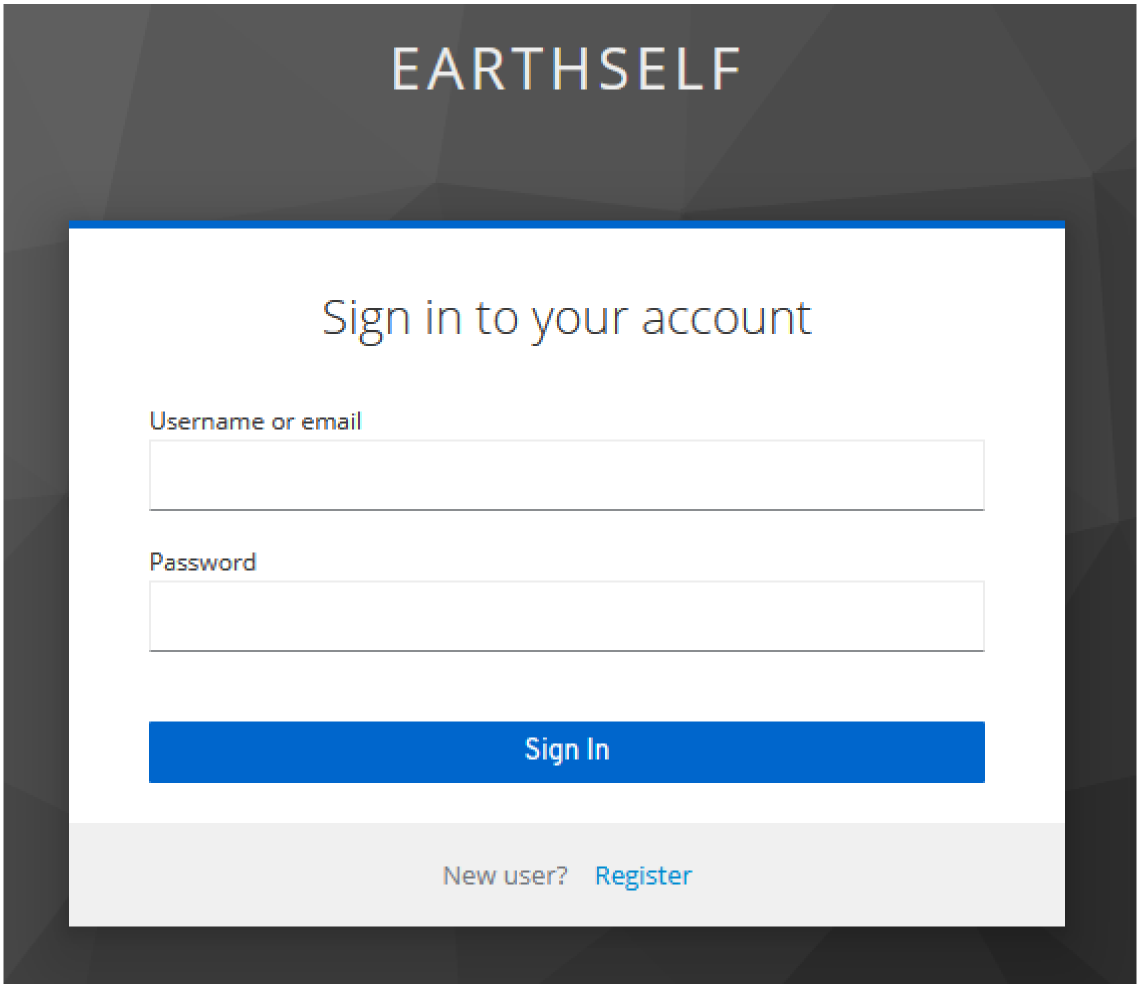
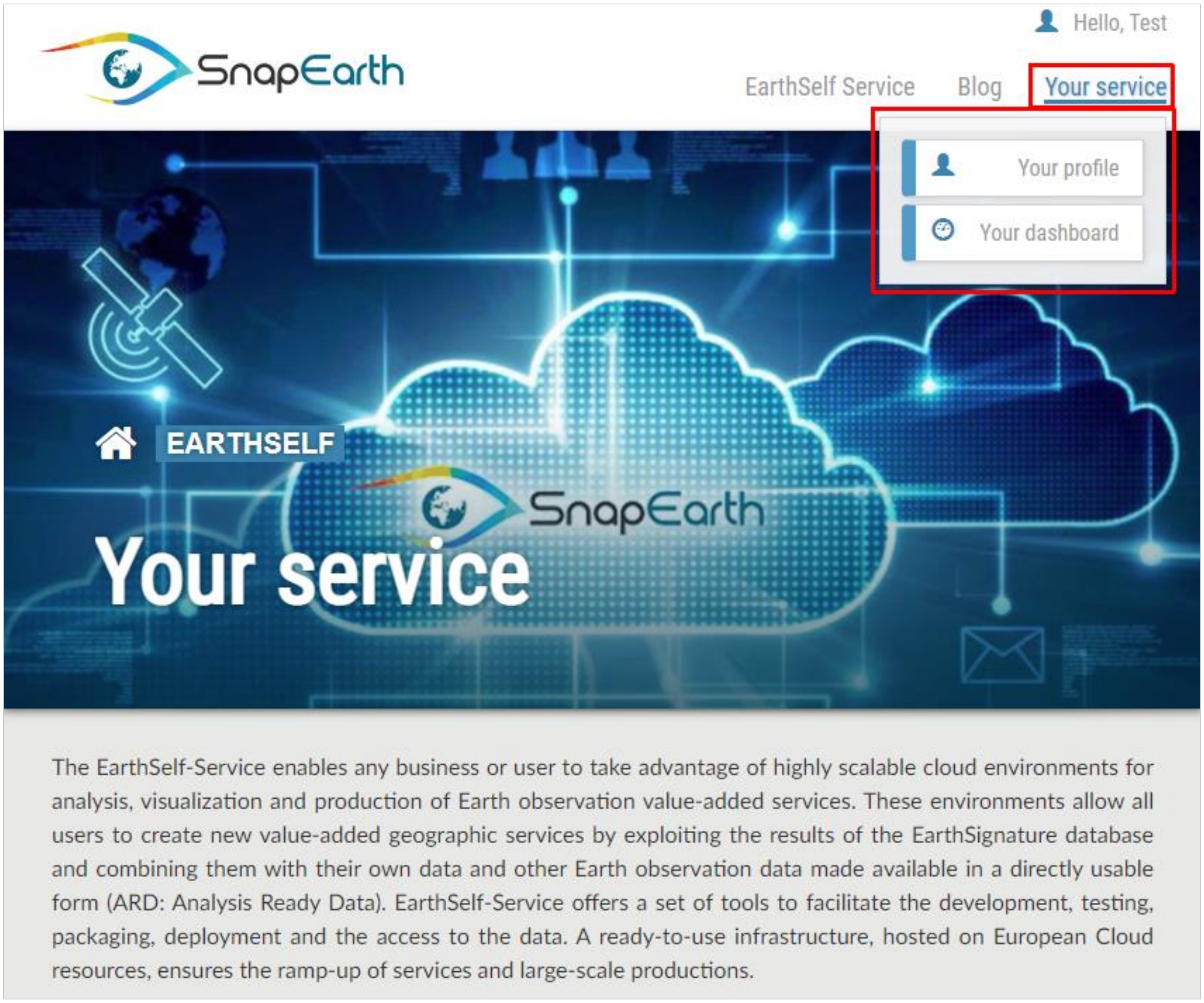


Figure 6: Login form

The password recovery process can also be accessed on this page. See section 3.2 for that.

Once logged in, the user is redirected back to the EarthSelf restricted area, a web platform containing the functionalities for setting up a request for creating EO value-added services.

- Use the menu "Your service" to gain access to all the restricted area functionalities.



The EarthSelf-Service enables any business or user to take advantage of highly scalable cloud environments for analysis, visualization and production of Earth observation value-added services. These environments allow all users to create new value-added geographic services by exploiting the results of the EarthSignature database and combining them with their own data and other Earth observation data made available in a directly usable form (ARD: Analysis Ready Data). EarthSelf-Service offers a set of tools to facilitate the development, testing, packaging, deployment and the access to the data. A ready-to-use infrastructure, hosted on European Cloud resources, ensures the ramp-up of services and large-scale productions.

Figure 7: Accessing portal restricted area

Please note that for reasons of security, the session will time out after 30 minutes of inactivity. For this reason, it is recommended that any un-submitted work to be dealt with before leaving the portal unattended.

Logging out of the EarthSelf Portal

Two ways of logging out of the EarthSelf Portal are offered:

- Simply close the browser or all the tabs of the browser in which the EarthSelf Portal application is open.
- Click the "Log Out" menu option to end the EarthSelf Portal session.

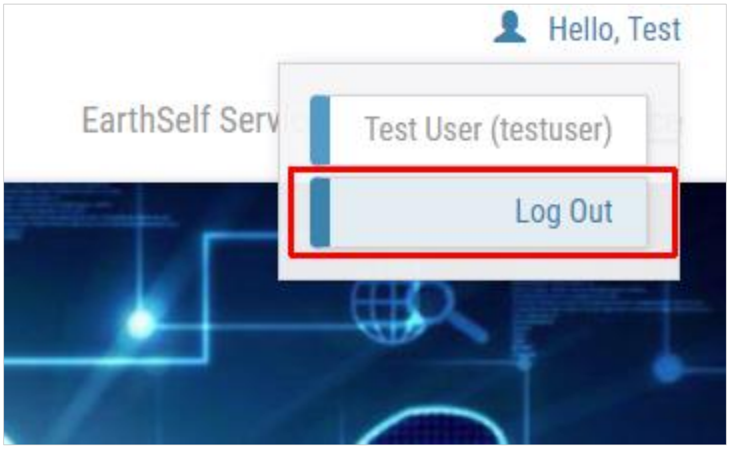


Figure 8: Log Out from EarthSelf Portal

After logging out, the user is redirected to the public area of the portal.

2.4 EarthSelf Portal interface – main screens of the application

In the following section, the main elements of the application are explained.

2.4.1 Elements in pages of the EarthSelf Web Portal

All pages available on the EarthSelf Portal application are organized as follows:

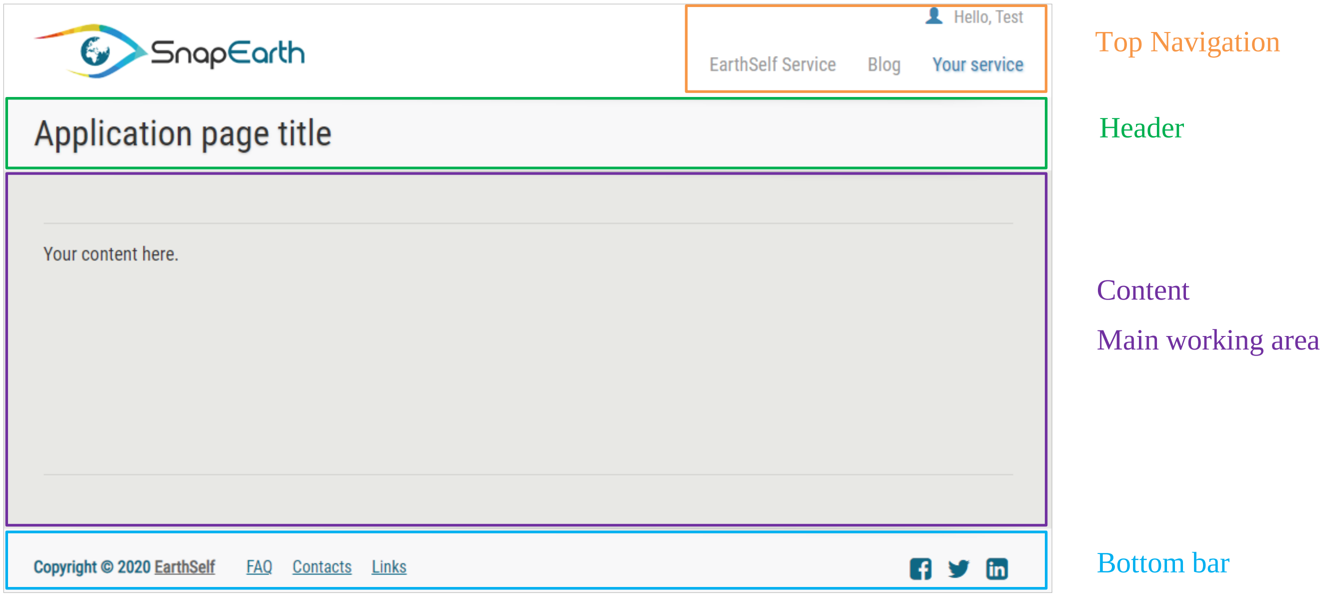


Figure 9: EarthSelf Portal page structure

The figure above illustrates the EarthSelf Portal interface, displaying various elements:

- The **top navigation bar** showing the following links:

  - Login menu: "First Name (username)", "Log Out"
  - Main menu: "EarthSelf Service", "Blog", "Your service", "Your profile", "Your dashboard"
- The **header** showing the SnapEarth logo, and current portal page title.
- The **main working area** where users can interact/create content.
- The **bottom bar** containing several useful links, Terms of Use of this website and access to SnapEarth social media pages.

2.4.2 Generic information relevant to the EarthSelf Portal

This section describes how you can review relevant general purpose information from the EarthSelf Portal.

The top navigation and bottom bar contain the following links:

- Blog – access to the community discussions section
- FAQ – useful tips about EarthSelf services
- Contacts/Help – a list of contacts from which user can ask for additional support
- Links – useful external links
- Terms and conditions: detailed information about conditions applicable to service requests
- About: general information about the EarthSelf Portal

3. Managing EarthSelf account

This chapter describes:

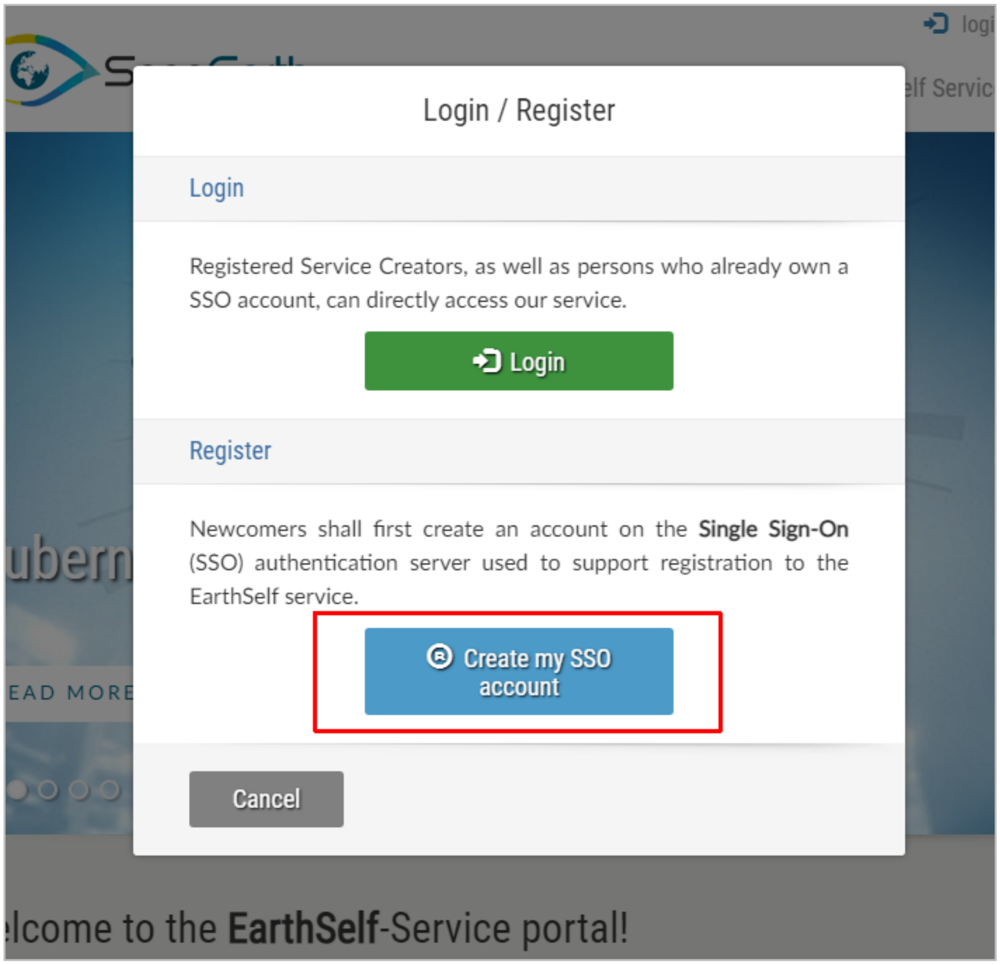
- Portal registration and subscription to EarthSelf services
- Password recovery
- Management of the user profile

3.1 Registration on the EarthSelf Portal

In order to gain access to EarthSelf Portal restricted area, the user must first register for an SSO account and then subscribe to EarthSelf services.

3.1.1 Registration for an SSO account

The SSO registration page is accessible from the users via the "login / register" link located at the top-right of the portal and the "Create my SSO account" link located on the "Login / Register" page.



Login / Register

Login

Registered Service Creators, as well as persons who already own a SSO account, can directly access our service.

Register

Newcomers shall first create an account on the **Single Sign-On** (SSO) authentication server used to support registration to the EarthSelf service.

lcome to the **EarthSelf**-Service portal!

Figure 10: Register page

In the registration form, the user has to fill in the following information:

- First name, Last name
- Email
- Username
- Password

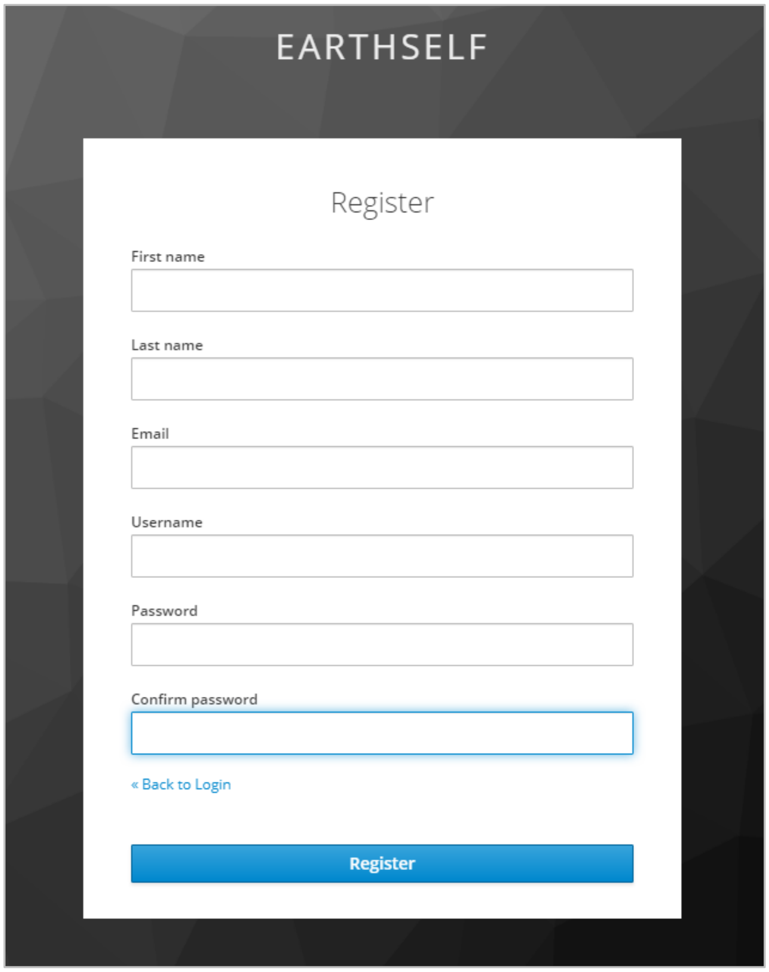


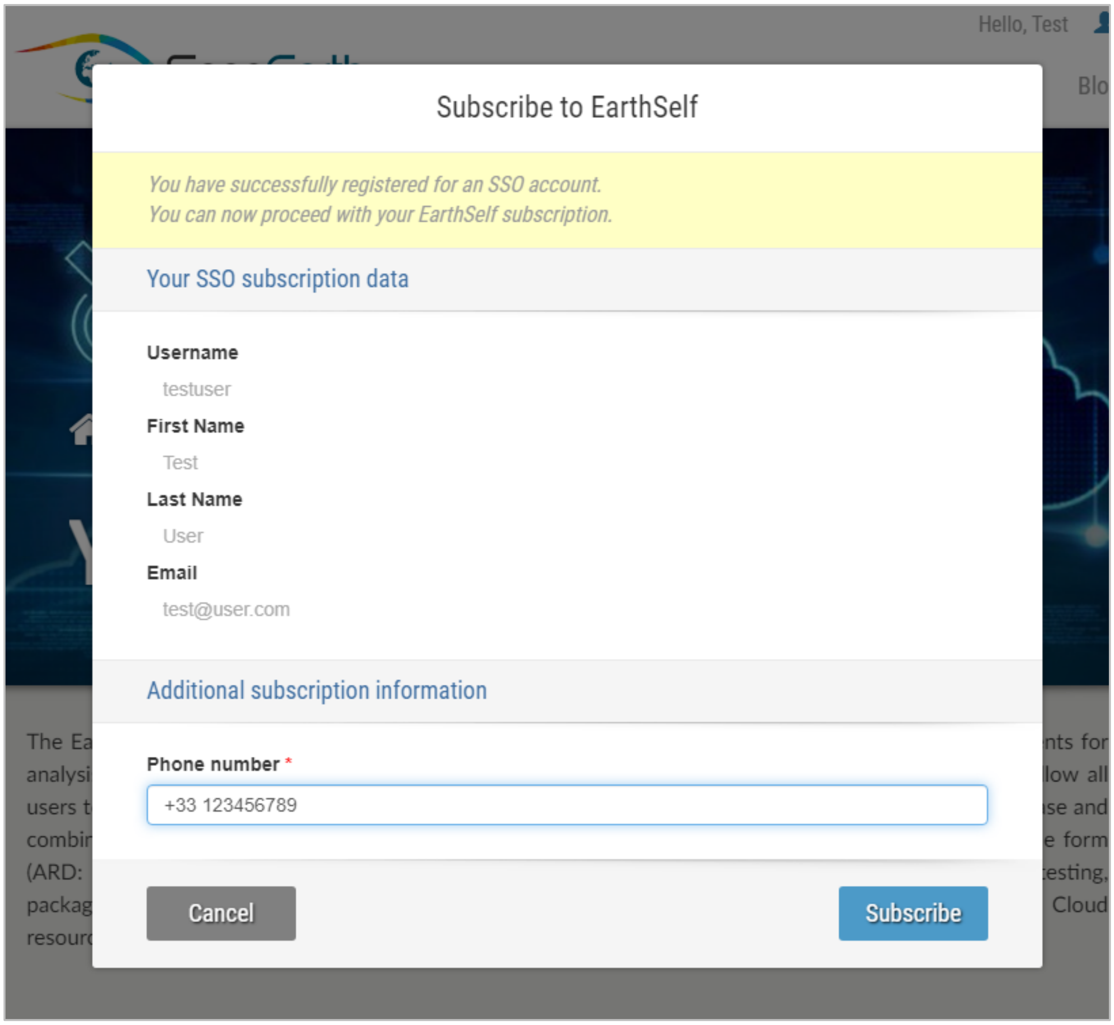
Figure 11: Registration form

Once registered the user is redirected to the second step of the registration process, the EarthSelf Portal services subscription.

3.1.2 Subscribtion to EarthSelf services

After SSO registration, the user is automatically logged in and redirected to the EarthSelf Portal, but the portal restricted area is not accessible yet and a second registration step is required. A pop-up message will inform the user about the successful SSO registration and that the subscription to EarthSelf Portal services can now be requested.

A subscription form is presented where all the SSO information is displayed, plus some extra fields that will complete the user's profile. These extra fields can also be modified later on, by accessing the "User profile" section.



Subscribe to EarthSelf

You have successfully registered for an SSO account.
You can now proceed with your EarthSelf subscription.

Your SSO subscription data

Username
testuser

First Name
Test

Last Name
User

Email
test@user.com

Additional subscription information

Phone number *
+33 123456789

Figure 12: Subscription to EarthSelf Portal services

The user has the option to decline the subscription by closing the form using the "Cancel" button. In that case however, the portal restricted area will remain inaccessible until the final step is completed. The subscription process can be resumed in two ways:

- At the next login
- By accessing the "Subscribe to EarthSelf" menu, which is located at the top-right corner of the portal

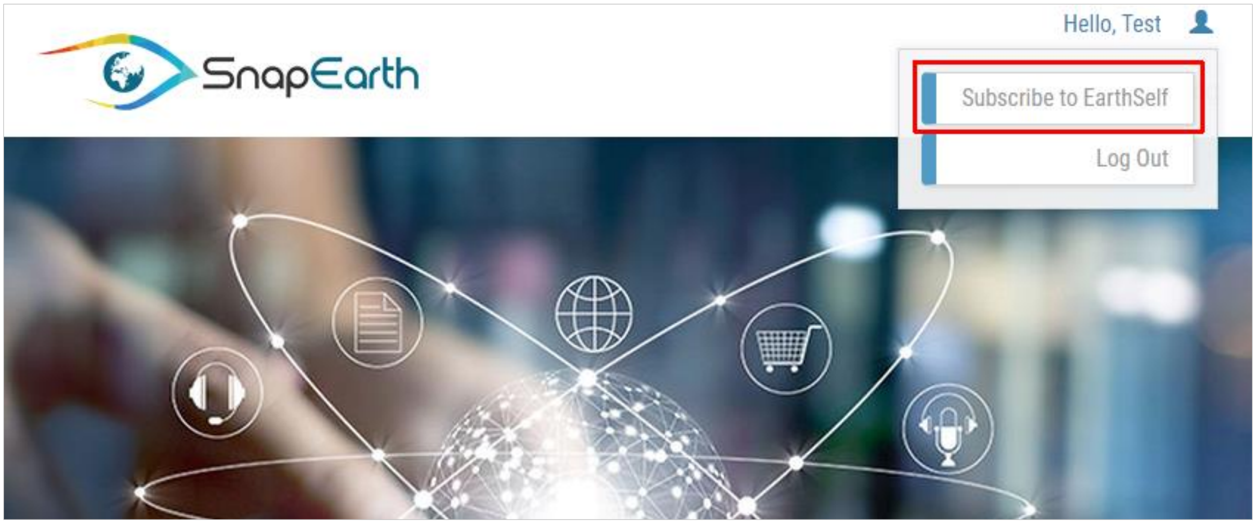


Figure 13: Resume subscription process

After subscription, the portal restricted content will be unlocked and the user can access all the functionalities that EarthSelf services can offer.

3.2 Password recovery

If the user has forgotten the password, it can be recovered by following these steps:

- Access "login / register" menu on the portal and get redirected to SSO login form
- Click the "Forgot Password?" link.

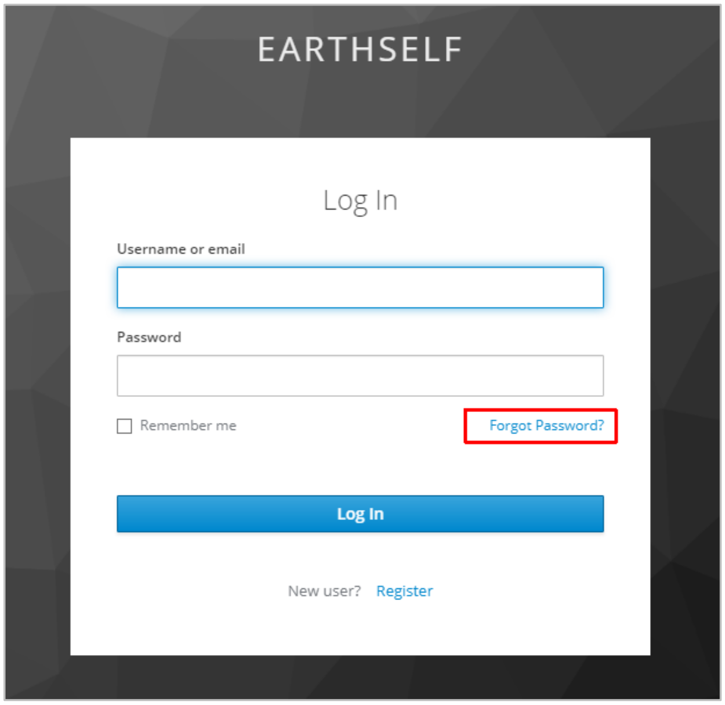
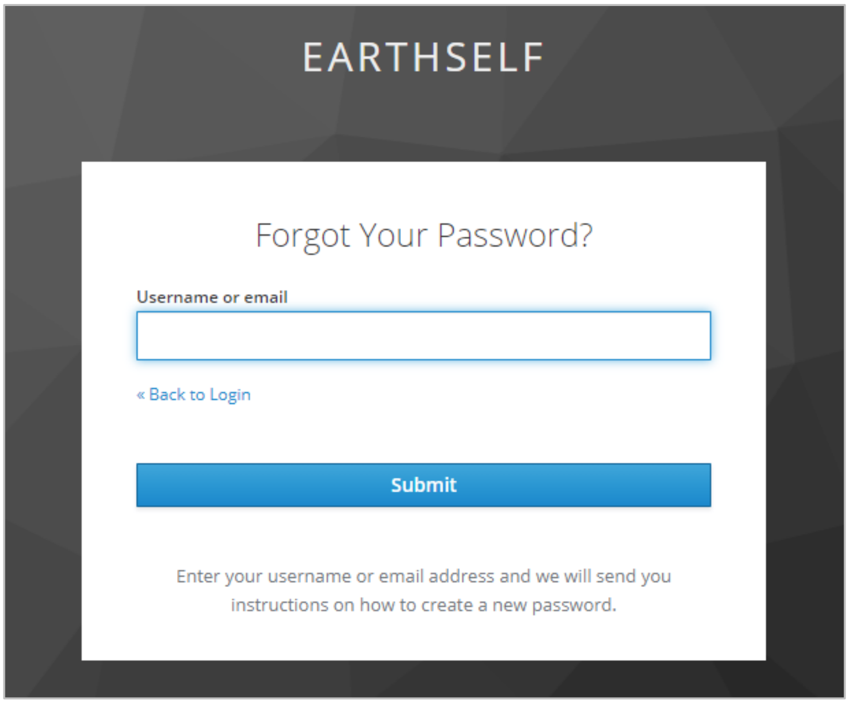


Figure 14: Forgot password link

- Users will see the following window:



EARTHSELF

Forgot Your Password?

Username or email

« Back to Login

Submit

Enter your username or email address and we will send you instructions on how to create a new password.

Figure 15: Forgot password window

- Provide the account e-mail or username and submit the request
- The system will validate the e-mail address and send a notification e-mail with all the necessary information required to reset the password.

3.3 Manage user profile

The user profile can be managed by either accessing the "Your profile" submenu from "Your service" menu, or by accessing the similar menu from login menu:

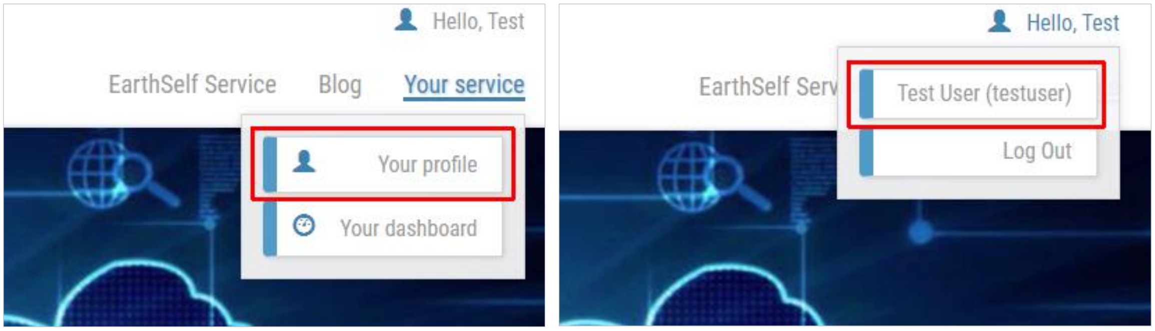
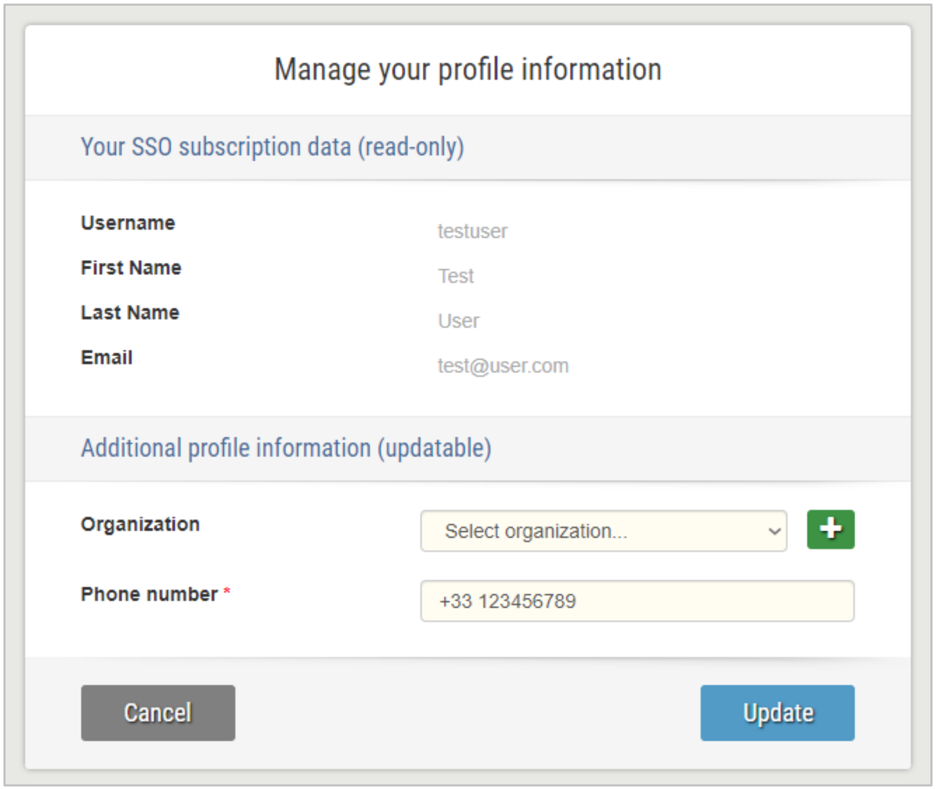


Figure 16: Accessing user profile

The user profile page allows the user to see the registration information, which consists of two sets of data:

- SSO registration data – read-only information that can only be reviewed
- Additional profile information – extra information that user has provided during the subscription to EarthSelf Portal services (see 3.1.2)



Manage your profile information

Your SSO subscription data (read-only)

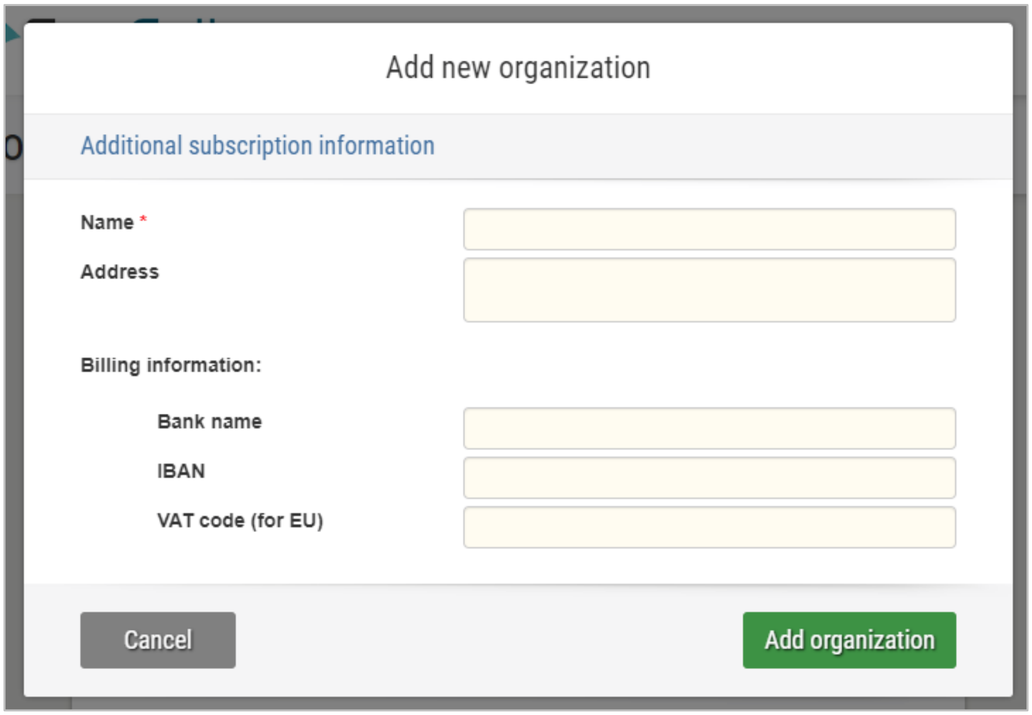
Username	testuser
First Name	Test
Last Name	User
Email	test@user.com

Additional profile information (updatable)

Organization	Select organization...
Phone number *	+33 123456789

Figure 17: User profile

The additional information allows the user to add his own organization if not already added by another user. By clicking on the "+" button next to the organizations list, the "Add new organization" form will pop-up and the user can fill in all the necessary details to add it to the EarthSelf portal database.



Add new organization

Additional subscription information

Name *

Address

Billing information:

Bank name

IBAN

VAT code (for EU)

Figure 18: Add new organization form

After the organization has been created, the user can select it from the organizations list and update the user profile.

4. Managing EarthSelf service environment

EarthSelf service Portal is dedicated to any business or user to create EO value-added services. Via this web Portal, they can create and deploy their cluster toward their own cloud provider.

This chapter describes:

- Viewing all service deployment requests
- Requesting a new service deployment
- Checking request status and additional information provided by helpdesk service

4.1 Viewing all service deployment requests

Authenticated users have access to their service environment through "Your dashboard" portal section. This is an application page where users can manage their requests, get information about their status, request additional information or raise an issue if necessary.

The user dashboard can be accessed from the "Your service" menu.

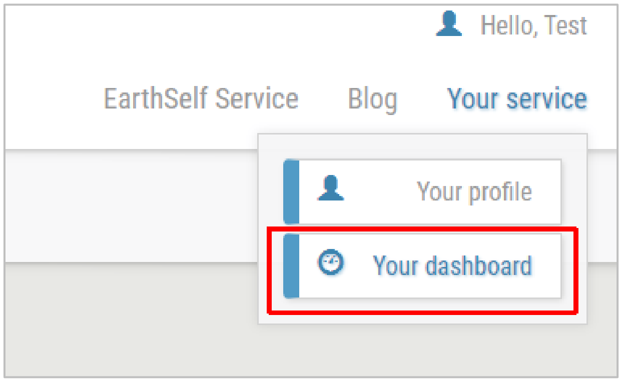


Figure 19: Accessing the user dashboard

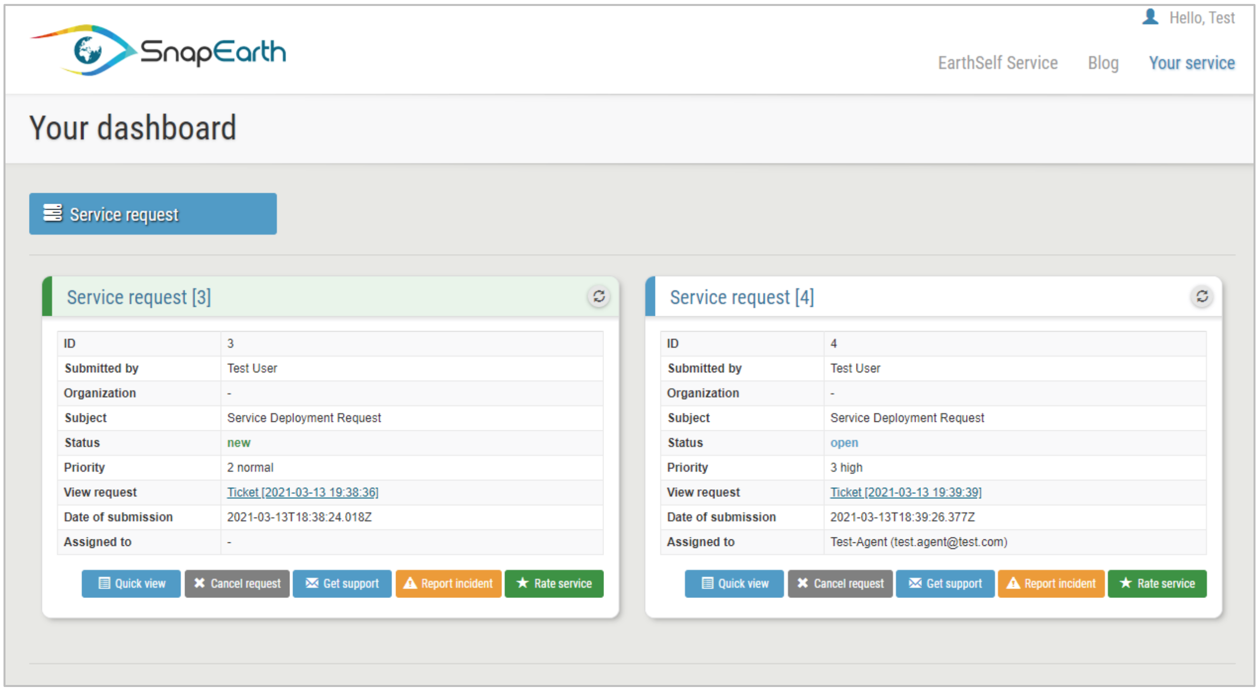
The main working area section of the dashboard page is the place where the user can see all the requests. Each request is presented as an information card where the user can check:

- Request status
- Request priority
- Information about the assignee
- Request ID
- Link with additional information provided by helpdesk service

At the bottom, each request card has a section with multiple available commands, depending on request's status:

- Quick view – opens a pop-up window with original request information.
- Cancel request – applicable to all requests with "New" status, will lead to request cancelation.

- ○ Get support – opens up a pop-up form where user can fill in and submit any additional information regarding the current request. Not applicable to "New" and "Closed" requests.
- ○ Report incident – similar with "Get support" but targeted for technical support.
- ○ Rate service – a form where user can rate and share opinions about the service. Only applicable to "Closed" requests.



Service request [3]

ID	3
Submitted by	Test User
Organization	-
Subject	Service Deployment Request
Status	new
Priority	2 normal
View request	Ticket [2021-03-13 19:38:36]
Date of submission	2021-03-13T18:38:24.018Z
Assigned to	-

Service request [4]

ID	4
Submitted by	Test User
Organization	-
Subject	Service Deployment Request
Status	open
Priority	3 high
View request	Ticket [2021-03-13 19:39:39]
Date of submission	2021-03-13T18:39:26.377Z
Assigned to	Test-Agent (test.agent@test.com)

Figure 20: Portal dashboard

4.2 Request a new service deployment

From within the dashboard page the user can access the Service Deployment Request form by accessing the "Service request" button at the top of the page.

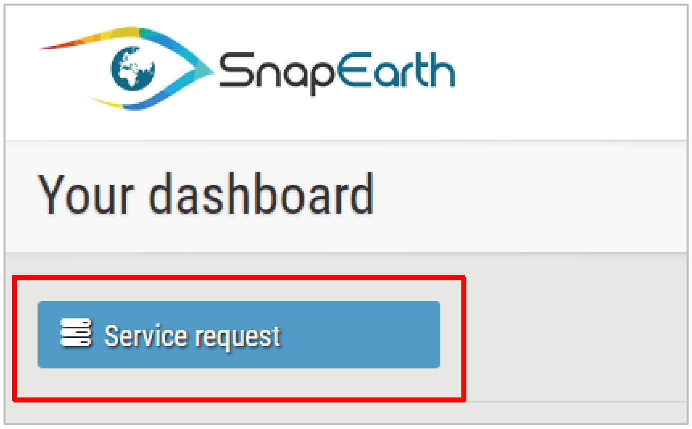


Figure 21: Access Service Deployment Request

To complete a Service Deployment Request, the user is guided through several steps:

1. Choose the deployment type
2. Set up your deployment type
3. EO data information
4. Customize search
5. Select provider and machine configurations
6. Review and submit the service deployment request

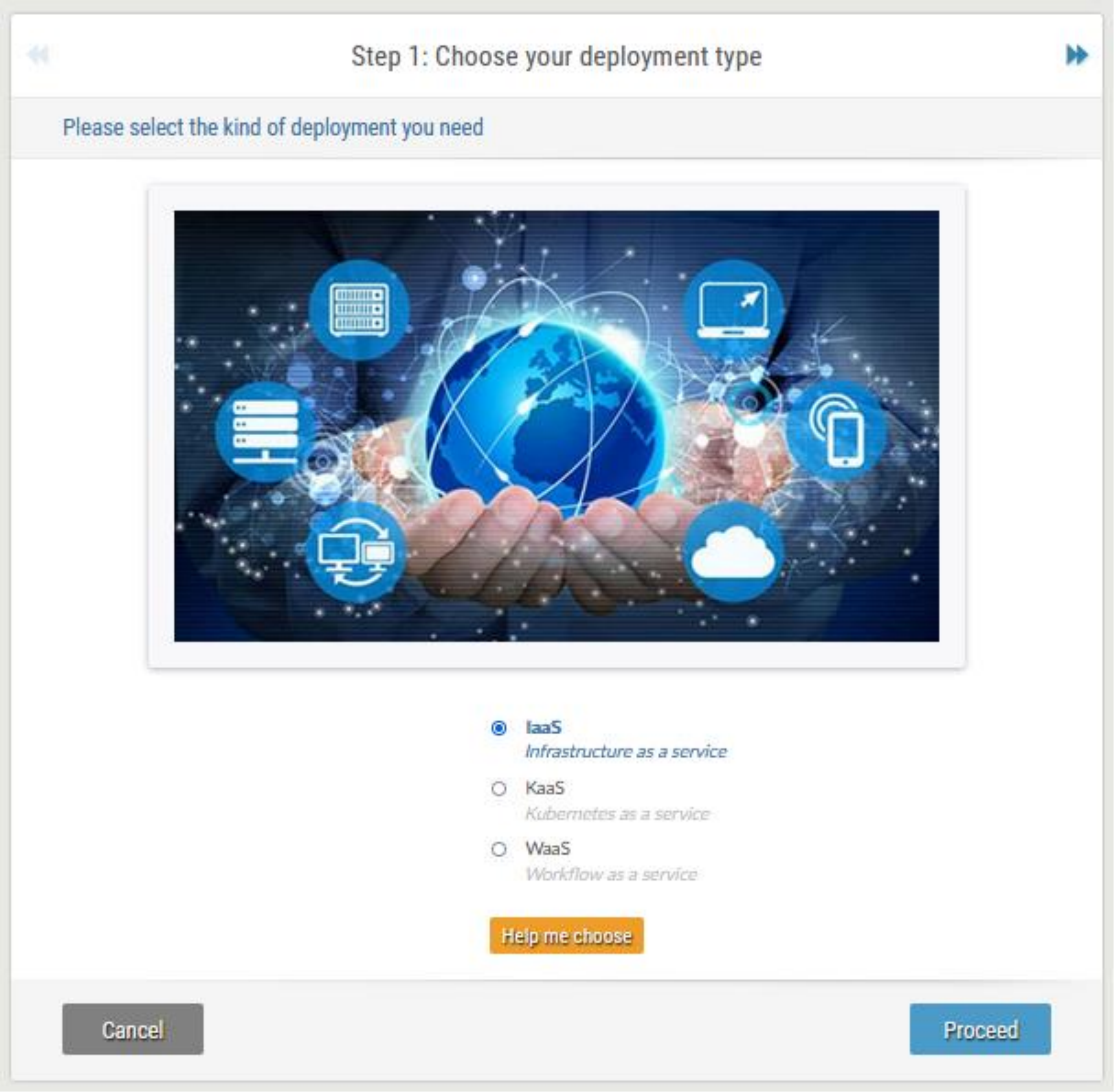
At any moment before submitting the request, the user has the possibility to go back and review or change any choice.

4.2.1 Choose the deployment type

The first step in defining the Service Deployment Request is to actually choose the type of deployment. Currently the user has two possibilities:

- Infrastructure as a service (IaaS) – A first level of integration, designed for “IT professionals”. At this level of integration, users access directly the virtual infrastructure (such as virtual networks, virtual machines or storage partitioning) and can build fully customized services.
- Kubernetes as a service (KaaS) – A second level of integration, positioned on top of the IaaS layer, which includes all the functionalities offered by this layer but by providing an abstraction layer over virtualized computing resources and, a fortiori, over hardware resources.
- Workflow as a service (WaaS) – Workflow as a service (WaaS) – A third level of integration, positioned on top of the KaaS layer, which includes all the functionalities offered by this layer but by providing an abstraction layer over container orchestration mechanism and its underlying infrastructure.

The user can choose one of these three options (IaaS, KaaS and WaaS) and be redirected to the second step where a set up process will be required according to the selected deployment type.



Step 1: Choose your deployment type

Please select the kind of deployment you need

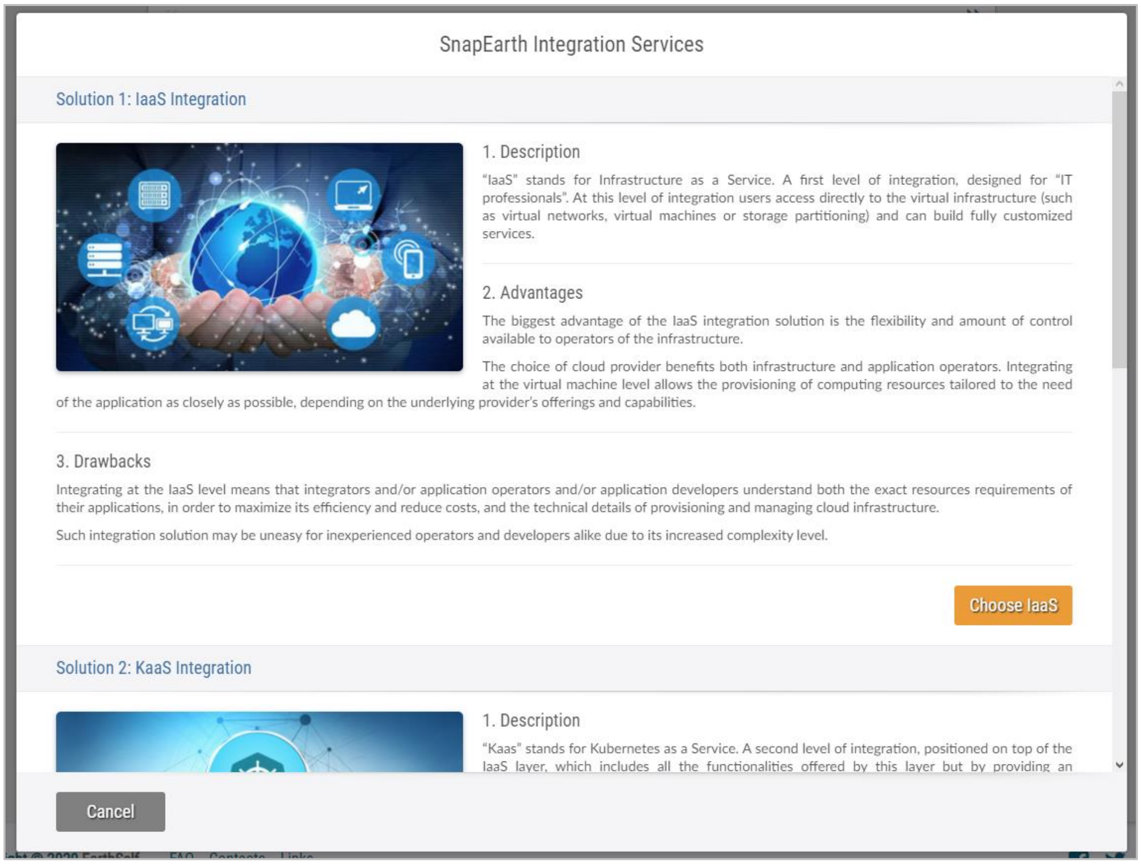
● IaaS
Infrastructure as a service

○ KaaS
Kubernetes as a service

○ WaaS
Workflow as a service

Figure 22: Choose your deployment type

If the user is not familiar with the present options, a help page is provided where detailed information about each option is displayed. The help page is accessible using the "Help me choose" button.



SnapEarth Integration Services

Solution 1: IaaS Integration

1. Description

"IaaS" stands for Infrastructure as a Service. A first level of integration, designed for "IT professionals". At this level of integration users access directly to the virtual infrastructure (such as virtual networks, virtual machines or storage partitioning) and can build fully customized services.

2. Advantages

The biggest advantage of the IaaS integration solution is the flexibility and amount of control available to operators of the infrastructure.

The choice of cloud provider benefits both infrastructure and application operators. Integrating at the virtual machine level allows the provisioning of computing resources tailored to the need of the application as closely as possible, depending on the underlying provider's offerings and capabilities.

3. Drawbacks

Integrating at the IaaS level means that integrators and/or application operators and/or application developers understand both the exact resources requirements of their applications, in order to maximize its efficiency and reduce costs, and the technical details of provisioning and managing cloud infrastructure.

Such integration solution may be uneasy for inexperienced operators and developers alike due to its increased complexity level.

Solution 2: KaaS Integration

1. Description

"Kaas" stands for Kubernetes as a Service. A second level of integration, positioned on top of the IaaS layer, which includes all the functionalities offered by this layer but by providing an

Figure 23: Help page for deployment type

4.2.2 Set up your deployment type

There are three setups possible, one for Infrastructure as a Service, one for Kubernetes as a Service and the last one for Workflow as a Service.

Set up your Infrastructure as a Service

IaaS (Infrastructure as a Service) represents a first level of integration, designed for "IT professionals". At this level of integration users access directly to the virtual infrastructure (such as virtual networks, virtual machines or storage partitioning) and can build fully customized services.

The advantages of the IaaS are:

- The biggest advantage of the IaaS integration solution is the flexibility and amount of control available to operators of the infrastructure.
- The choice of cloud provider benefits both infrastructure and application operators. Integrating at the virtual machine level allows the provisioning of computing resources tailored to the need of the application as closely as possible, depending on the underlying provider's offerings and capabilities.

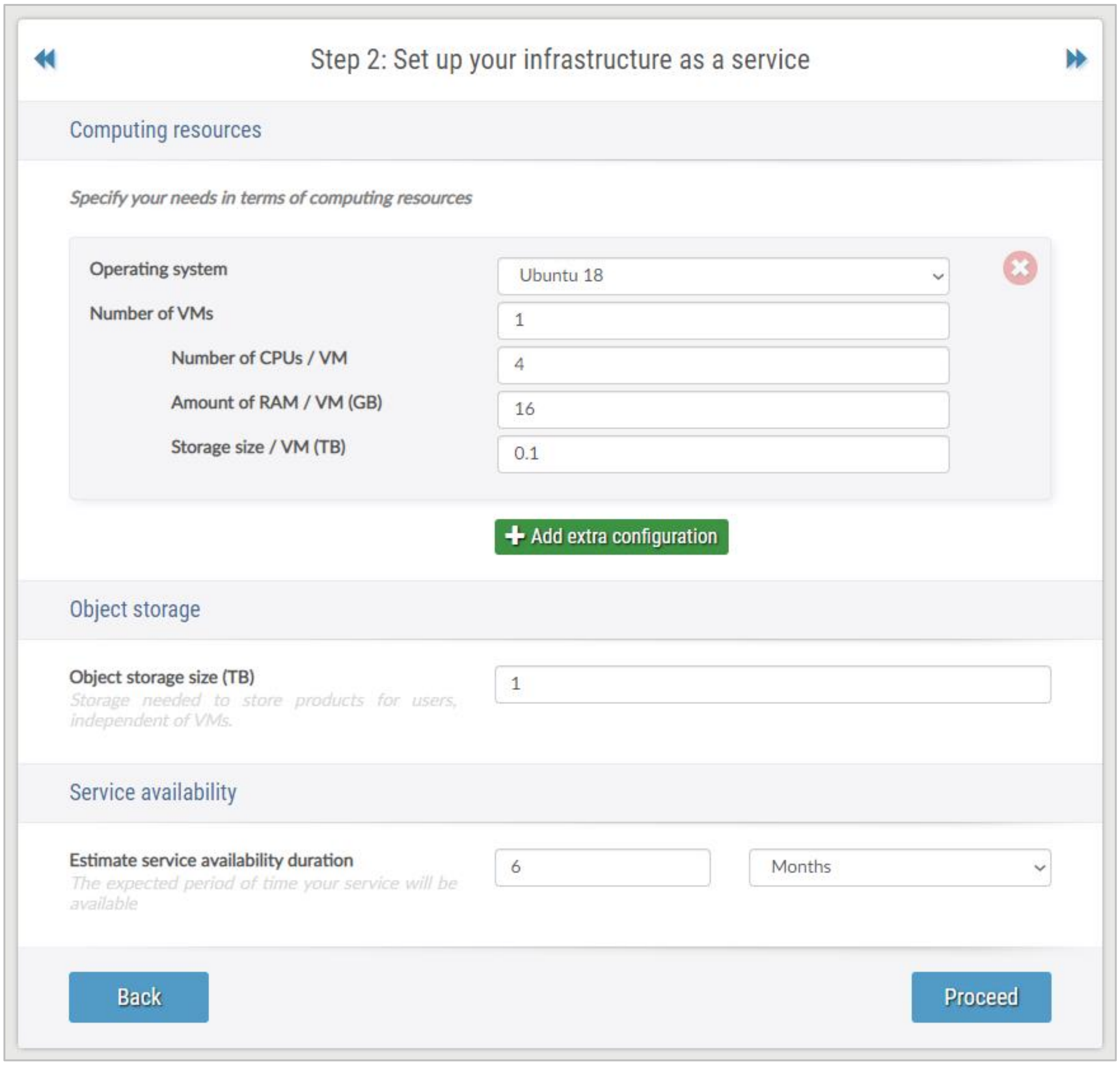
- The IaaS integration solution permits tight control over the cost of deploying, operating and migrating an application depending on its resource requirements and the cost of infrastructure and capabilities offered by such or such cloud provider.

- Operators in charge of the IaaS integration can provision virtual networks, virtual machines and storage capacities to form clusters fitting the exact requirements of the application they are deploying and operating. They can also dynamically provision or release those resources on the fly, in order to closely match the availability and performance constraints throughout the lifecycle of the application they operate.

Nevertheless, the IaaS has also some drawbacks:

- Integrating at the IaaS level means that integrators and/or application operators and/or application developers understand both the exact resources requirements of their applications, in order to maximize its efficiency and reduce costs, and the technical details of provisioning and managing cloud infrastructure.
- Such integration solution may be uneasy for inexperienced operators and developers alike due to its increased complexity level.
- Deploying an application in this context means provisioning virtual networks, machines and storage capacities as a forethought, meaning, in this instance, both planning in advance and consideration for the future of the application. The infrastructure, thus provisioned, is ready to host the application, and infrastructure operators must use or provide ways for application operators or developers to deploy the application onto the hosts and configure it to use the available resources.
- Infrastructure operators must apply constant care to the health of the computing resources and interact with application operators or developers to notify them of any perturbation or inconsistencies at the infrastructure layer, while at the same time accommodate for static application requirements and its elasticity requirements.
- Such ability requires visibility over the whole system provided by monitoring and alerting features which must be maintained by infrastructure operators as an additional burden.

As above mentioned, when Infrastructure as a Service is selected, it is known that the users can access directly to the virtual infrastructure and can build fully customized services. For this it is mandatory that they can fully configure the cluster.



Step 2: Set up your infrastructure as a service

Computing resources

Specify your needs in terms of computing resources

Operating system	Ubuntu 18
Number of VMs	1
Number of CPUs / VM	4
Amount of RAM / VM (GB)	16
Storage size / VM (TB)	0.1

Object storage

Object storage size (TB) Storage needed to store products for users, independent of VMs.	1

Service availability

Estimate service availability duration The expected period of time your service will be available	6	Months

Figure 24: Set up your infrastructure as a service

The request form allows the user to define multiple number or virtual machines configurations. A configuration is defined by the number of CPUs, amount of RAM and the storage size. The user can also select the operating system from the provided list and the number of machines with the selected configuration.

Accessing the "Add extra configuration" button will add a new section where the user can define a new configuration. A configuration can also be discarded by clicking the attached close ("X") button.

The user is also required to define in this step the amount of storage needed to store products for users, and this is independent of any defined configuration.

Last parameter on the second step (IaaS) is the estimated service availability duration, which defines the expected period of time the Service Creator decides to make the service available for the end users.

Set up your Kubernetes as a Service

The KaaS (Kubernetes as a Service) represent a second level of integration, positioned on top of the IaaS layer, which includes all the functionalities offered by this layer but by providing an abstraction layer over virtualized computing resources and, a fortiori, over hardware resources. SnapEarth users can then deploy and manage their applications using Kubernetes management tools they are the most familiar with by focusing on building, deploying and operating their applications without worrying about the underlying architecture.

The KaaS layer is also Intended for "IT professionals" users, but optimizing Time To Market and Total Cost of Operation. The KaaS integration solution offers them the following services:

- Orchestration of micro services: To accelerate the Time To Market by simplify service deployments
- Observability and security enhancing: tackling the Total Cost of Operation by offering ergonomic solution to monitor performance and security and to understand and troubleshot applications.

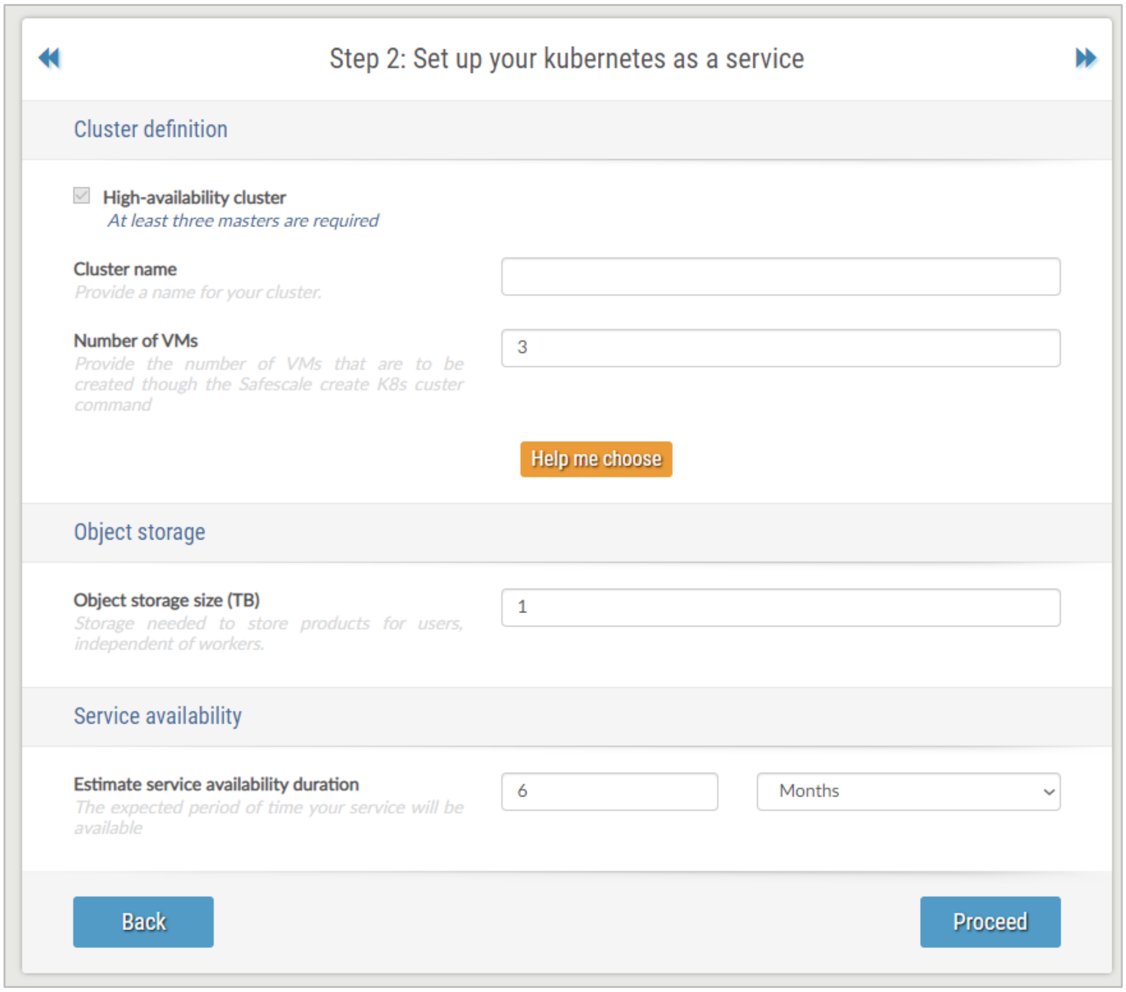
The KaaS has the following advantages:

- As a higher layer of abstraction on top of virtualized computing resources, integration at the container level, through Kubernetes, allows operators to deal with applications' processing, memory and storage requirements and deployment topology rather than hosts and volumes. It frees operators and application developers from the burden of assigning services and replicas to specific hosts, also called scheduling.
- Because Kubernetes provides a higher level of service than infrastructure management, it sits on top of higher level concepts which are abstraction over application deployment concepts. Examples of such concepts are Secrets, Pods, Volume Claims or Services, which represent opaque data available to application components, groups of containers running on a same host, dynamically allocated storage volumes or service discovery capabilities, respectively.
- Built-in monitoring features provides integrators with automated ways to track and add more or retract unnecessary resources depending on the runtime performance and availability requirements of the application. Such elasticity thereby grants efficient cost savings by reducing the computing resources allocation at its lowest while sustaining the running application.
- Git/Helm repositories watching and automated continuous deployment further simply integration with the platform. By pushing Kubernetes management files, or manifests, a background task will automatically deploy the Kubernetes resources described in those.
- For a higher ease of use, the SnapEarth platform will also provide support for continuous integration and continuous deployment (CI/CD) through capabilities such as automated Git/Helm repositories watching (GitOps) so that integrators can easily push forward deployment changes through configuration management alone, without resorting to direct communication/interaction with their cluster.

On the other hand, the KaaS has the following drawbacks:

- Container technologies and Kubernetes, while allowing operators and developers to manage high level concepts, come with additional unfamiliarity and an arguably steeper learning curve than traditional or cloud-based infrastructure management tools and techniques.
- Managing computing resources at the container/Kubernetes level also means that neither the underlying virtualized hosts nor the underlying physical hardware is accessible to operators, which can be limiting for certain types of maintenance work or access to low level details and debug information.
- As a relatively new technology, Kubernetes and Kubernetes management tools are still under very active development. Furthermore, managed Kubernetes clusters' features may differ from one cloud provider to another. Parameters such the supported Kubernetes versions, maximum number of nodes in a cluster and SLAs (Service Layer Agreement) may defer quite a lot, even though Kubernetes concepts themselves are based on the lowest common denominator between infrastructure and deployment components.
- Deployment container-based applications using Kubernetes is solving the problem of easily deploying and updating scattered application services. And in doing so, it requires additional monitoring, logs/metrics aggregation, tracing, dashboards and alerting mechanisms in order to provide visibility on how the application is behaving throughout its lifespan.

When the user is selecting Kubernetes as a Service, they can deploy and manage their applications using Kubernetes management tools they are the most familiar with by focusing on building, deploying and operating their applications without worrying about the underlying architecture.



Step 2: Set up your kubernetes as a service

Cluster definition

☑ High-availability cluster
At least three masters are required

Cluster name
Provide a name for your cluster.

Number of VMs
Provide the number of VMs that are to be created though the Safescale create K8s custer command
3

Object storage

Object storage size (TB)
Storage needed to store products for users, independent of workers.
1

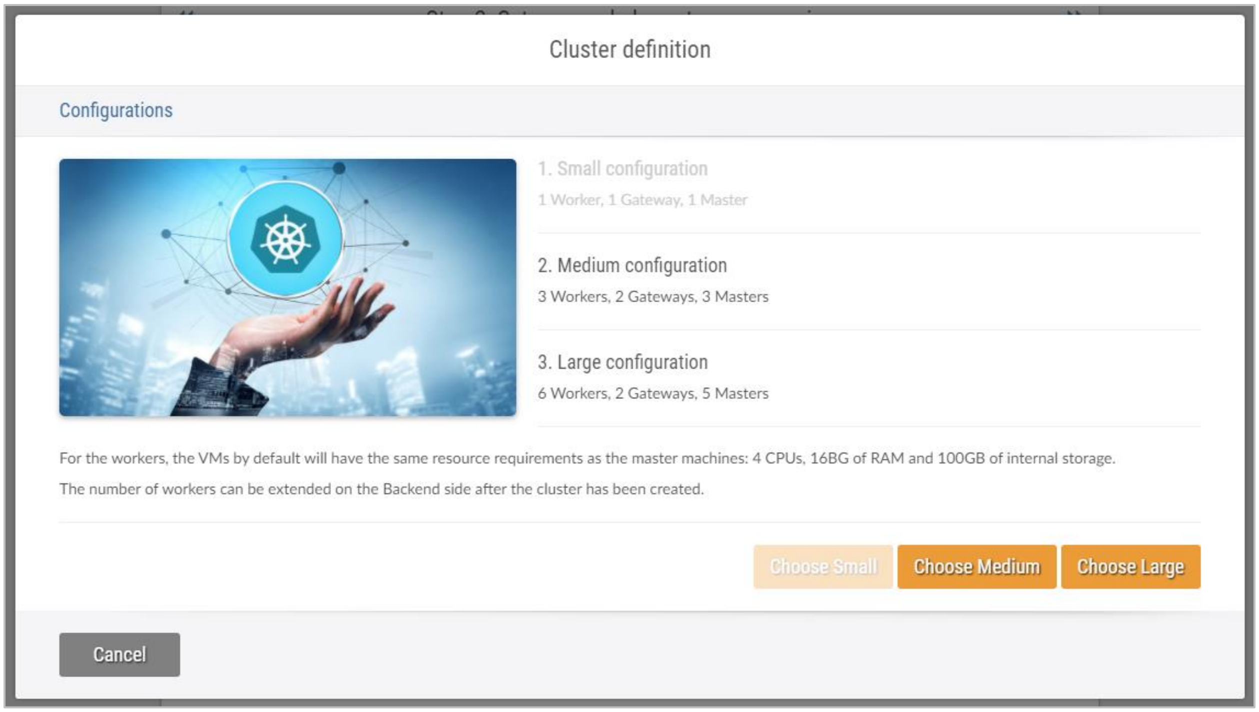
Service availability

Estimate service availability duration
The expected period of time your service will be available
6 Months

Figure 25: Set up your Kubernetes as a Service

The request form allows the user to select the number of workers (virtual machines) depending on the service to be deployed. A cluster name will also be required during the cluster creation so the user must provide it.

A help page is available where the user can inspect the capabilities of each type of configuration.



Cluster definition

Configurations

1. Small configuration

1 Worker, 1 Gateway, 1 Master

2. Medium configuration

3 Workers, 2 Gateways, 3 Masters

3. Large configuration

6 Workers, 2 Gateways, 5 Masters

For the workers, the VMs by default will have the same resource requirements as the master machines: 4 CPUs, 16BG of RAM and 100GB of internal storage.

The number of workers can be extended on the Backend side after the cluster has been created.

Figure 26: Help page for Kubernetes as a Service

As for Infrastructure as a Service, the user must choose the object storage size and estimate availability duration.

Set up your Workflow as a Service

The WaaS (Workflow as a Service) represents the last level of integration, positioned on top of the KaaS and IaaS layers, includes all the functionalities offered by the layers underneath it in order to allow users to quickly create operational and secure services without requiring any knowledge of neither the underlying container orchestration mechanism nor its underlying infrastructure. This layer is intended for users, who are not IT professionals but who have good ideas and want to implement them by combining existing services to produce added value. This layer, allow them to focus on developing their individual processing tasks, using whichever technology they are the most familiar with; then to push them through Git repositories which will be managed through a workflow management layer. Thus, users will be able to access all the services on top of this layer (such as access to the EarthSignature database and the other SnapEarth services). In addition, they will not have to worry about the large-scale processing, (e.g. to reach national, continental or even global land cover computing areas).

The advantages of WaaS are:

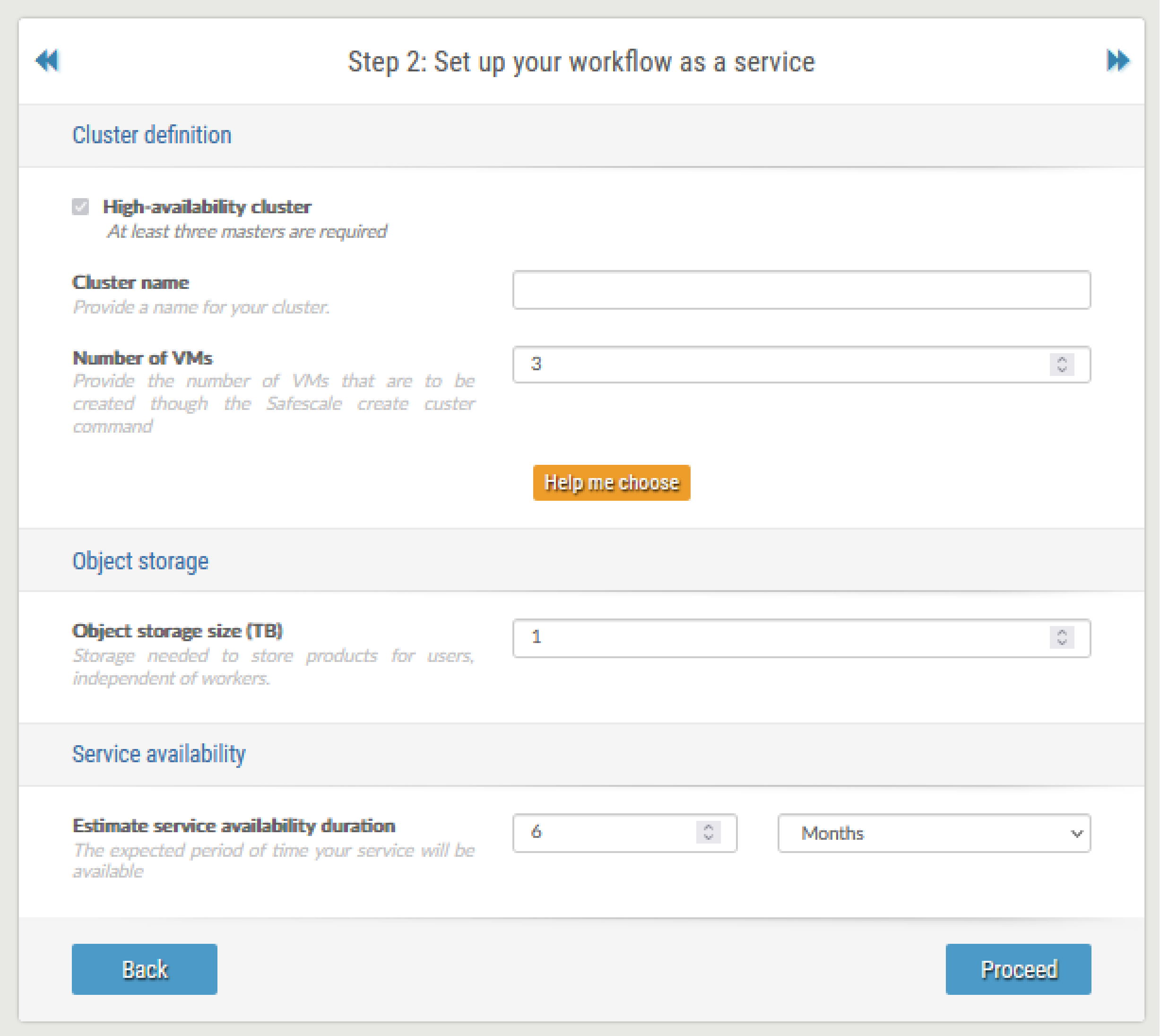
- As yet another layer of indirection, WaaS provides a higher level of integration than KaaS or IaaS. The workflow abstraction allows application developers and operators to reason about applications as a series, or graph, of tasks to be executed, rather than an application to be deployed and maintained.

- Resource constraints can be specified on individual units of work without having to worry about provisioning, allocation or deallocation of computing resources. Usage of the underlying infrastructure is thus tailored to the exact runtime needs of individual processing jobs or applications, increasing resource utilization efficiency and reducing costs.
- Application developers can focus on developing individual processors, or tasks, using whichever technology they are the most familiar with such as any programming language packaged application or simple scripts. Data access can be made assuming data locality on the task's POSIX-like file system by referring to distant objects via configuration only, leveraging efficient, automatic and cost saving data retrieval offered by the SnapEarth platform.
- Workloads or applications requiring the consumption of external data sources or streams of events/data can also benefit from built-in ways to connect their processing tasks to ingoing or outgoing Web API/Web Hooks, event queues, storage watchers or scheduled (CRON-like) planning.
- For a higher ease of use, the SnapEarth platform will also provide support for continuous integration and continuous deployment (CI/CD) through capabilities such as automated Git repositories watching (GitOps) so that operators and developers can easily push forward new workflow definitions, and let the SnapEarth platform perform deployment changes, without resorting to direct communication/interaction with their cluster.

Nevertheless, some drawbacks also exist in the usage of KaaS:

- In the same manner that integration at the KaaS solution level abstracts the complexity of the IaaS solution, integration at the WaaS level abstracts the complexity of the KaaS solution, but does so by introducing new concepts that operators need to learn.
- Moreover, workflow technologies, such as the workflow framework provided by the SnapEarth platform, but other too, don't abstract the underlying container orchestration solution they are based on in its totality. This means that, sometimes, for specific tasks, operators and/or application developers may need to familiarize themselves with some concepts of the underlying stack, such as Kubernetes, in order to perform tasks and leverage the power of the platform.
- Formation and resource docs will be available to users of the SnapEarth platform in order to get started with container orchestration and workflow technologies.

When the user is selecting Workflow as a Service, they can deploy and manage their workflows using Workflow management tools they are the most familiar with by focusing on building, deploying and operating their workflows without worrying about the underlying architecture.



Step 2: Set up your workflow as a service

Cluster definition

☑ High-availability cluster
At least three masters are required

Cluster name
Provide a name for your cluster.

Number of VMs: 3
Provide the number of VMs that are to be created though the Safescale create custer command

Object storage

Object storage size (TB): 1
Storage needed to store products for users, independent of workers.

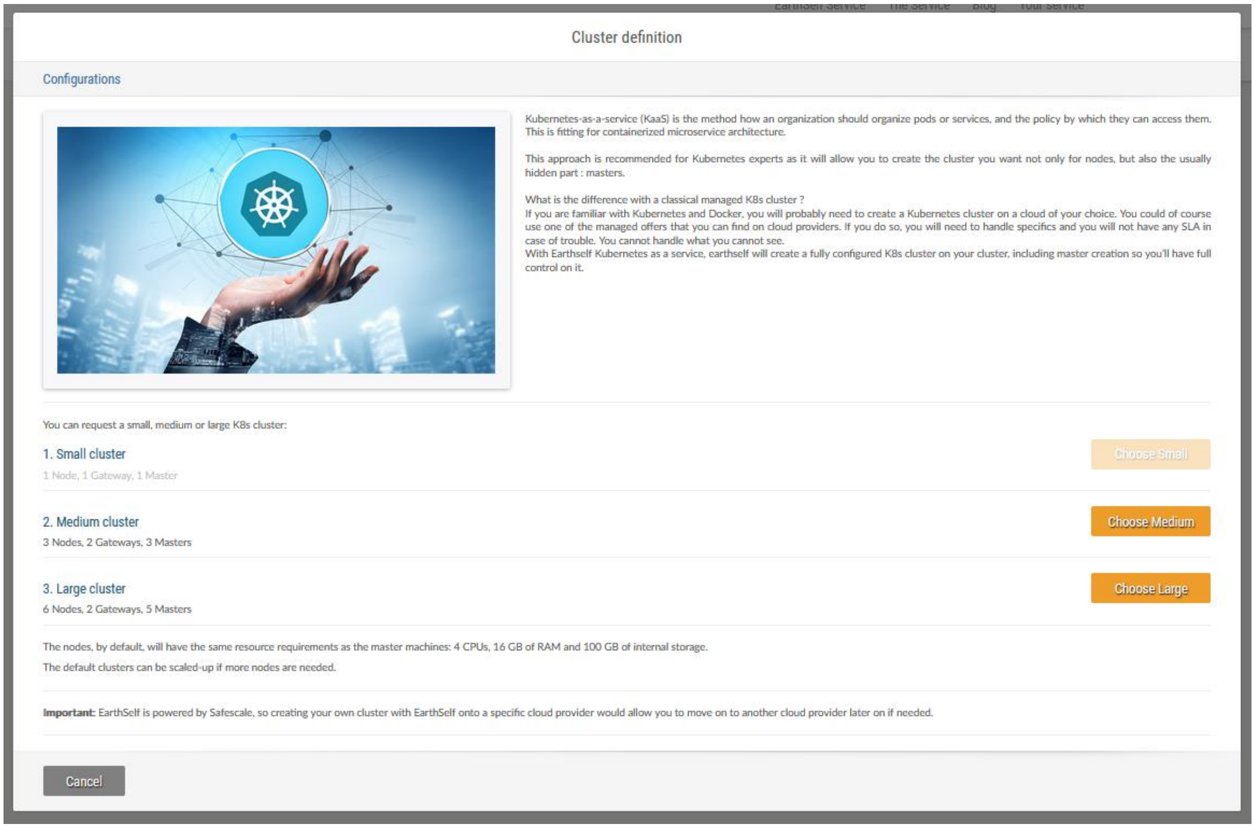
Service availability

Estimate service availability duration: 6 Months
The expected period of time your service will be available

Figure 27 - Set up your Workflow as a Service

Similar to the Kubernetes as a service, the request form allows the user to select the number of workers (virtual machines) depending on the service to be deployed. A cluster name will also be required during the cluster creation so the user must provide it.

A help page is available where the user can inspect the capabilities of each type of configuration.



Cluster definition

Configurations

Kubernetes-as-a-service (KaaS) is the method how an organization should organize pods or services, and the policy by which they can access them. This is fitting for containerized microservice architecture.

This approach is recommended for Kubernetes experts as it will allow you to create the cluster you want not only for nodes, but also the usually hidden part : masters.

What is the difference with a classical managed K8s cluster ?
If you are familiar with Kubernetes and Docker, you will probably need to create a Kubernetes cluster on a cloud of your choice. You could of course use one of the managed offers that you can find on cloud providers. If you do so, you will need to handle specifics and you will not have any SLA in case of trouble. You cannot handle what you cannot see.
With Earthself Kubernetes as a service, earthself will create a fully configured K8s cluster on your cluster, including master creation so you'll have full control on it.

You can request a small, medium or large K8s cluster:

1. Small cluster
1 Node, 1 Gateway, 1 Master

2. Medium cluster
3 Nodes, 2 Gateways, 3 Masters

3. Large cluster
6 Nodes, 2 Gateways, 5 Masters

The nodes, by default, will have the same resource requirements as the master machines: 4 CPUs, 16 GB of RAM and 100 GB of internal storage.

The default clusters can be scaled-up if more nodes are needed.

Important: EarthSelf is powered by Safescale, so creating your own cluster with EarthSelf onto a specific cloud provider would allow you to move on to another cloud provider later on if needed.

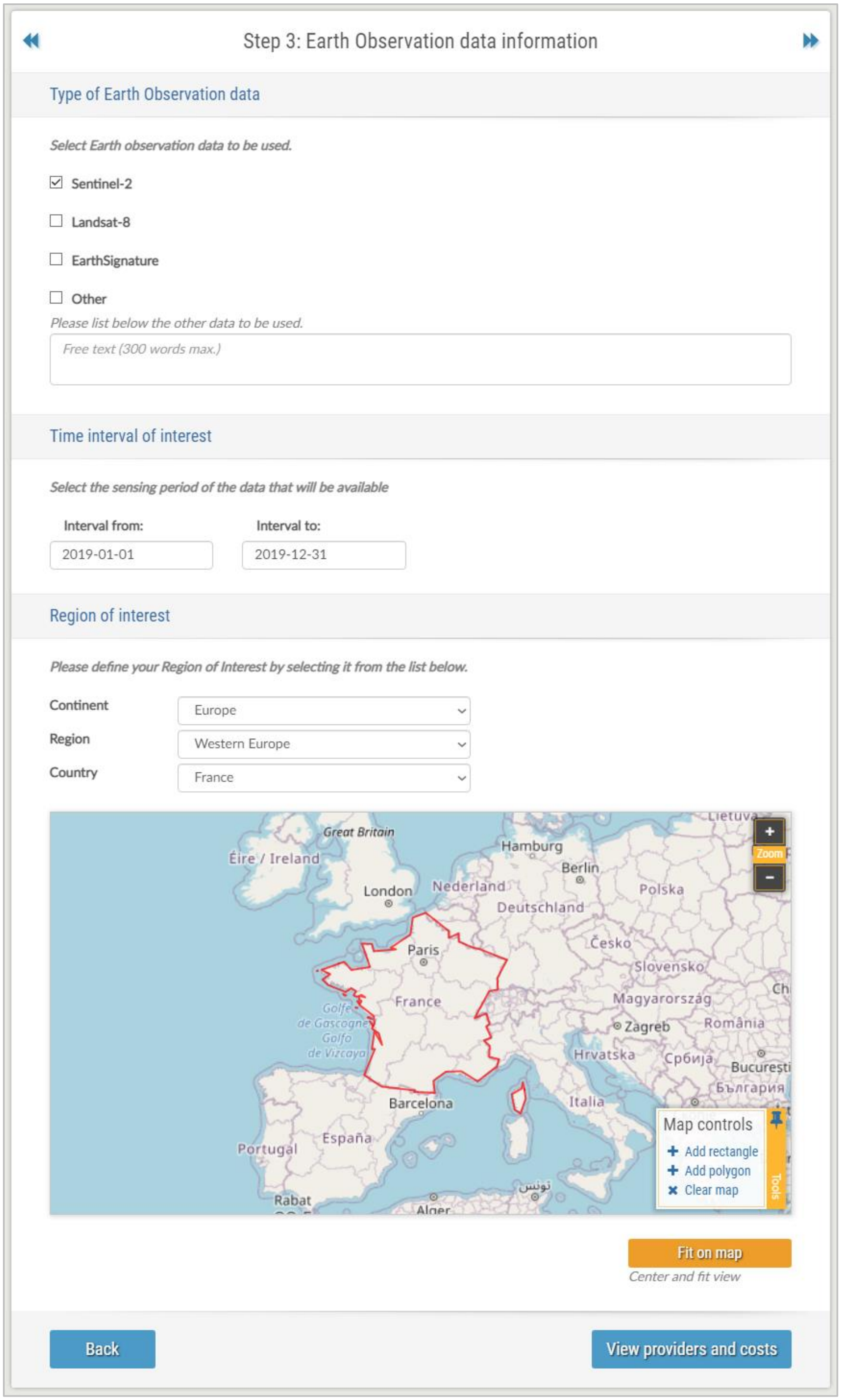
4.2.3 EO data information

The next step in configuring the request is defining the EO data information.

The user must provide information about the followings:

- EO data to be used
- Time interval of interest
- Region of interest

Although not all the above requested information is directly used in the total cost computation for the user virtual machines, they are used by the Suggest Engine to compute a score depending on the cloud provider availability of data. For example, a user requesting a region from Africa might find out that not all cloud providers are offering the Sentinel-2 products for his region or are providing them upon request (which means the products are archived and they are made available online upon request, operation that could take even several hours). Similarly, some cloud providers might offer or not Landsat 8 or Sentinel-1 data or the products are kept online only for the last month. All these are influencing the score and the results from the cloud providers are sorted such the most relevant and close to the user's criteria (highest score with a scale from 0 to 5) are displayed on the top. Nevertheless, the less relevant machines are still displayed in the list, the user having the possibility to select them if his main constraint is the price, and the data availability is not a critical one.



Step 3: Earth Observation data information

Type of Earth Observation data

Select Earth observation data to be used.

☑ Sentinel-2

□ Landsat-8

□ EarthSignature

□ Other

Please list below the other data to be used.

Free text (300 words max.)

Time interval of interest

Select the sensing period of the data that will be available

Interval from:	Interval to:
2019-01-01	2019-12-31

Region of interest

Please define your Region of Interest by selecting it from the list below.

Continent	Europe
Region	Western Europe
Country	France

Fit on map

Center and fit view

Back

View providers and costs

Figure 28: EO data information

EO data to be used

The user can select from a given list the type of EO data:

- Sentinel-2
- Landsat-8

There is also a free text field where the user can describe any other type of EO data that might be used. The helpdesk service will investigate and give feedback about its availability.

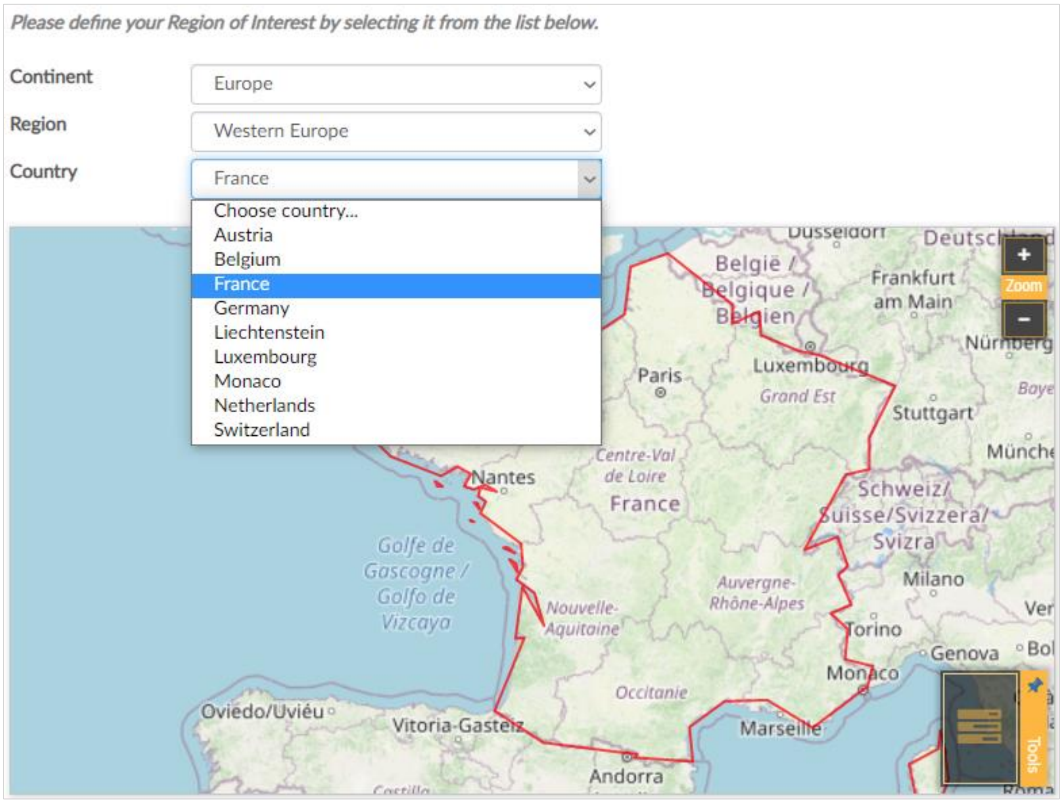
Time interval of interest

Along with the type of EO data, the user must also provide an interval of time defining the sensing period of the data that will be available.

Region of interest

Using an interactive map, the user can define the region of interest for the EO data. A region can be defined in two ways:

- By selecting a country from the provided list of regions



Please define your Region of Interest by selecting it from the list below.

Continent: Europe

Region: Western Europe

Country: France

Figure 29: Select region interest from predefined list

- Drawing the actual region using the available map tools.
  The user has the possibility to directly draw on the map a simple rectangle or a complex polygon by selecting the appropriate tool available on the “Map controls” section.

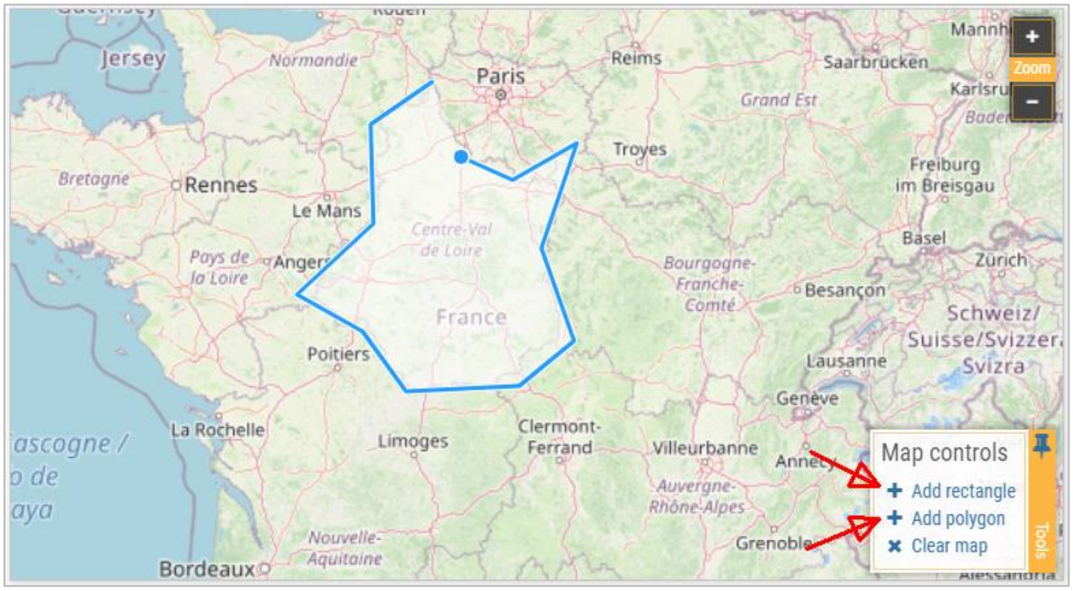


Figure 30: Define a custom region

Furthermore, the user can adjust the defined region by using the feature handlers:

- Scale
- Rotate
- Pan

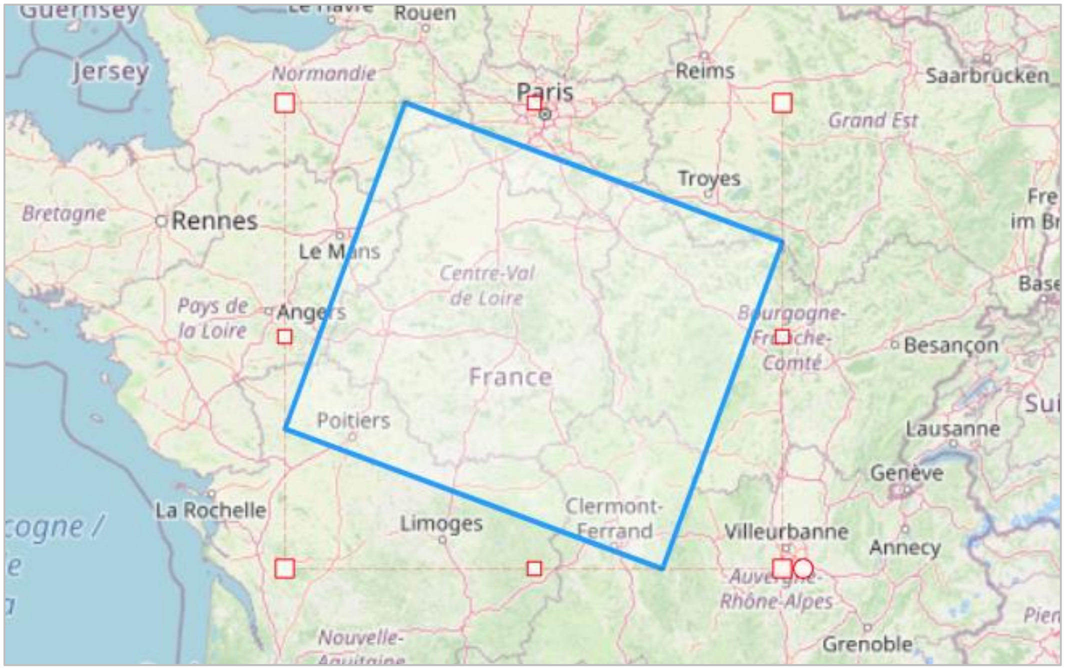
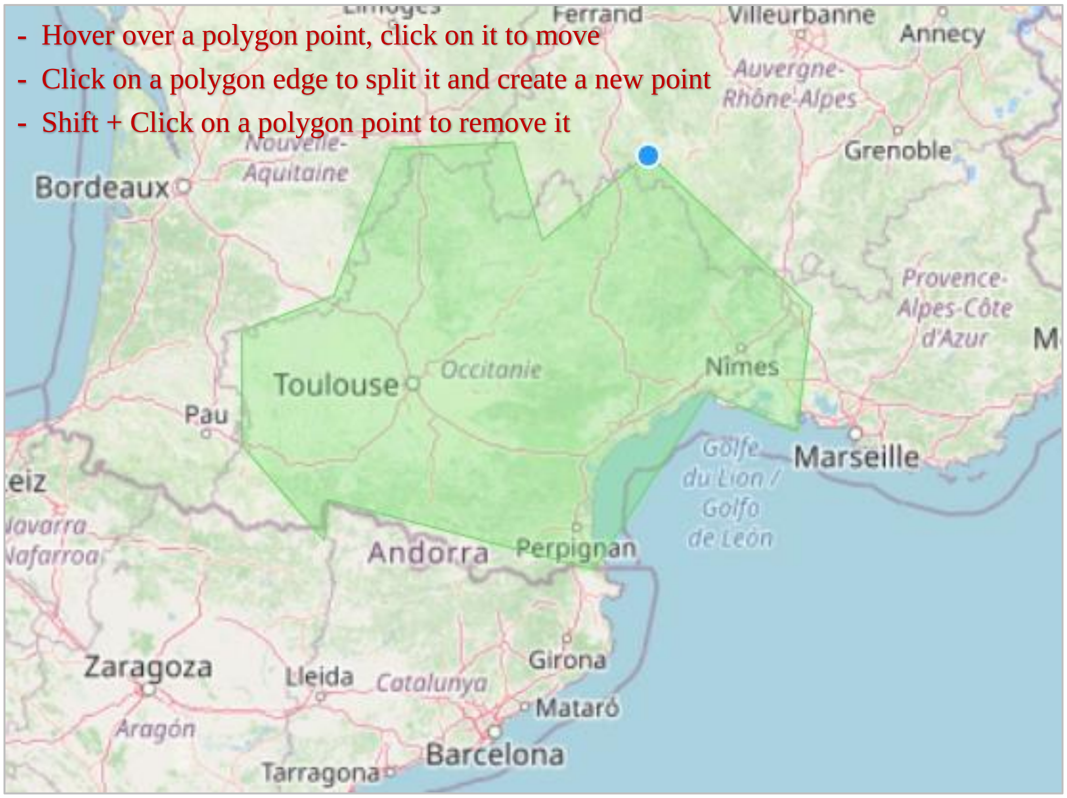


Figure 31: Adjust a feature on the map

By double-clicking on the defined polygon, it enters edit mode where the user can add, remove or reposition polygons points and edges. To exit the edit mode, the user must double-click again the polygon.



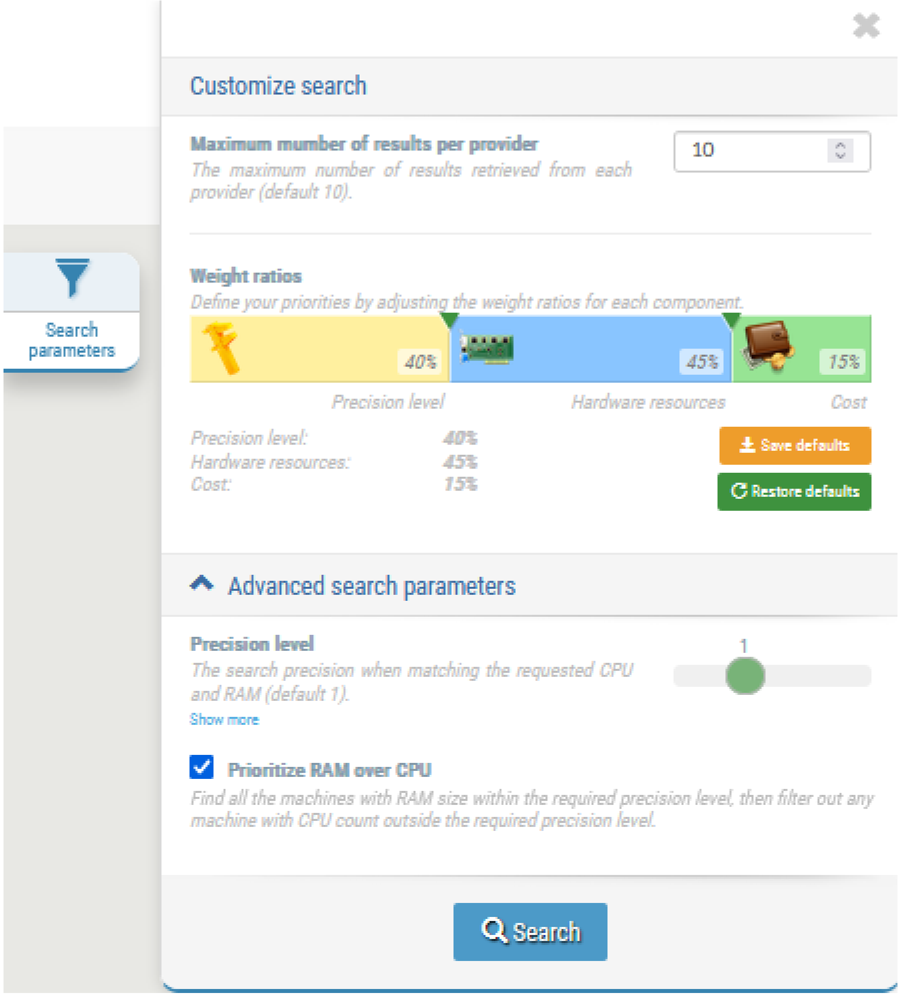
- Hover over a polygon point, click on it to move
- Click on a polygon edge to split it and create a new point
- Shift + Click on a polygon point to remove it

Figure 32: Edit a feature on the map

4.2.4 Customize search

The last step in Service Deployment Request is the configuration of Suggest Engine search algorithm and selecting a provider from the returned list. A brief description of the algorithm and the inputs used by the Suggest Engine to compute the score for each cloud provided can be found in "Deliverable D4.1: EarthSelf-Service Definition Document", section "4.3.1 Suggest Engine". Also, the Suggest Engine API and the detailed algorithm can be found in Annex 2 – Suggest Engine API and Annex 3 – Suggest Engine Algorithm, respectively.

The Suggest Engine is an algorithm that searches for virtual machines from several cloud providers, machines that satisfy the configuration requirements defined by the user on the second step.



Customize search

Maximum number of results per provider
The maximum number of results retrieved from each provider (default 10).
10

Weight ratios
Define your priorities by adjusting the weight ratios for each component.

Precision level	Hardware resources	Cost
40%	45%	15%

Precision level: 40%
Hardware resources: 45%
Cost: 15%

Advanced search parameters

Precision level
The search precision when matching the requested CPU and RAM (default 1).
1

☑ Prioritize RAM over CPU
Find all the machines with RAM size within the required precision level, then filter out any machine with CPU count outside the required precision level.

Figure 33: Configure search

Search configuration parameters slide into view when “Search parameters” control is accessed.

The user can customize:

- Maximum number of machines – for each provider, the user can define how many virtual machined are to be retrieved. These will be the top score machines for every provider, calculated according to all other search parameters.
- Precision level – this parameter guides the Suggest Engine on how to handle any machine with computing resources different from what user has requested.

  For example, when requesting 32 GB of RAM:

  - Unfiltered search will match everything: 1 GB, 2 GB, 8 GB, 16 GB, 20 GB, 24 GB, 32 GB, 60 GB, 64 GB, 128 GB, etc.
  - Precision level 0: prioritize machines with 32 GB, then return all other;
  - Precision level 1: prioritize machines with 32 GB, then with 24 GB and 60 GB, and then return all remaining;

  - Precision level 2: prioritize machines with 32 GB, then level 1 machines with 24 GB and 60 GB, afterwards level 2 machines with 20 GB and 64 GB and only then return the remaining;
- RAM/CPU priority – the user can decide if RAM size is more important than the CPU count. The idea behind this parameter is to force the algorithm to search first for all machines that satisfy the RAM requirements and then, on the resulted list, to apply the CPU count requirement.
- Weight ratios – the user can define which parameter is more important when calculating the score for each machine in the list retrieved by the Suggest Engine algorithm.

The weight ratios are:

  - Machine cost ratio – this ratio controls how much the score decreases with the increasing of machine cost. The default value is 40.
  - Hardware resources ratio – this ratio controls how much the score decreases when the hardware resources do not satisfy the user request. The default value is 45.
  - Precision level ratio – the farther the machine resources are from the requested configuration, the lower the score. This ratio applies both ways. Machines that are too powerful will also get low score. The default value is 15.

The weight ratios default values were chosen this way taking into account that:

  - User is most often interested in retrieving first the hardware configuration close to his processing needs and therefore, it has the highest weight.
  - Another important aspect is also the price (having a weight close to the hardware configuration), from two identical or very close machine configurations differing only slightly (for example only by the storage), the higher weight is given to the one that is cheaper.
  - The lowest weight is given to the precision level.

Nevertheless, the user can change at any time the weights according to his preferences or needs, the application allowing him to apply some ratios, check the results and then come back to change them, in order to see the differences before selecting the machines and submitting the request.

Based on the weight ratios, the following formula is applied by the Suggest Engine for computing the score of the machines:

Machine score = Machine cost ratio * machine cost score +
Hardware resources ratio * Machine Hardware Score +
Precision level ratio * Precision Level Score

Where:

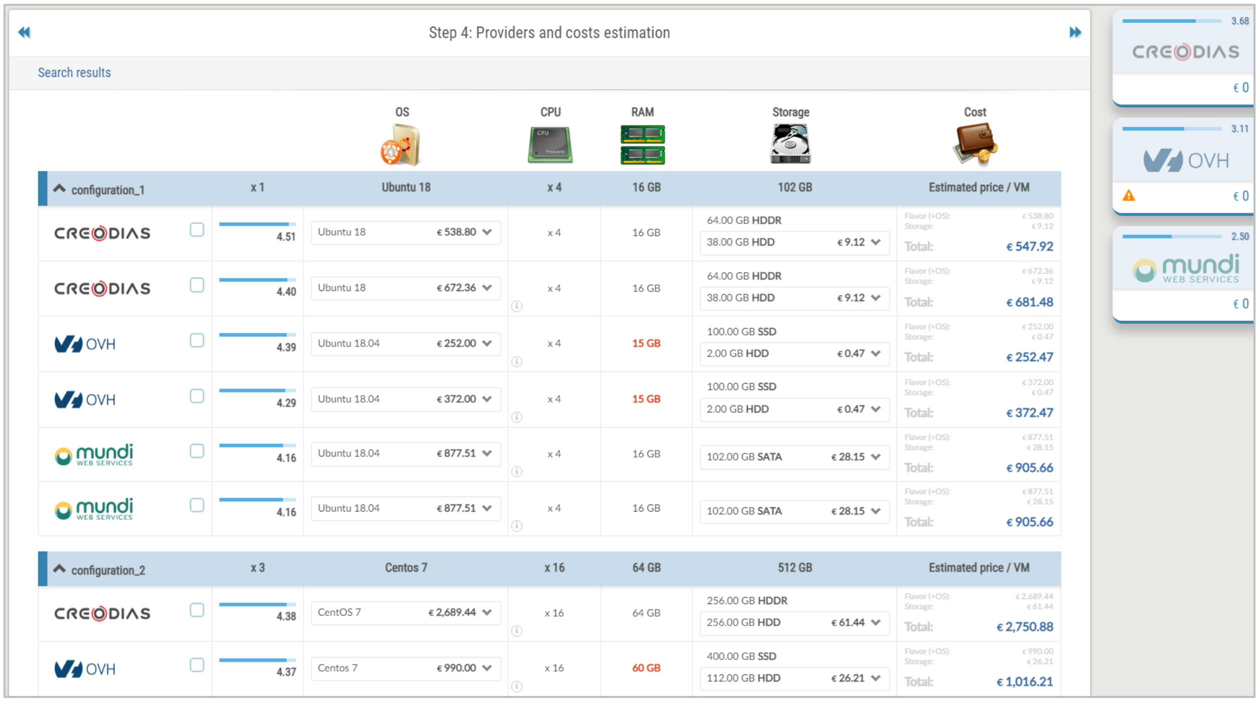
- Machine cost score – is the score of the cost of the machine in the cloud provider's list of available machines
- Machine hardware score - is the score of the hardware of the machine (CPU, RAM and storage) in the cloud provider's list of available machines
- Precision level score – the precision level score computed according to the provided precision level, in the cloud provider's list of available machines

For more details about the individual score calculations, please refer to section Annex 3 – Suggest Engine Algorithm.

4.2.5 Select provider and machine configurations

The Suggest Engine results are grouped in two categories:

- Cloud providers
- Virtual machines



Step 4: Providers and costs estimation

Search results

			OS	CPU	RAM	Storage	Cost
configuration_1		x 1	Ubuntu 18	x 4	16 GB	102 GB	Estimated price / VM
CREODIAS	□	4.51	Ubuntu 18 € 538.80	x 4	16 GB	64.00 GB **HDDR** 38.00 GB **HDD** € 9.12	Flavor (+OS): € 538.80 Storage: € 9.12 Total: € 547.92
CREODIAS	□	4.40	Ubuntu 18 € 672.36	x 4	16 GB	64.00 GB **HDDR** 38.00 GB **HDD** € 9.12	Flavor (+OS): € 672.36 Storage: € 9.12 Total: € 681.48
OVH	□	4.39	Ubuntu 18.04 € 252.00	x 4	15 GB	100.00 GB **SSD** 2.00 GB **HDD** € 0.47	Flavor (+OS): € 252.00 Storage: € 0.47 Total: € 252.47
OVH	□	4.29	Ubuntu 18.04 € 372.00	x 4	15 GB	100.00 GB **SSD** 2.00 GB **HDD** € 0.47	Flavor (+OS): € 372.00 Storage: € 0.47 Total: € 372.47
mundi WEB SERVICES	□	4.16	Ubuntu 18.04 € 877.51	x 4	16 GB	102.00 GB **SATA** € 28.15	Flavor (+OS): € 877.51 Storage: € 28.15 Total: € 905.66
mundi WEB SERVICES	□	4.16	Ubuntu 18.04 € 877.51	x 4	16 GB	102.00 GB **SATA** € 28.15	Flavor (+OS): € 877.51 Storage: € 28.15 Total: € 905.66
configuration_2		x 3	Centos 7	x 16	64 GB	512 GB	Estimated price / VM
CREODIAS	□	4.38	CentOS 7 € 2,689.44	x 16	64 GB	256.00 GB **HDDR** 256.00 GB **HDD** € 61.44	Flavor (+OS): € 2,689.44 Storage: € 61.44 Total: € 2,750.88
OVH	□	4.37	Centos 7 € 990.00	x 16	60 GB	400.00 GB **SSD** 112.00 GB **HDD** € 26.21	Flavor (+OS): € 990.00 Storage: € 26.21 Total: € 1,016.21

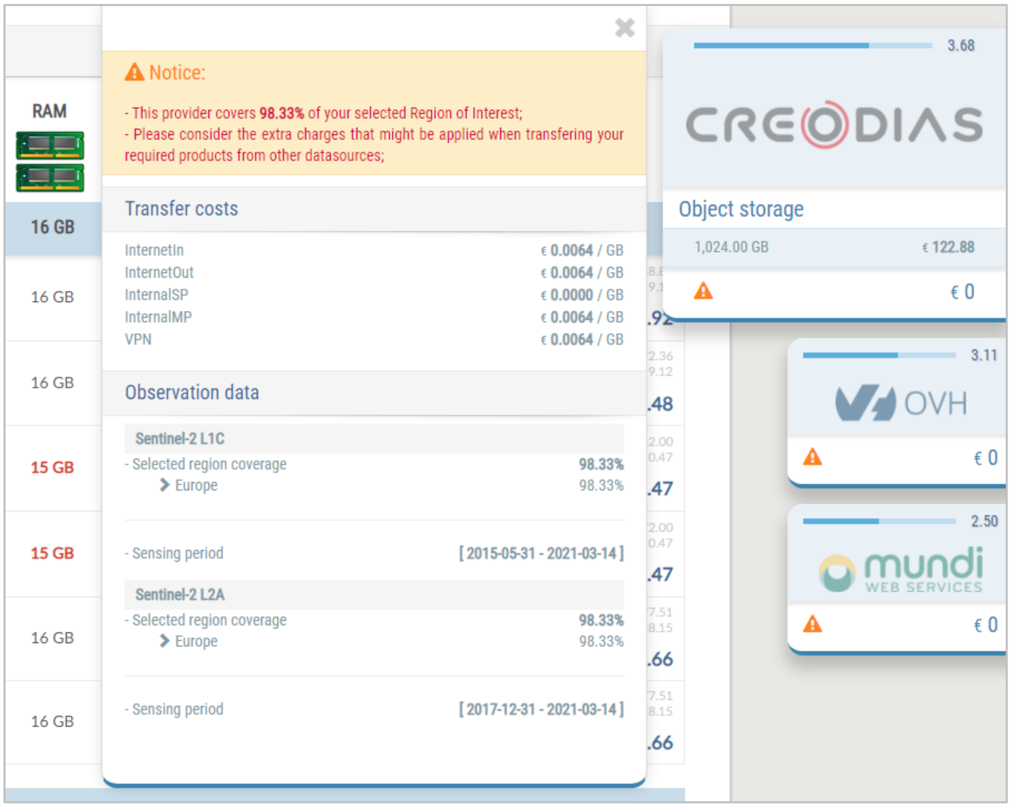
CREODIAS	3.68	€ 0
OVH	3.11	⚠ € 0
mundi WEB SERVICES	2.50	€ 0

Figure 34: Search results

The list of cloud providers which is returned by the Suggest Engine is displayed on the right side of the screen. Each provider in this list is depicted as a container which functions as a shopping cart. By default, the containers are collapsed, only showing limited information:

- the provider’s name and logo.
- ranking position within the providers list.
- the total cost of the components that have been selected from the available resources. notification icon which warns about possible resource limitations. The user should first examine these warnings before deciding to use any resource from that provider.

To examine all information available for a provider, the user must expand its corresponding container by clicking on the logo/name. While expanding, the provider details will slide into view next to the selected container, which in turns also expands and now will display complete details about the user selected resources.



Notice:

- This provider covers **98.33%** of your selected Region of Interest;
- Please consider the extra charges that might be applied when transfering your required products from other datasources;

Transfer costs

InternetIn	€ **0.0064** / GB
InternetOut	€ **0.0064** / GB
InternalSP	€ **0.0000** / GB
InternalMP	€ **0.0064** / GB
VPN	€ **0.0064** / GB

Observation data

Sentinel-2 L1C

- Selected region coverage	**98.33%**
› Europe	98.33%
- Sensing period	**[2015-05-31 - 2021-03-14]**

Sentinel-2 L2A

- Selected region coverage	**98.33%**
› Europe	98.33%
- Sensing period	**[2017-12-31 - 2021-03-14]**

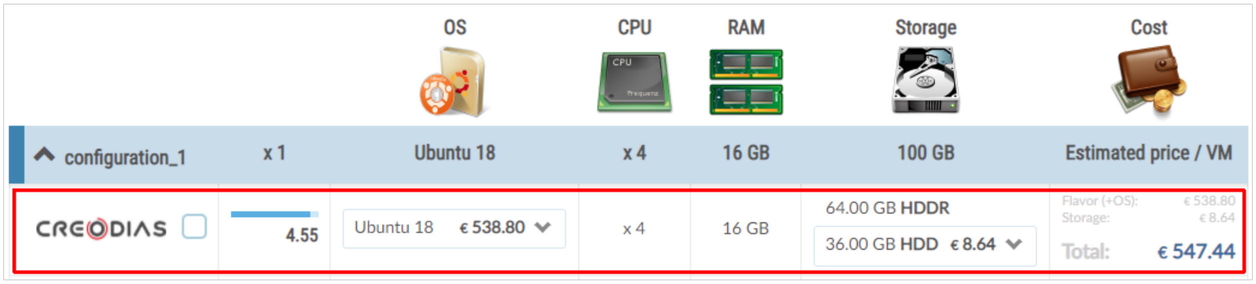
Figure 35: Provider details

The provider details panel displays information related to EO data request. When certain requirements are not met, information notices are displayed at the top. These notices can be related to region coverage, sensing period requirement not being satisfied or extra costs due to certain provider limitations. Other information available in the provider details panel is the detailed list of transfer costs. The user must take into consideration these extra costs, which are not reflected in the final estimation cost for the request.

Selecting a machine configuration

The search results are grouped by configurations. These configurations have been defined by the user in the request's second step. Within each configuration list, the machines are sorted according to the Suggest Engine score. As explained in the search paragraph (see 4.2.4), these scores can be tweaked by the user.

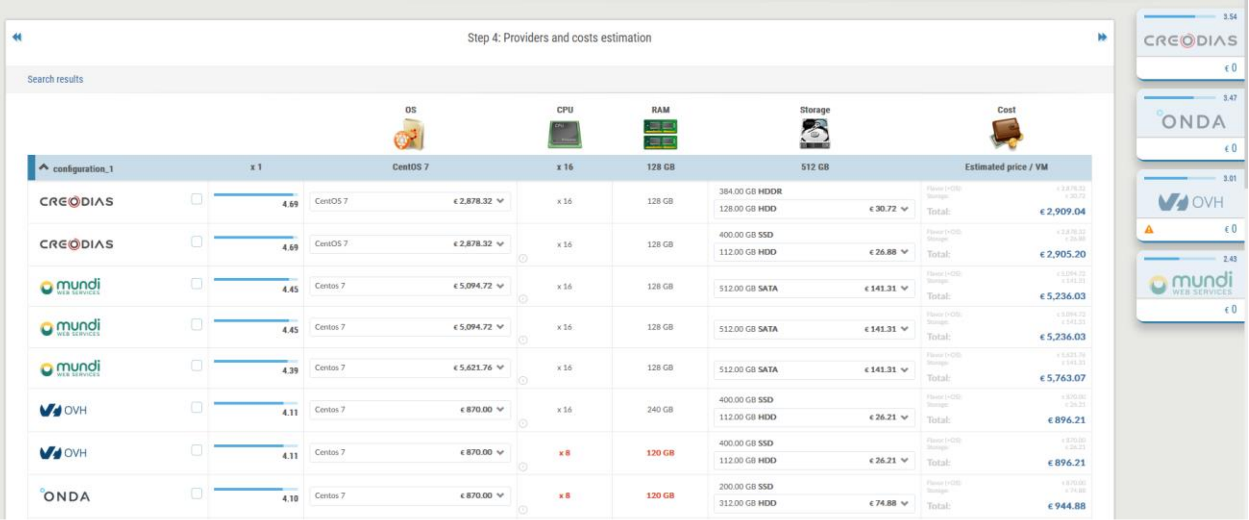
The list of virtual machines can be displayed in two different ways depending on screen size. On large displays, the list is presented as a table with each virtual machine as a row in the table.



		OS	CPU	RAM	Storage	Cost
configuration_1	x 1	Ubuntu 18	x 4	16 GB	100 GB	Estimated price / VM
CREODIAS ☐	4.55	Ubuntu 18 € 538.80	x 4	16 GB	64.00 GB HDDR 36.00 GB HDD € 8.64	Flavor (+OS): € 538.80 Storage: € 8.64 Total: € 547.44

Figure 36: Virtual machine displayed as a table

On smaller screens, the list is presented as a grid:



Step 4: Providers and costs estimation

Search results

		OS	CPU	RAM	Storage	Cost
configuration_1	x 1	CentOS 7	x 16	128 GB	512 GB	Estimated price / VM
CREODIAS ☐	4.69	CentOS 7 € 2,878.32	x 16	128 GB	384.00 GB HDDR 128.00 GB HDD € 30.72	Flavor (+OS): Storage: Total: € 2,909.04
CREODIAS ☐	4.69	CentOS 7 € 2,878.32	x 16	128 GB	400.00 GB SSD 112.00 GB HDD € 26.88	Flavor (+OS): Storage: Total: € 2,905.20
mundi WEB SERVICES ☐	4.45	Centos 7 € 5,094.72	x 16	128 GB	512.00 GB SATA € 141.31	Flavor (+OS): Storage: Total: € 5,236.03
mundi WEB SERVICES ☐	4.45	Centos 7 € 5,094.72	x 16	128 GB	512.00 GB SATA € 141.31	Flavor (+OS): Storage: Total: € 5,236.03
mundi WEB SERVICES ☐	4.39	Centos 7 € 5,621.76	x 16	128 GB	512.00 GB SATA € 141.31	Flavor (+OS): Storage: Total: € 5,763.07
OVH ☐	4.11	Centos 7 € 870.00	x 16	240 GB	400.00 GB SSD 112.00 GB HDD € 26.21	Flavor (+OS): Storage: Total: € 896.21
OVH ☐	4.11	Centos 7 € 870.00	x 8	120 GB	400.00 GB SSD 112.00 GB HDD € 26.21	Flavor (+OS): Storage: Total: € 896.21
ONDA ☐	4.10	Centos 7 € 870.00	x 8	120 GB	200.00 GB SSD 312.00 GB HDD € 74.88	Flavor (+OS): Storage: Total: € 944.88

CREODIAS	3.54	€ 0
ONDA	3.47	€ 0
OVH	3.01	⚠ € 0
mundi WEB SERVICES	2.43	€ 0

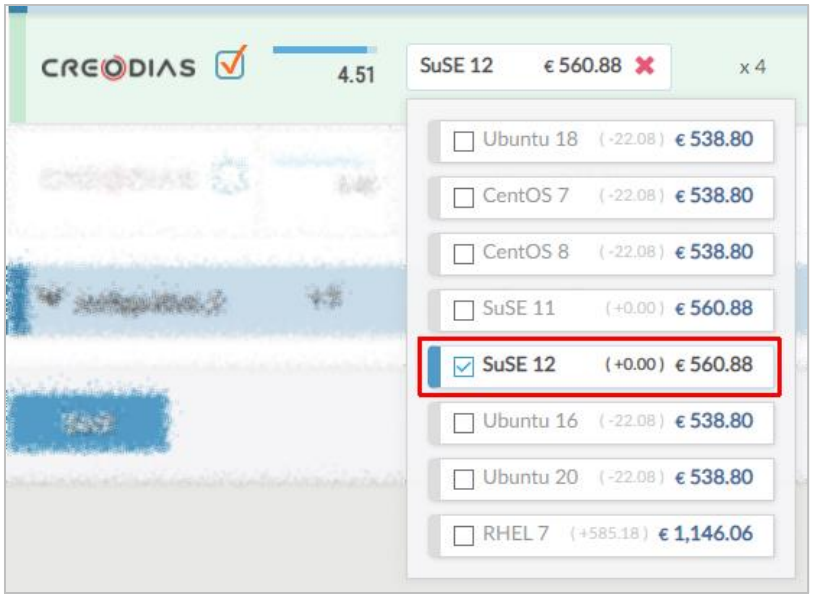
Figure 37: Virtual machine displayed as a grid

Each row/card provides information about:

- Cloud provider logo/name;
- Suggest Engine score;
- Operating system;
- CPUs count;
- Additional hardware information;
- Amount of RAM;
- Storage;
- Estimated cost for selection;

If necessary, the user can change the operating system or the type of extra storage.

The operating system control is a list which includes all available operating systems from the provider. Each operating system has its own base price, which defines the cost for the flavor. In the following picture, the price seen at the right of the operating system name is the actual base price of the virtual machine including the OS. To make it easier for the user to compare flavors, a price difference is displayed between OS name and the price.



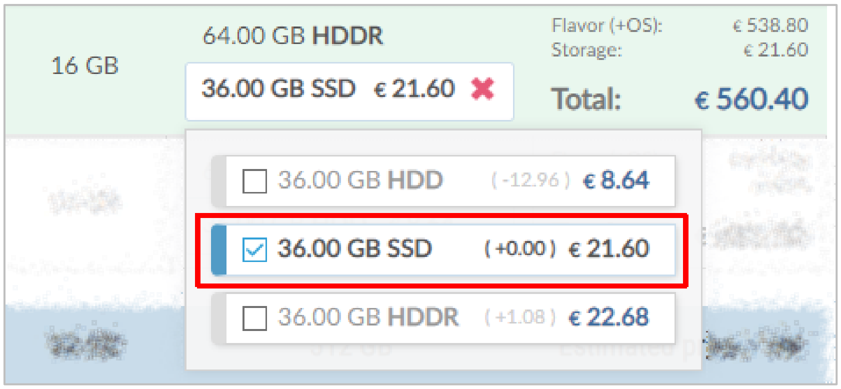
CREODIAS ☑ 4.51 SuSE 12 € 560.88 ✖ x 4

☐	Ubuntu 18	(-22.08)	€ 538.80
☐	CentOS 7	(-22.08)	€ 538.80
☐	CentOS 8	(-22.08)	€ 538.80
☐	SuSE 11	(+0.00)	€ 560.88
☑	SuSE 12	(+0.00)	€ 560.88
☐	Ubuntu 16	(-22.08)	€ 538.80
☐	Ubuntu 20	(-22.08)	€ 538.80
☐	RHEL 7	(+585.18)	€ 1,146.06

Figure 38: Changing operating system

An OS selection is mandatory, so when user deselects the current choice, the system will automatically choose the default OS, which usually is the less expensive in the list.

A similar control is implemented for the additional storage. A list of additional storage options is presented to the user when the requested amount of storage is not found on the current machine. For example, if the user has requested 100 GB of storage but the current machine flavor only offers 64 GB, the Suggest Engine will present the extra costs for the additional 36 GB.



16 GB

64.00 GB HDDR

36.00 GB SSD € 21.60 ✖

Flavor (+OS): € 538.80
Storage: € 21.60

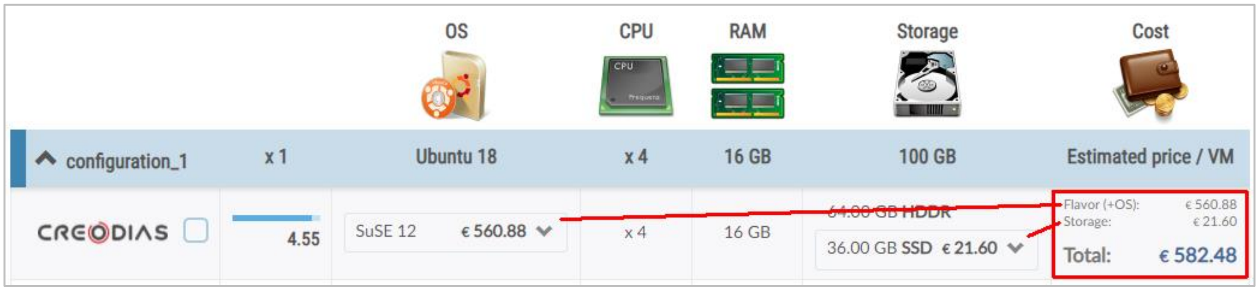
Total: € 560.40

☐	36.00 GB HDD	(-12.96)	€ 8.64
☑	36.00 GB SSD	(+0.00)	€ 21.60
☐	36.00 GB HDDR	(+1.08)	€ 22.68

Figure 39: Selecting additional storage type

When current flavor does not offer the requested storage size, the additional storage selection is mandatory. If the user is satisfied with the flavor’s default storage and does not want any additional costs, he/she can go back to step 2, change the requested amount accordingly and restart the search.

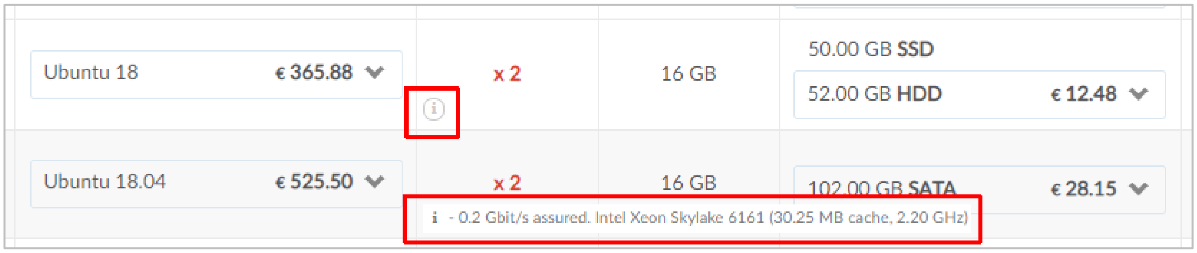
Each time the user customizes the flavor resources (OS, additional storage) the total estimated price is updated to reflect the selection. This can be seen in the last table cell if the flavor table row.



		OS	CPU	RAM	Storage	Cost
configuration_1	x 1	Ubuntu 18	x 4	16 GB	100 GB	Estimated price / VM
CREODIAS □	4.55	SuSE 12 € 560.88	x 4	16 GB	~~64.00 GB HDDR~~ 36.00 GB SSD € 21.60	Flavor (+OS): € 560.88 Storage: € 21.60 Total: € 582.48

Figure 40: Update virtual machine total cost

In the same location with the CPU count, the user can find some additional hardware information by hovering above the (i) icon.

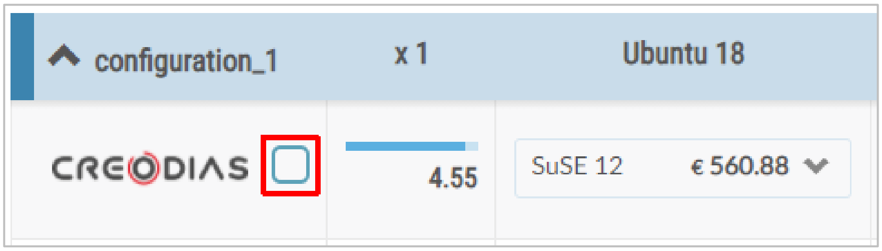


Ubuntu 18 € 365.88	x 2 ⓘ	16 GB	50.00 GB SSD 52.00 GB HDD € 12.48
Ubuntu 18.04 € 525.50	x 2	16 GB	102.00 GB SATA € 28.15

i - 0.2 Gbit/s assured. Intel Xeon Skylake 6161 (30.25 MB cache, 2.20 GHz)

Figure 41: Flavor additional hardware information

After inspecting all the results, the user can decide with which provider to continue with his request. To select a virtual machine from the list, the user must click on the checkbox control situated next to the provider logo/name:

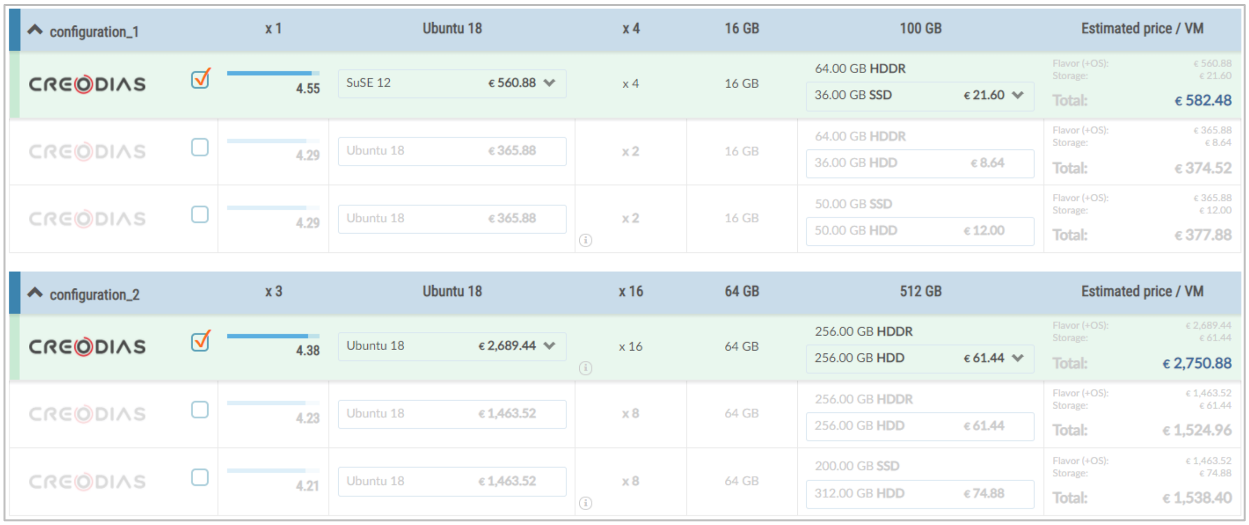


configuration_1	x 1	Ubuntu 18
CREODIAS □	4.55	SuSE 12 € 560.88

Figure 42: Select virtual machine

Upon selection, all flavors not belonging to the selected cloud provider are hidden. This happens for all configurations. The selected flavor is highlighted and all siblings dimmed. The user can switch to another flavor from the same provider.

To proceed with the request, the user must select one flavor from each configuration.



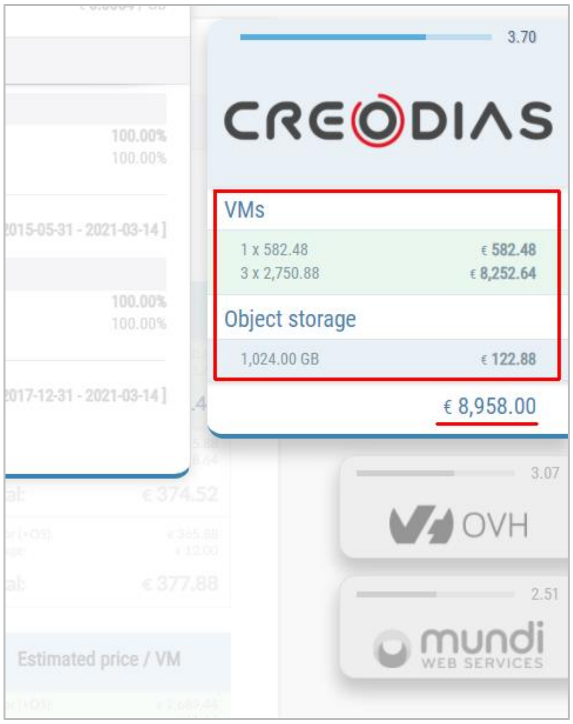
configuration_1		x 1	Ubuntu 18	x 4	16 GB	100 GB	Estimated price / VM
CREODIAS	☑	4.55	SuSE 12 € 560.88	x 4	16 GB	64.00 GB **HDDR** 36.00 GB **SSD** € 21.60	Flavor (+OS): € 560.88 Storage: € 21.60 Total: € 582.48
CREODIAS	□	4.29	Ubuntu 18 € 365.88	x 2	16 GB	64.00 GB **HDDR** 36.00 GB **HDD** € 8.64	Flavor (+OS): € 365.88 Storage: € 8.64 Total: € 374.52
CREODIAS	□	4.29	Ubuntu 18 € 365.88	x 2	16 GB	50.00 GB **SSD** 50.00 GB **HDD** € 12.00	Flavor (+OS): € 365.88 Storage: € 12.00 Total: € 377.88

configuration_2		x 3	Ubuntu 18	x 16	64 GB	512 GB	Estimated price / VM
CREODIAS	☑	4.38	Ubuntu 18 € 2,689.44	x 16	64 GB	256.00 GB **HDDR** 256.00 GB **HDD** € 61.44	Flavor (+OS): € 2,689.44 Storage: € 61.44 Total: € 2,750.88
CREODIAS	□	4.23	Ubuntu 18 € 1,463.52	x 8	64 GB	256.00 GB **HDDR** 256.00 GB **HDD** € 61.44	Flavor (+OS): € 1,463.52 Storage: € 61.44 Total: € 1,524.96
CREODIAS	□	4.21	Ubuntu 18 € 1,463.52	x 8	64 GB	200.00 GB **SSD** 312.00 GB **HDD** € 74.88	Flavor (+OS): € 1,463.52 Storage: € 74.88 Total: € 1,538.40

Figure 43: Complete configuration selection

The user selection is also reflected on the provider’s shopping carts. Current provider contents are updated with user’s selection, whilst all other carts are deactivated.

The total estimated cost is displayed at the bottom of the provider’s cart and it includes the cost of each selected flavor multiplied by the number of requested VMs of each type, plus the cost of the requested object storage.



VMs

1 x 582.48	€ 582.48
3 x 2,750.88	€ 8,252.64

Object storage

1,024.00 GB	€ 122.88

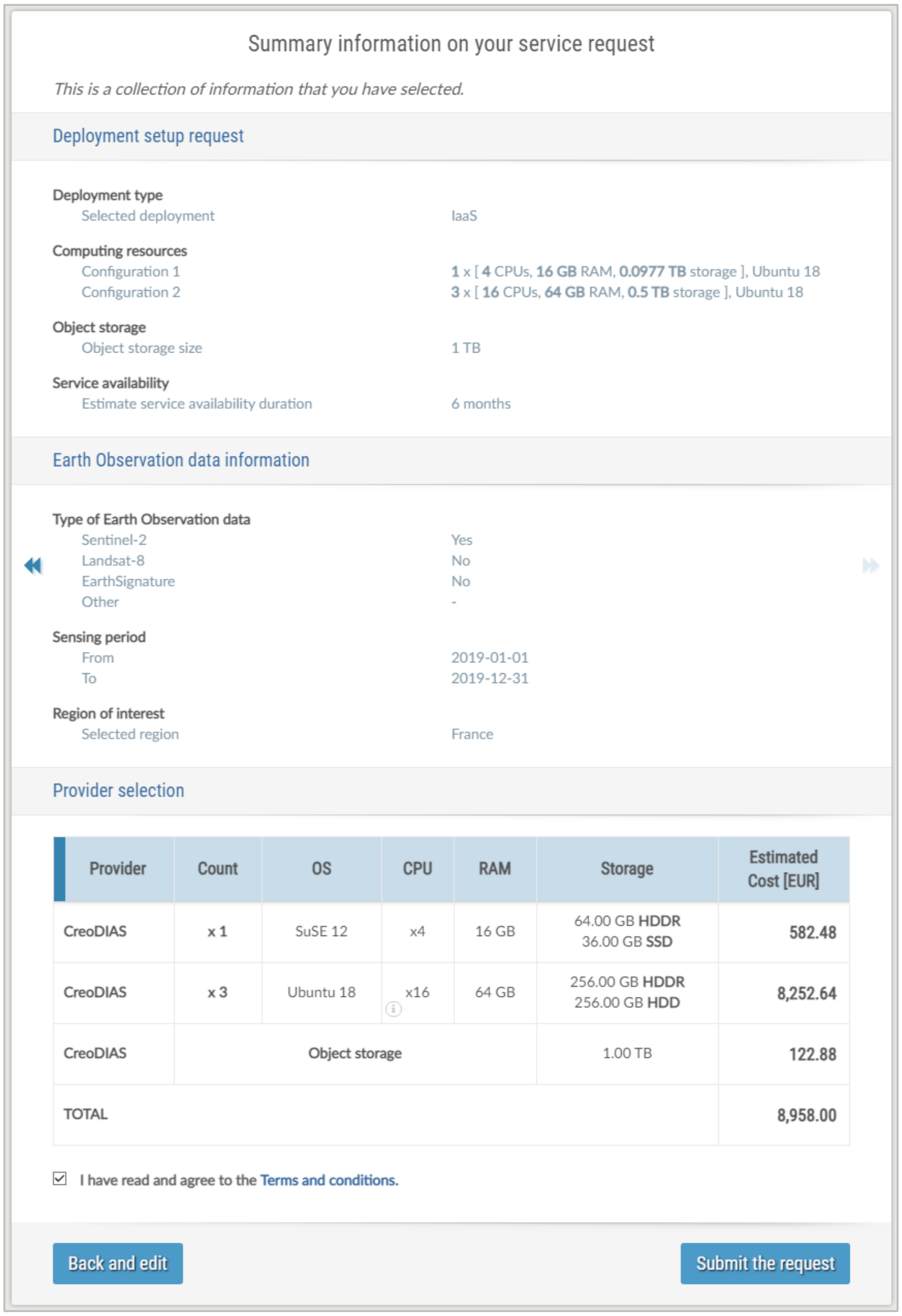
€ 8,958.00

Figure 44: Provider cart updated contents

4.2.6 Review and submit the service deployment request

When the user is happy with the selection, he/she can move to the last step, reviewing and submitting the request.

The last page of the request form consists in a summary information of all the previous steps where user can review everything and decide if everything is as required. If not satisfied, the user can always go back and adjust any parameter or selection.



Summary information on your service request

This is a collection of information that you have selected.

Deployment setup request

Deployment type	
Selected deployment	IaaS
Computing resources	
Configuration 1	**1** x [**4** CPUs, **16 GB** RAM, **0.0977 TB** storage], Ubuntu 18
Configuration 2	**3** x [**16** CPUs, **64 GB** RAM, **0.5 TB** storage], Ubuntu 18
Object storage	
Object storage size	1 TB
Service availability	
Estimate service availability duration	6 months

Earth Observation data information

Type of Earth Observation data	
Sentinel-2	Yes
Landsat-8	No
EarthSignature	No
Other	-
Sensing period	
From	2019-01-01
To	2019-12-31
Region of interest	
Selected region	France

Provider selection

Provider	Count	OS	CPU	RAM	Storage	Estimated Cost [EUR]
CreoDIAS	x 1	SuSE 12	x4	16 GB	64.00 GB **HDDR** 36.00 GB **SSD**	**582.48**
CreoDIAS	x 3	Ubuntu 18	x16	64 GB	256.00 GB **HDDR** 256.00 GB **HDD**	**8,252.64**
CreoDIAS	Object storage				1.00 TB	**122.88**
TOTAL						**8,958.00**

☑ I have read and agree to the Terms and conditions.

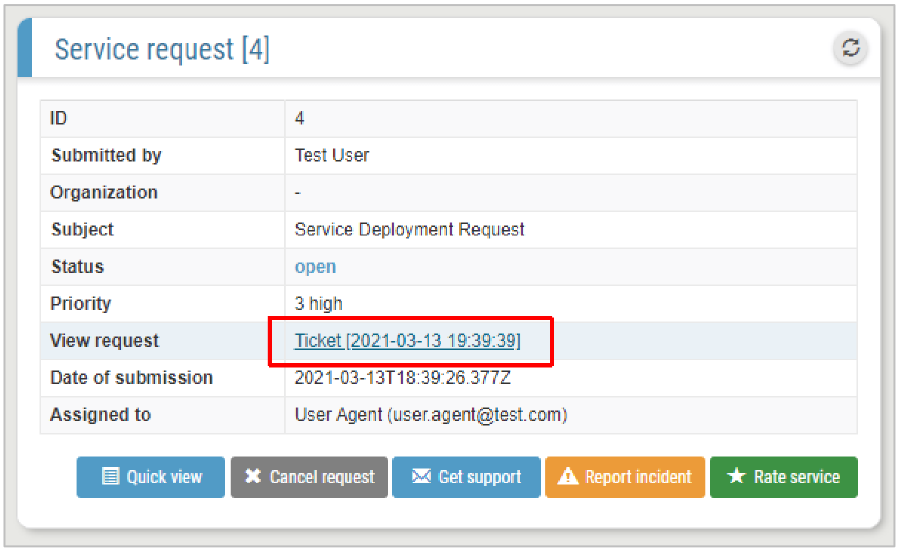
Figure 45: Review and submit the request form

The request can only be submitted if user agrees with the Terms and conditions, which can be inspected by clicking the link available at the bottom of the form.

After submission, the user is redirected to the dashboard.

4.3 Follow the service request

Following the link provided in each card on the dashboard, the user can inspect each request status and the responses from helpdesk service.



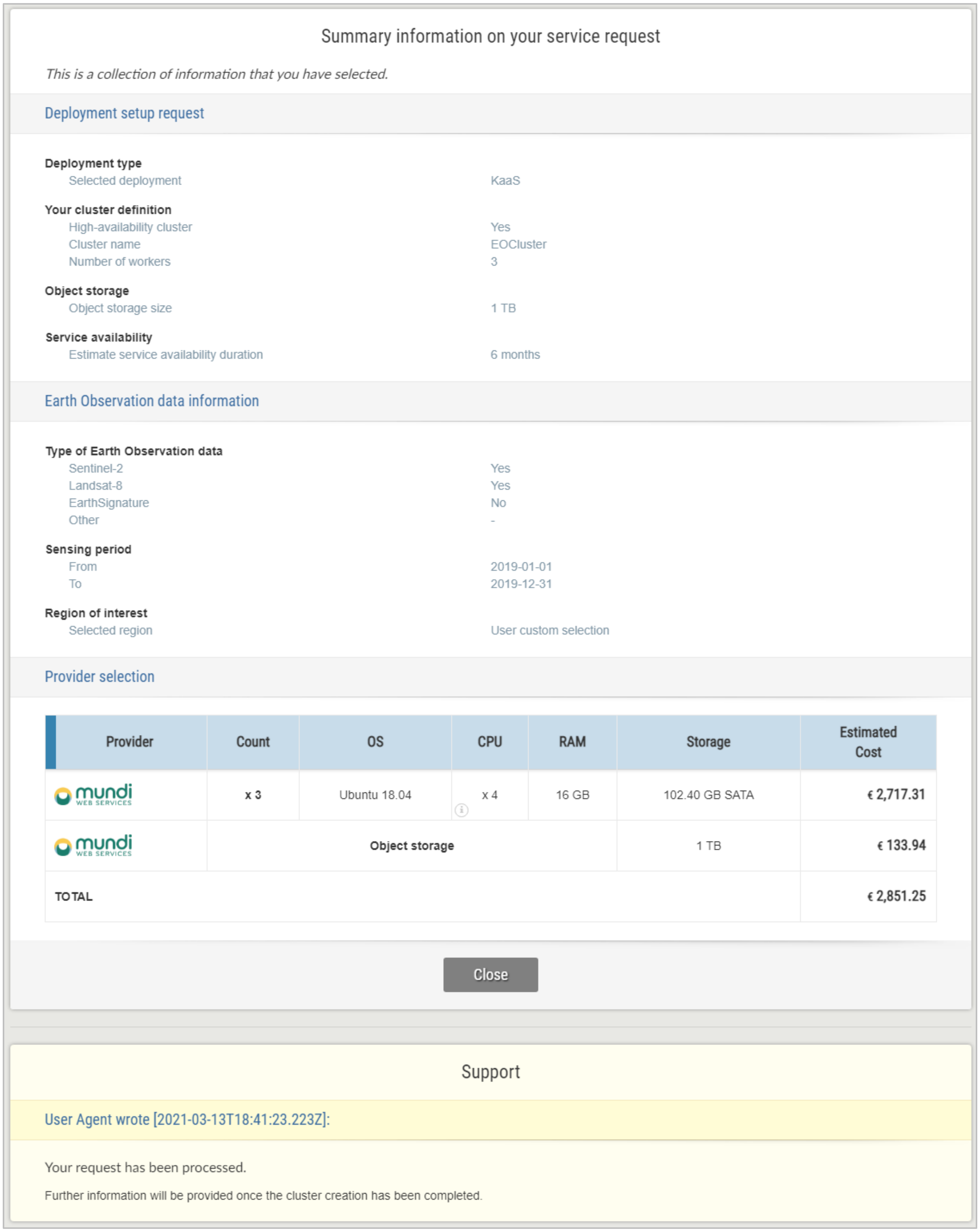
Service request [4]

ID	4
Submitted by	Test User
Organization	-
Subject	Service Deployment Request
Status	open
Priority	3 high
View request	Ticket [2021-03-13 19:39:39]
Date of submission	2021-03-13T18:39:26.377Z
Assigned to	User Agent (user.agent@test.com)

Figure 46: Accessing the service request

The service request page is similar to the summary information page on the request form.

Any help provided by the helpdesk service is displayed at the bottom of the page.



Summary information on your service request

This is a collection of information that you have selected.

Deployment setup request

Deployment type	
Selected deployment	KaaS
Your cluster definition	
High-availability cluster	Yes
Cluster name	EOCluster
Number of workers	3
Object storage	
Object storage size	1 TB
Service availability	
Estimate service availability duration	6 months

Earth Observation data information

Type of Earth Observation data	
Sentinel-2	Yes
Landsat-8	Yes
EarthSignature	No
Other	-
Sensing period	
From	2019-01-01
To	2019-12-31
Region of interest	
Selected region	User custom selection

Provider selection

Provider	Count	OS	CPU	RAM	Storage	Estimated Cost
mundi WEB SERVICES	x 3	Ubuntu 18.04	x 4	16 GB	102.40 GB SATA	€ 2,717.31
mundi WEB SERVICES	**Object storage**				1 TB	€ 133.94
TOTAL						€ 2,851.25

Support

User Agent wrote [2021-03-13T18:41:23.223Z]:

Your request has been processed.

Further information will be provided once the cluster creation has been completed.

Figure 47: Summary the service request

As in EarthSelf there is no automatic mechanism for billing, this being a complex mechanism (it is basically a project itself) and it was never foreseen to be implemented in EarthSelf, the billing can be performed after the user created a request, by a specialized department that also receives the created ticket. This department, based on the ticket received, will send to the user a payment plan that needs to be accepted by the user. Once this acceptance is done, the hardware resources will be allocated for the user and the bills will be released according to the accepted plan.

5. Differences in EarthSelf V2 compared with EarthSelf V1

5.1 Architecture and component evolution

In reference to Figure 1 EarthSelf overall architecture, presented in V1, the architecture has been slightly updated in V2 with the actually implemented components as follows:

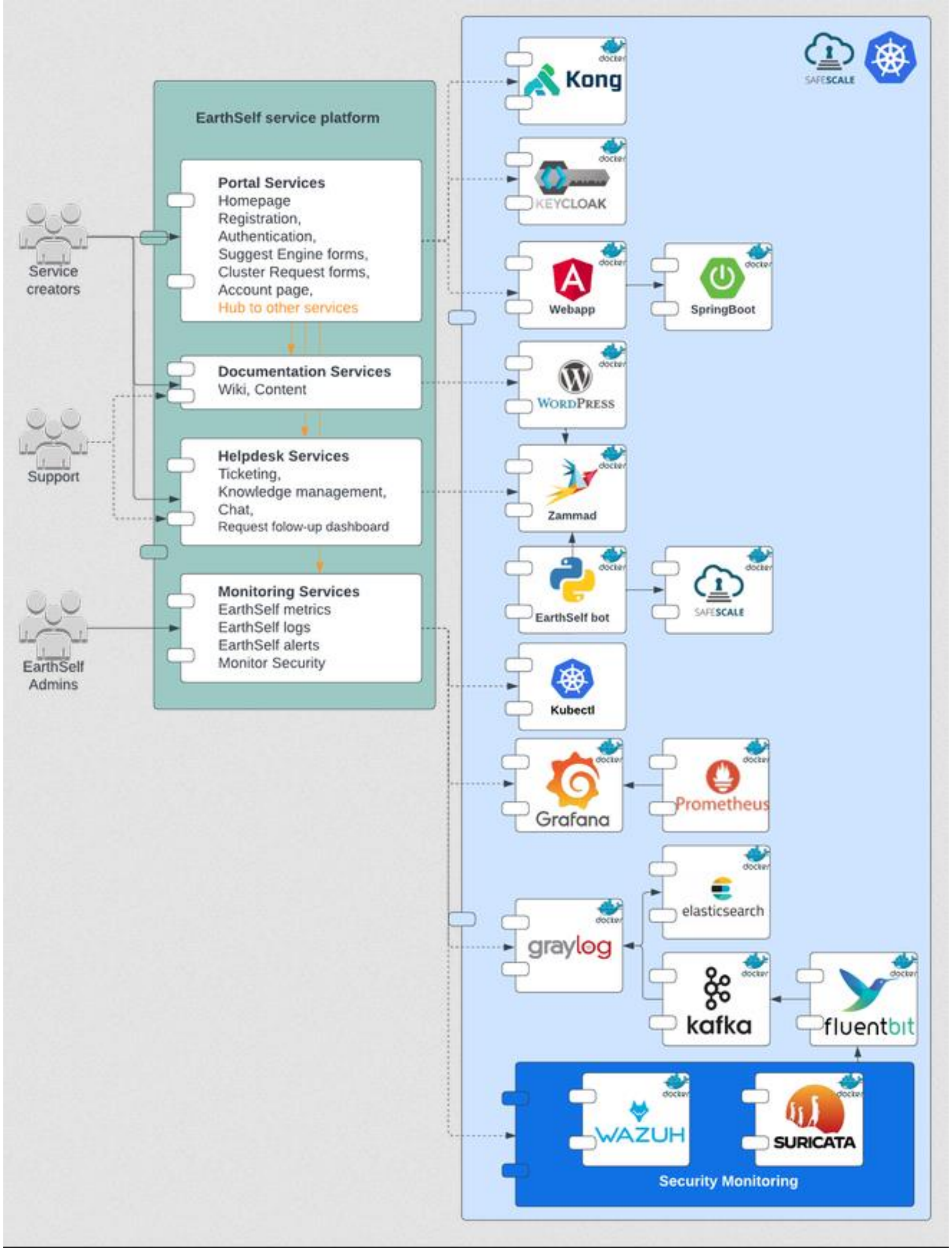


Figure 48: EarthSelf overall architecture (update V2)

The status of the development in EarthSelf V2 compared to EarthSelf V1 is the following:

- The first evolution implemented in V2 was a migration from Kubernetes 1.18 to 1.20. It forced us to migrate helm charts to take in account minor evolutions in the API.
- The **reverse proxy** managed by **Kong** [7] was mostly rewritten for V2. Indeed, in V1 the ingress rules were added by a script after service deployment, in V2 the ingress rules are now fully provided by the service itself by using the plugin provided by Kong.
- **Keycloak** [8] was added in V1 to manage the security of the private parts of the portal. In V2 security was improved in two ways:
  - Services were all switched to HTTPS by using the CERT-manager, the SSL rules are provided by the service and certificate is automatically provided and kept up to date by the CERT-manager.
  - **Passwords** and **critical configurations** of the cluster is now stored encrypted, only administrators with an access to the private key can decode through **SOPS** [9] the platform access file and access to its content.
- The monitoring services described in V1 was implemented in V2 using **Grafana** [10] and **Prometheus** [11]. Grafana is in charge of collecting metrics using probes inside the Kubernetes cluster and Prometheus is used by the administrator to check logs and alerts provided by the monitoring. This service is detailed in dedicated deliverable documents D4.4 [4] & D4.5 [5].
- A EarthSelf **bot** [12] was developed in V2 to create hosts automatically from user requests. It takes the requests from **Zammad** [13] and translates it to **Safescale** command and execute them, the result is provided back in the Zammad ticket.
- The **Portal** was improved in V2 and was fully integrated to the Kubernetes cluster with its own Helm chart, it can now be deployed and maintained without manual intervention.

5.2 ONDA DIAS support

To facilitate and standardise access to data, the European Commission has funded the deployment of five cloud-based platforms. They provide centralised access to Copernicus data and information, as well as to processing tools. These platforms are known as the DIAS, or Data and Information Access Services.

In this moment, there are 5 DIASes available: Creodias [14], Mundi [15], Onda [16], Sobloo [17] and WEkEO [18]. In the first version of the Suggest Engine was offered support for Creodia and Mundi DIASes and a non-DIAS cloud provider (OVH). Nevertheless, even if SafeScale was supporting a priori only Creodias and Onda, it was extended to support also Mundi so in the end it was a discrepancy between the cloud providers supported by SafeScale and Suggest Engine.

In order to solve this discrepancy, a new DIAS (ONDA DIAS) was added in the list of the available cloud providers supported by Suggest Engine beside Creodias, OVH and Mundi.

In order to support ONDA DIAS into Suggest Engine the following steps were performed:

- Extracted the virtual machine flavors supported by Onda DIAS. This normally was an easy task as the ONDA DIAS is using OVH as cloud provider (that was already supported by the Suggest Engine). Nevertheless, the configuration needed by the Suggest Engine is not limited only to the flavors but also contains information about the EO products supported, the coverage, and information about the EO products that are online or archived and for what interval. This additional information was extracted from ONDA and the configuration in the Suggest Engine was updated accordingly.

- A new plugin handler was added in the Suggest Engine that was able to provide the desire information to the Suggest Engine core for computing the scores and costs. Even if the ONDA DIAS is based on OVH, the existing handler was not possible due to additional information present into the configuration and a new plugin handler was created.
- Additional unit and integration tests were created to check the correct behaviour of the Suggest Engine using the new plugin but also for the plugin itself.
- The web portal mechanism invoking the Suggest Engine was updated such that the new cloud provided is known and displayed in the web interface.

5.3 The WaaS (Workflow as a Service) support

In the first version of the portal only the IaaS (Infrastructure as a Service) and KaaS (Kubernetes as a Service) were supported, the WaaS option being deactivated as no support was present for it in the underlaying mechanism (SafeScale). Lately, the WaaS support was also implemented in SafeScale and consequently the web portal was updated in order to:

- Activate the WaaS option beside IaaS and KaaS.
- Implemented the "Step 2: Set up your workflow as a service" configuration page allowing the selection of the cluster name, the number of VMs, the object storage size and the period for which the service will be available.
- Implemented the page allowing selection of area of interest, sensors to be used and the time interval for the processing. This step is needed for computing the scores for each cloud provider and the total cost for the execution.
- As for the other services, it was also added the option for WaaS to select the machines for the cluster and review and submit the request.

5.4 Suggest Engine database extensions

In this moment, the configuration of the Suggest Engine is kept in JSON [19] files, having a well-defined structure. The Annex 1 – Suggest Engine JSON Configuration File Example a description and an example of such a JSON configuration for the Creodias cloud provider. While this is perfect for a static configuration, due to the simplicity in reading or editing it, where the values do not change very often, at the same time is difficult to manage when an automatic update is desired. As one of the reviewers' remarks was to implements also a mechanism of automatic updating the flavors and prices for the cloud providers, it was decided to implement the automatic update for ONDA DIAS which is providing at the following address4 a table with the costs for each configuration they provide, a screen scrapping of the page being possible. Additionally, they provide on the same file a CSV corresponding to the displayed picture and this can be also used in case scrapping is no longer available. In this case, the migration from the JSON format to a database configuration was decided and the team started to analyse and create the design for the database and also the operations needed for updating and retrieving

[4] https://www.onda-dias.eu/cms/services/catalogues/virtual-servers/?wdt_column_filter[1]=#offer

information from this new database. The database schema for the Suggest Engine configuration database can be found in the diagram Figure 49 Suggest Engine Configuration Database Structure.

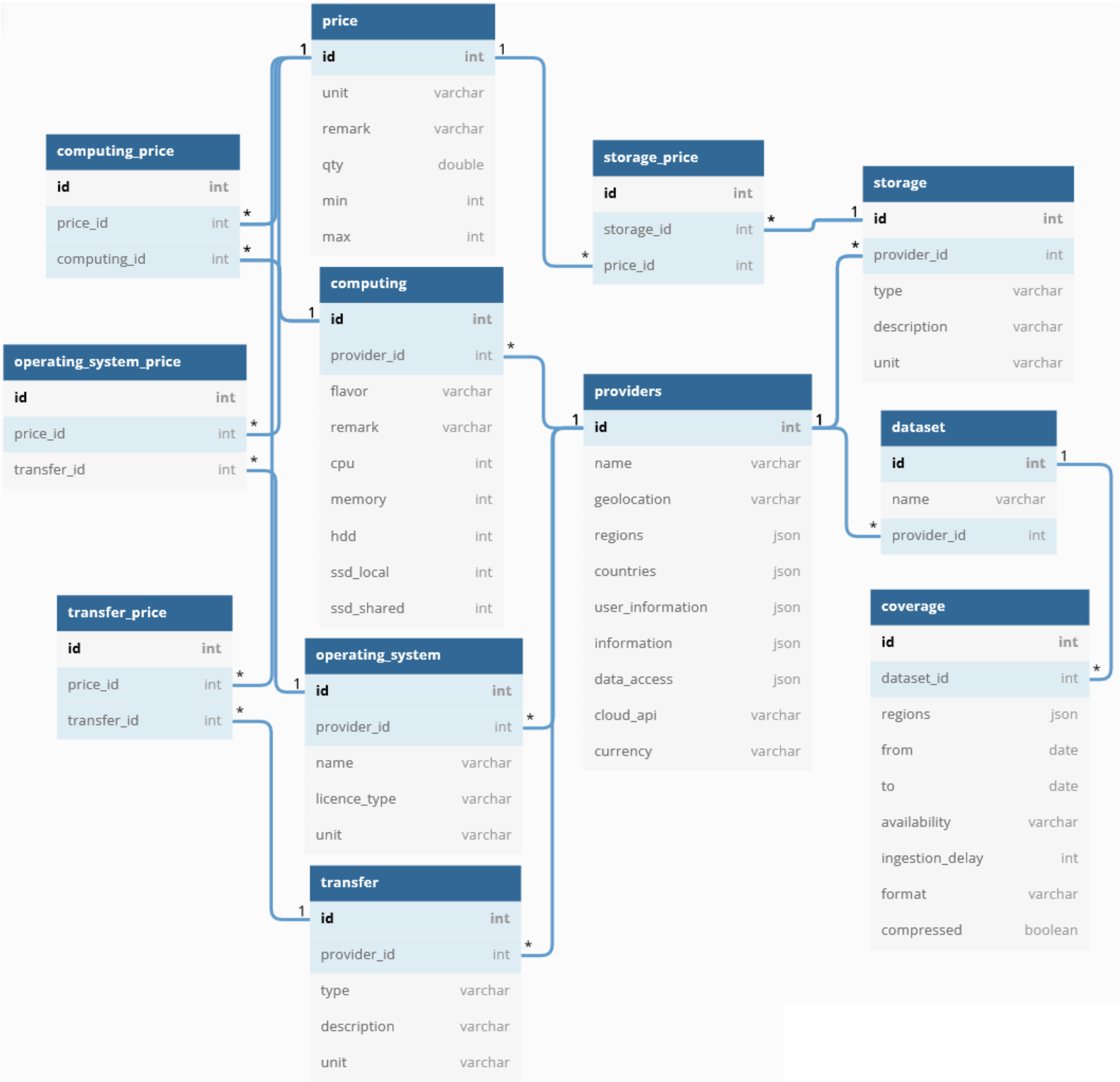


Figure 49 Suggest Engine Configuration Database Structure

5.5 Migration of the development platform to production platform

The initial development and tests of the EarthSelf portal was performed on a local platform where only developers had access and where various configuration and tests were performed. As this platform was not possible to be made publicly available due to the various limitations (firewalls, weak configuration, availability, etc.) a migration to a production platform was needed. This production platform is the one that is accessible to the users, has the proper hardware configuration and has only the needed administration users and configuration (no dummy test users or temporary configurations). As the migration cannot be automatically performed (with simple a save and load), the following operations were needed (more details about the below tools can be found in document “D4.1: EarthSelf-Service Definition Document”, section “3.2 Technical stack”):

- Install and configure Wordpress [20] and re-deploy the web portal
- Install Kong for Kubernetes as an ingress controller solution to handle and manage incoming traffic toward the EarthSelf cluster.
- Install a fresh version of Zammad helpdesk and configure it by also adding the needed admin and agent users.
- Install a fresh instance of keycloak and configure it, not only as a single sign on solution for web apps and RESTful web services but also as a complete IAM solution, with other features like identity federation and social login support.
- Import the SuggestEngine and integrate it in a docker container that can be called from the web-portal using the existing API. Additionally, Onda DIAS configuration and code was redeployed when the new plugin was available.
- Perform all the connections with Zammad and keycloak in the web-portal
- Perform tests from the web-portal to check the correct integration with Zammad and keycloak. This assumed creating of users in portal and Zammad, browse through all pages, and perform administration or regular operations in order to see any abnormal situation. During the tests, some anomalies were observed and corrected in the portal or in the interaction between portal and Zammad and Keycloak (like for example, errors in the redirection URLs that were not updated in the portal, issues with the format of the e-mail addresses in Wordpress, misconfiguration in Keycloak, etc.).

5.6 Updates and bug corrections in the EarthSelf portal

Once the EarthSelf portal became available and was possible to be tested by other users, some issues were raised and corrected by the development teams. From the users’ remarks can be mentioned, as an example:

- “Even when no EO observation are checkboxes are ticked in the second page, an area selection is still mandatory” – the bug was that the “Type of Earth Observation data” was not mandatory (when it should). The correction was made to such that the user should not be allowed to leave Step 3 without selecting at least one checkbox.
- After creating a new user account, an error was given even if the creation itself was successful.
- Incorrect displaying in Microsoft Edge of the IaaS pages due to some controls working only in Firefox and Chrome. Rewrite of the corresponding pages was needed to be completely browser independent.
- Other small display bugs (icons missing, invalid initialization values in controls, incorrect page displayed when moving to next step from the map page).

Beside the real issues, there were also raised by the users some fake bugs that in reality proved to be normal behaviour and it was just a misunderstanding of the users. Nevertheless, even if no change was performed, investigations were performed, and time consumed in order to check if is a real issue or not.

Some new tooltips and messages were added in the portal for better explain what an operation is, especially for the cloud costs computation and cloud providers ranking.

5.7 EarthSignature integration within EarthSelf

The integration of EarthSignature in EarthSelf services has been achieved with the creation of a new access point implementing the policy interaction with EarthSelf as the first authorized client (Figure 50: EathSignature integration within EathSelf platform). This access point will be restricted in the long term and will only be possible for business partners with strong authentication.

The deployment of the four pilots has started. The pilots already started to use the EarthSelf portal and started the deployment of their service on the cloud of their choice. They can access EarthSignature through EarthSelf, which will take care of the self-provisioning of each pilot platform in a DIAS by using SafeScale, thus minimizing the need for knowledge in the cloud. The team has ensured to set up a proxy to manage the access to the API in EarthSelf. Pilots and future service providers can then use EarthSignature API via secure authentication within EarthSelf. Once the clusters are created by CS GROUP on the cloud, the pilots are autonomous to run and launch their service on the created platform. CS GROUP will provide support to assist them in this process and will provide them a set of documentation and tools to make their platform more easily accessible. On the other hand, QWANT will provide support to help them in the use of EarthSignature.

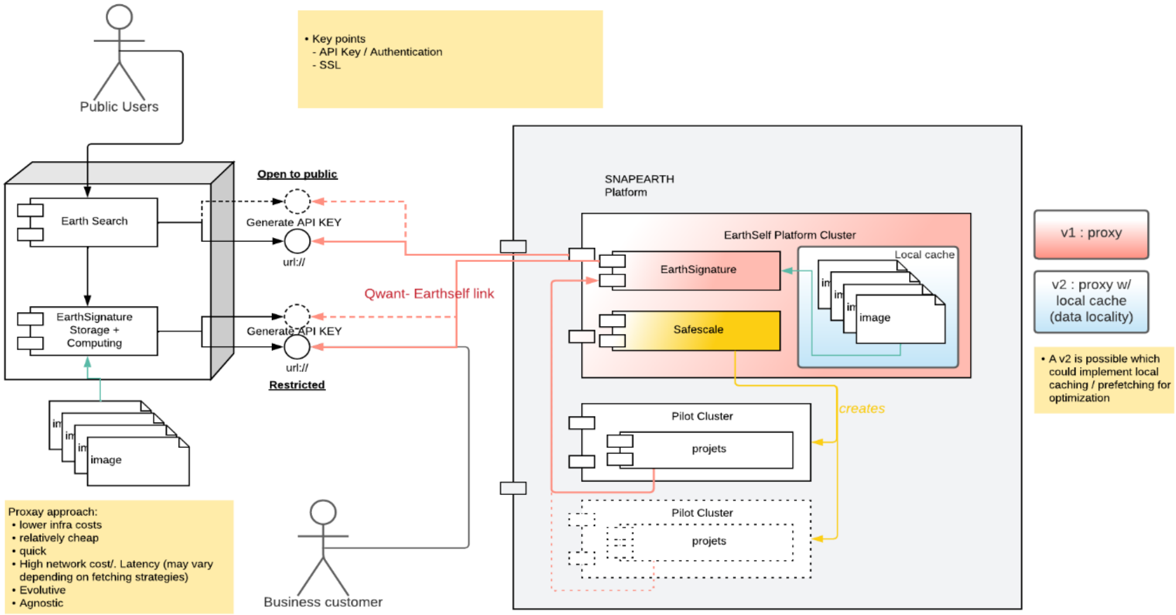


Figure 50: EathSignature integration within EathSelf platform

6. Conclusion

Built on WordPress component for static content (articles, documentation, and news) and custom PHP-enabled web pages for forms and dynamic navigation scenarios (i.e., Suggest Engine), the SnapEarth web portal offers to Service Providers a way to manage, using personal accounts, their own EO value-added services and build up their own product for their own users.

The Service Providers have the possibility to create accounts, register and configure their services using the SnapEarth dashboard. Requests for a new service deployment can be initiated, the user being led through a wizard like interface where he can configure all the parameters of his request like the area of interest, interval for the processing, specific cloud provider machines configurations for the created cluster, estimated costs etc. Once a request is done, the user can monitor it and also ask for the additional support, if needed, to the helpdesk team by opening tickets in the portal. In the end, the Service Provider can install his services on the created cluster and provide, in turn, his services to the interested users.

References

[1] SnapEarth Deliverable D4.2 – “EarthSelf Service Portal V1”
[2] SnapEarth Deliverable D4.1 – “EarthSelf-Service Definition Document”
[3] SnapEarth Deliverable D2.5 – “ SnapEarth Platform Service User Requirement”
[4] SnapEarth Deliverable D4.4 – EarthSelf-Service Tracking Tool V1
[5] SnapEarth Deliverable D4.5 – EarthSelf-Service Tracking Tool V2
[6] SnapEarth Deliverable D3.1 – SnapEarth Design Dossier
[7] https://konghq.com/kong/
[8] https://www.keycloak.org/docs/latest/server_development/#_themes
[9] Standard operating procedures (SOPs): https://en.wikipedia.org/wiki/Standard_operating_procedure
[10] https://grafana.com/
[11] https://prometheus.io/
[12] a python script that monitors zammad and turns tickets into SafeScale commands
[13] https://zammad.org/
[14] https://creodias.eu/
[15] https://mundiwebservices.com/
[16] https://www.onda-dias.eu/cms/
[17] https://sobloo.eu/
[18] https://www.wekeo.eu/
[19] https://www.json.org/json-en.html
[20] https://wordpress.org

Annex 1 – Suggest Engine JSON Configuration File Example

This chapter presents a simplified example of the JSON configuration file for Creodias. The configuration file contains several sections:

- A general section contains the name of the provider, the location of the cloud provider, the country, some information about when the configuration was updated, some user information (optional), the type of the data access, API used, currency etc.
- The datasets contain the supported EO datasets, for what regions, interval and other characteristics of the dataset.
- The flavors supported for computing along with their costs.
- The storage types supported and their costs.
- The operating systems supported.
- The costs for the inbound, outbound, internal, VPN etc. transfers.

```
{
        "providerName": "CreoDIAS",
        "geolocation": "POINT(52.084856792206075,21.036435291152287)",
        "regions": ["Europe"],
        "countries": ["POL"],
        "information":{
                "description": "Prices are updated manualy on a monthly basis.",
                "last-update": "2021-02-22T18:00:00",
                "sources": ["https://creodias.eu/price-list"]
        },
        "userInformation":[],
        "dataSets": [
                {
                        "name": "Sentinel-1 SLC",
                        "coverages": [
                                {
                                        "regions": ["Europe"],
                                        "from": "2014-07-01",
                                        "to": "today",
                                        "availability": "online",
                                        "ingestionDelay": 12,
                                        "format": "ESA",
                                        "compressed": false
                                },
                                {
                                        "regions": ["Global"],
                                        "from": "2018-01-01",
                                        "to": "today",
                                        "availability": "request",
                                        "ingestionDelay": 48,
                                        "format": "ESA",
                                        "compressed": false
                                }
                        ]
                },
                {
                        "name": "Sentinel-2 L1C",
                        "coverages": [
                                {
                                        "regions": ["Global"],
                    "from": "2015-06-01",
                    "to": "today",
                    "availability": "online",
                    "ingestionDelay": 12,
                    "format": "ESA",
                    "compressed": false
                }
            ]
        },
        {
            "name": "Sentinel-2 L2A",
            "coverages": [
                {
                    "regions": ["Global"],
                    "from": "2018-01-01",
                    "to": "today",
                    "availability": "online",
                    "ingestionDelay": 12,
                    "format": "ESA",
                    "compressed": false
                }
            ]
        },
        {
            "name": "Landsat-8 L1T",
            "coverages": [
                {
                    "regions": ["Global"],
                    "from": "2011-01-01",
                    "to": "today",
                    "availability": "request",
                    "ingestionDelay": 48,
                    "format": "USGS",
                    "compressed": false
                }
            ]
        }
    ],
    "dataAccess": ["NFS", "S3", "HTTP"],
    "cloudAPI": "OpenStack",
    "currency": "EUR",
    "computing": [
        {
            "flavor": "eo1.xsmall",
            "remark": "",
            "cpu": 1,
            "memory": 1,
            "hdd": 0,
            "ssdLocal": 0,
            "ssdShared": 8,
            "prices": [
                {
                    "unit": "h",
                    "remark": "Hourly",
                    "qty": 0.018
                },
                {
                    "unit": "M",
                    "remark": "Monthly",
                    "qty": 12.46
                },
				{
					"unit": "M",
					"remark": ">=6 Month",
					"qty": 11.16
				},
				{
					"unit": "M",
					"remark": ">=12 Month",
					"qty": 8.5
				}
			]
		},
		{
			"flavor": "eo1.small",
			"remark": "",
			"cpu": 2,
			"memory": 2,
			"hdd": 0,
			"ssdLocal": 0,
			"ssdShared": 16,
			"prices": [
				{
					"unit": "h",
					"remark": "Hourly",
					"qty": 0.036
				},
				{
					"unit": "M",
					"remark": "Monthly",
					"qty": 24.91
				},
				{
					"unit": "M",
					"remark": ">=6 Month",
					"qty": 22.25
				},
				{
					"unit": "M",
					"remark": ">=12 Month",
					"qty": 17.03
				}
			]
		},
		{
			"flavor": "eo1.xmedium",
			"remark": "",
			"cpu": 1,
			"memory": 2,
			"hdd": 0,
			"ssdLocal": 0,
			"ssdShared": 8,
			"prices": [
				{
					"unit": "h",
					"remark": "Hourly",
					"qty": 0.025
				},
				{
					"unit": "M",
					"remark": "Monthly",
					"qty": 16.85
```

```
                                },
                                {
                                        "unit": "M",
                                        "remark": ">=6 Month",
                                        "qty": 15.05
                                },
                                {
                                        "unit": "M",
                                        "remark": ">=12 Month",
                                        "qty": 11.52
                                }
                        ]
                }
         ....
        ],
        "storage": [
                {
                        "type": "HDD",
                        "description": "HDD magnetic storage",
                        "unit": "GB",
                        "prices": [
                                {
                                        "unit": "h",
                                        "remark": "Hourly",
                                        "qty": 0.0000556
                                },
                                {
                                        "unit": "M",
                                        "remark": "Monthly",
                                        "qty": 0.040
                                },
                                {
                                        "unit": "M",
                                        "remark": ">=6 Month",
                                        "qty": 0.040
                                },
                                {
                                        "unit": "M",
                                        "remark": ">=12 Month",
                                        "qty": 0.038
                                }
                        ]
                },
                {
                        "type": "SSD",
                        "description": "SSD fast solid state storage",
                        "unit": "GB",
                        "prices": [
                                {
                                        "unit": "h",
                                        "remark": "Hourly",
                                        "qty": 0.0001389
                                },
                                {
                                        "unit": "M",
                                        "remark": "Monthly",
                                        "qty": 0.1
                                },
                                {
                                        "unit": "M",
                                        "remark": ">=6 Month",
                    "qty": 0.1
                },
                {
                    "unit": "M",
                    "remark": ">=12 Month",
                    "qty": 0.1
                }
            ]
        },
    ....
        {
            "type": "OS",
            "description": "Object storage",
            "unit": "GB",
            "prices": [
                {
                    "unit": "M",
                    "remark": "0-500 TB",
                    "min": 0,
                    "max": 512000,
                    "qty": 0.02
                },
                {
                    "unit": "M",
                    "remark": "501-1000 TB",
                    "min": 512001,
                    "max": 1024000,
                    "qty": 0.019
                },
                {
                    "unit": "M",
                    "remark": ">1000 TB",
                    "min": 1024001,
                    "qty": 0.017
                }
            ]
        }
    ],
    "transfer": [
        {
            "type": "InternetIn",
            "description": "Internet transmission in",
            "unit": "GB",
            "prices": [
                {
                    "unit": "h",
                    "remark": "Hourly",
                    "qty": 0.0064
                },
                {
                    "unit": "M",
                    "remark": "Monthly",
                    "qty": 0.0064
                },
                {
                    "unit": "M",
                    "remark": ">=6 Month",
                    "qty": 0.0064
                },
                {
                    "unit": "M",
                                "remark": ">=12 Month",
                                "qty": 0.0064
                        }
                ]
        },
 ....
        {
                "type": "InternetOut",
                "description": "Internet transmission out",
                "unit": "GB",
                "prices": [
                        {
                                "unit": "h",
                                "remark": "Hourly",
                                "qty": 0.0064
                        },
                        {
                                "unit": "M",
                                "remark": "Monthly",
                                "qty": 0.0064
                        },
                        {
                                "unit": "M",
                                "remark": ">=6 Month",
                                "qty": 0.0064
                        },
                        {
                                "unit": "M",
                                "remark": ">=12 Month",
                                "qty": 0.0064
                        }
                ]
        }
],
"operatingSystems": [
        {
                "name": "CentOS 7",
                "licenseType": "per vCore",
                "unit": "vCore",
                "prices": [
                        {
                                "unit": "M",
                                "remark": "Hourly",
                                "qty": 0
                        },
                        {
                                "unit": "M",
                                "remark": "Monthly",
                                "qty": 0
                        }
                ]
        },
 ....
        {
                "name": "RHEL 7",
                "licenseType": "per CPU",
                "unit": "CPU",
                "prices": [
                        {
                                "unit": "M",
                                "remark": "Hourly",
                                        "qty": 101.21
                                },
                                {
                                        "unit": "M",
                                        "remark": "Monthly",
                                        "qty": 101.21
                                }
                        ]
                }
        ]
}
```

Annex 2 – Suggest Engine API

The Suggest Engine offers a REST API providing the following functionalities used by the EarthSelf portal and but also by other potential clients.

The API provided offers the following endpoint:

GET : /providers/os
Parameters:

providerName - The name of the provider

Returns:

The unique operating system names. If the provider name is specified, it is returned the list containing its operating system names.

GET : /providers/common/os
Returns:

The common operating system names of all the providers

POST : /suggest-engine/compute
Parameters:

The body of the POST request containing all the information to do the computation. A JSON example would be like:

```
{
  "computingResources" : {
    "machinesConfiguration" : [
      {
        "name":"configuration_1",
        "machineCount" : 1,
        "operatingSystemName" : "Ubuntu 16",
        "cpuCount" : 2,
        "memorySizeGB" : 4,
        "storageSizeTB" : 2
      }
    ],
    "searchRange" : 2,
    "searchCriteria" : "searchByMemoryOrCpu",
    "searchRatioPercents" : {
      "hardware" : 0.35,
      "price" : 0.15,
      "range" : 0.5
    },
    "objectStorageSizeTB" : 347.5
  },
  "serviceAvailability" : {
    "expectedDuration" : 10,
    "expectedDurationType" : "days"
  },
  "earthObservationData" : {
    "types" : ["Sentinel-2"],
    "other" : "Sentinel-1"
  },
  "timeOfInterest" : {
    "from" : "2014-10-11",
    "to" : "2019-12-12"
  },
  "regionOfInterest" : {
    "footprint":"POLYGON((8.692168    46.403315,27.336585    46.403315,27.336585
50.83633,8.692168 50.83633,8.692168 46.403315))"
  }
}
```

Returns:

A JSON like below:

```
{
  "data":[
    {
      "providerName":"CreoDIAS",
      "currency":"EUR",
      "score":3.94,
      "machinesConfiguration":[
        {
          "request":{
            "name":"configuration_1",
            "operatingSystemName":"Ubuntu 16",
            "machineCount":1,
            "cpuCount":2,
            "memorySizeGB":4,
            "storageSizeTB":2.0
          },
          "responses":[
            {
              "score":3.54,
              "cpuCount":2,
              "memorySizeGB":2,
              "remark":null,
              "storage":[
                {
                  "sizeTB":0.0,
                  "type":"HDD"
                },
                {
                  "sizeTB":0.0,
                  "type":"SSD"
                },
                {
                  "sizeTB":0.015625,
                  "type":"HDDR"
                }
              ],
              "flavorPrice":8.64,
              "flavorName":"eo1.small",
              "additionalStorage":{
                "sizeTB":1.984375,
                "price":27.12,
                "type":"HDD",
                "others":[
                  {
                    "sizeTB":1.984375,
                    "priceDiff":40.62,
              "type":"SSD"
            },
            {
              "sizeTB":1.984375,
              "priceDiff":51.89,
              "type":"HDDR"
            }
          ]
        },
        "operatingSystems":{
          "name":"Ubuntu 16",
          "others":[
            {
              "name":"CentOS 7",
              "priceDiff":0.0
            },
            {
              "name":"CentOS 8",
              "priceDiff":0.0
            },
            {
              "name":"SuSE 11",
              "priceDiff":1.19
            },
            ...
          ]
        }
      },
      ...
    ]
  }
],
"observationData":[
  {
    "productType":"Sentinel-1 SLC",
    "regions":[
      {
        "name":"Europe",
        "intersectionPercent":99.99998584269602
      }
    ],
    "score":4.0,
    "timePeriod":{
      "from":"2014-06-30"
    }
  },
  {
    "productType":"Sentinel-2 L1C",
    "regions":[
      {
        "name":"Europe",
        "intersectionPercent":99.99998584269602
      }
    ],
    "score":3.0,
          "timePeriod":{
            "from":"2015-05-31"
          }
        },
        ...
      ],
      "transfer":[
        {
          "type":"InternetIn",
          "unit":"GB",
          "price":0.0064
        },
        {
          "type":"InternetOut",
          "unit":"GB",
          "price":0.0064
        },
        ...
      ],
      "objectStorage":{
        "sizeTB":347.5,
        "price":2372.27
      },
      "userInformation":[

      ]
    }
  ],
  "status":"SUCCEEDED"
}
```

GET : /suggest-engine/regions
Returns:

All the regions together with their extent polygons as a tree containing three levels:

- the first level represents the continents
- the second level represents the regions of a continent
- the three level represents the countries of a region

GET : /suggest-engine/region-extent-polygons
Returns:

The extent polygon for all regions (continents).

GET : /suggest-engine/subregion-extent-polygons
Returns:

The extent polygon for all subregions (regions of the continents).

GET : /suggest-engine/country-extent-polygons
Returns:

The extent polygon for all countries.

GET : /suggest-engine/item-extent-polygon
Parameters:

name – the name of the item (being the name of a continent, country, region) according to the provided type

type – the type of the item (continent, country, region)

Returns:

The wrapping polygon of a certain region, subregion or country.

GET : /suggest-engine/item-geometry

Parameters:

name – the name of the item (being the name of a continent, country, region) according to the provided type

type – the type of the item (continent, country, region)

Returns:

The complete geometry of a certain region, subregion or country.

Annex 3 – Suggest Engine Algorithm

The Suggest Engine algorithm performs two types of computations:

- Computation of the score for each cloud machine and flavor
- Computation of the costs for the requested resources

```
For each provider in configuration:
       o For each machine configuration in the request:
              * Extract the machine flavors in configuration having the identical requested
              characteristics
              * Extract the machines flavors in configuration having smaller characteristics
              (less CPU and/or RAM, depending on the provided searchCriteria)
              * Extract the machines flavors in configuration having larger characteristics
              (more CPU and/or RAM, depending on the provided searchCriteria)
        * For each extracted machines flavor:
            + request to the current provider plugin to compute price for the machine, by
             providing:
                > machine flavor
                > time period for the usage of the machine
                > the operating systems
            + compute the score of the machine  :
                > compute the unique CPU values list
                > compute the unique RAM values list
                > compute the CPU score by providing maximum value to exact matche CPU and
                lower scores to CPUs different (linearly computed so the "far" different CPUs
                will have the lowest score)
                > compute the RAM score similarly
                > compute the storage score similarly
                > compute the machine hardware score of the machine with a weighted formula:
                  machine_hw_score = 40% * CPU score + 40% * RAM score + 20% * Storage score
                > validate the computed score to avoid out of ranges
                > machines with a 0 score are ignored
                > compute the machine cost score for this provider (from all machines found
                for it)
                > compute the level score : according to precision level provided and the
                machine CPU and RAM, give a score for each level, with higher scores for the
                configurations closer to the requested CPU and RAM.
                      For example, when requesting 32 GB of RAM:
                          oUnfiltered search will match everything: 1 GB, 2 GB, 8 GB, 16 GB,
                           20 GB, 24 GB, 32 GB, 60 GB, 64 GB, 128 GB, etc.
                          oPrecision level 0: prioritize machines with 32 GB, then return
                           all other;
                          oPrecision level 1: prioritize machines with 32 GB, then with 24
                           GB and 60 GB, and then return all remaining;
                          oPrecision level 2: prioritize machines with 32 GB, then level 1
                           machines with 24 GB and 60 GB, afterwards level 2 machines with
                           20 GB and 64 GB and only then return the remaining;

                > compute the final score with a weighted formula with the weights provided in
                 searchRatioPercents:
                  >> final_machine_score = Machine cost ratio * machine cost score +
                                           Hardware resources ratio * machine_hw_score +
                                           Precision level ratio * level score
            + sort descending all machines according to the extracted scores
            + a response JSON fragment for the machine is created with:
                > the total price for this type of machine, according to the number of
                 machines requested
                > the machine storage
                > the machine additional storage
                > the operating system
                > the score

    o If at least one valid machine configuration was found for the current provider:
        * compute the cost for the Object Storage
        * compute the score of the provider:
            + compute the average score from the machines scores
            + compute the provider average costs from the machines prices, including also the
              Object Storage price
            + compute the provider costs score from the above computed price (higher scores
              for prices close to providers minimum prices)
            + compute the data availability score for the area of interest and interval
              requested (average)
            + compute the total score of the provider with a weighted formula:
                > total_score = 33% * Costs Score + 33% * Data availability score + 33% *
                  Machines scores
        * create the JSON fragment for the provider from:
            + the machine fragment
            + information about the provider, extracted from the configuration (name,
              currency, etc.)
            + the observation data supported by the provider
            + the provider score

Return a JSON with all provider JSON fragments
```