Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS

D5.6 GEO-CRADLE Portal (III)

Contract Number	H2020 SC5-18b-2015, Project GA number: 690133	**Acronym**	GEO-CRADLE
Full title	Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS.		
Project URL	http://geocradle.eu		
EC Project Officers	Ms Gaëlle LE BOULER & Ms Malgorzata ROGIVAL		

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Prepared by	Vassilis Tsironis, Anna Polychroniou, Eleni Christia, Alexia Tsouni					
Quality Assurance	Haris Kontoes (Project Coordinator), Lefteris Mamais (TQM), Evangelos Gerasopoulos (WP Leader)					
Contact Person	Charalampos (Haris) Kontoes			Project Coordinator		
	Metaxa & Vas. Pavlou Str. • 152 36 Penteli, Greece					
	Email	kontoes@noa.gr	**Phone**	+30-2108109113	**Fax**	+30-2106138343

Project Information

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Project GA number: 690133

Project Title: GEO-CRADLE - Coordinating and integRating state-of-the-art Earth Observation Activities in the regions of North Africa, Middle East, and Balkans and Developing Links with GEO related initiatives towards GEOSS.

Project Beneficiaries:

ID	Participant Organisation Name	Country	Logo
1	National Observatory of Athens (NOA) - **Coordinator**	Greece	
2	Interbalkan Environment Center (IBEC)	Greece	
3	Center for Environment and development for the Arab Region and Europe (CEDARE)	Egypt	
4	Research and Studies Telecommunications Centre (CERT)	Tunisia	
5	Tel Aviv University (TAU)	Israel	
6	Cyprus University of Technology (CUT)	Cyprus	
7	TUBITAK UZAY Space Technologies Research Institute (UZAY)	Turkey	
8	Space research and technology institute (SRTI)	Bulgaria	
9	National Institute of R&D for Optoelectronics (INOE)	Romania	
10	University of Ss Cyril and Methodius (USCM)	FYROM	
11	Institute for Nature Conservation in Albania (INCA)	Albania	
12	Institute of Physics Belgrade (IPB)	Serbia	
13	CIMA Research Foundation (CIMA)	Italy	
14	Academy of Athens (AOA)	Greece	
15	INOSENS (INS)	Serbia	
16	European Association of Remote Sensing Companies (EARSC)	EU	
17	EURISY	EU	
18	EuroGeoSurveys (EGS)	EU	
19	World Radiation Center (PMOD/WRC)*	Switzerland	

*Note: Switzerland is not requesting financial contribution from the EC

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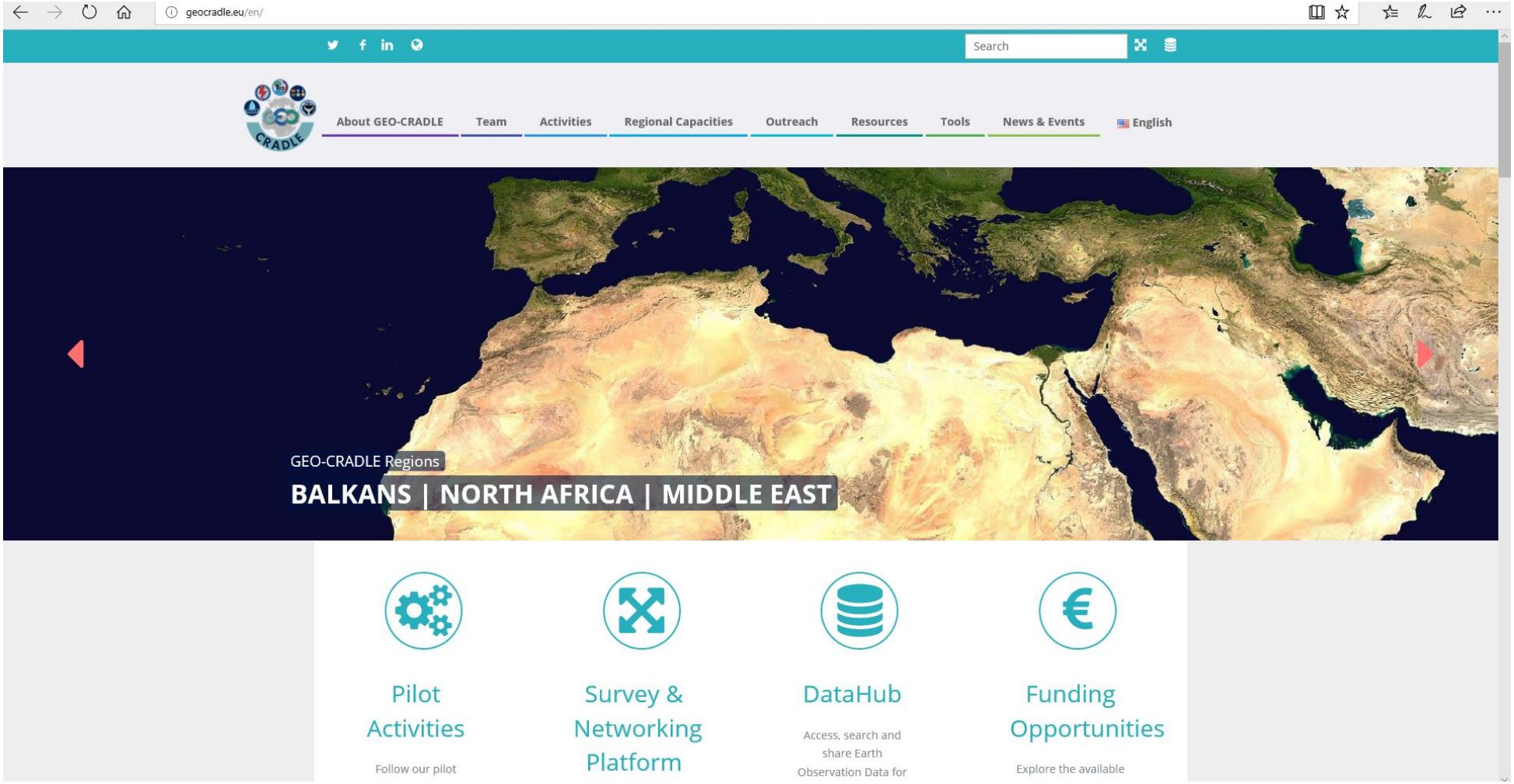
1) Home page

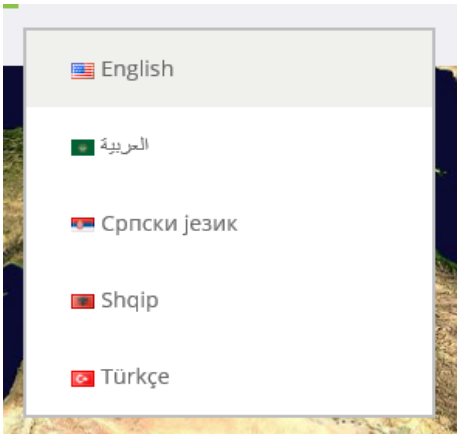
http://geocradle.eu/



2) Updates from previous version D5.5 GEO-CRADLE Portal (II)

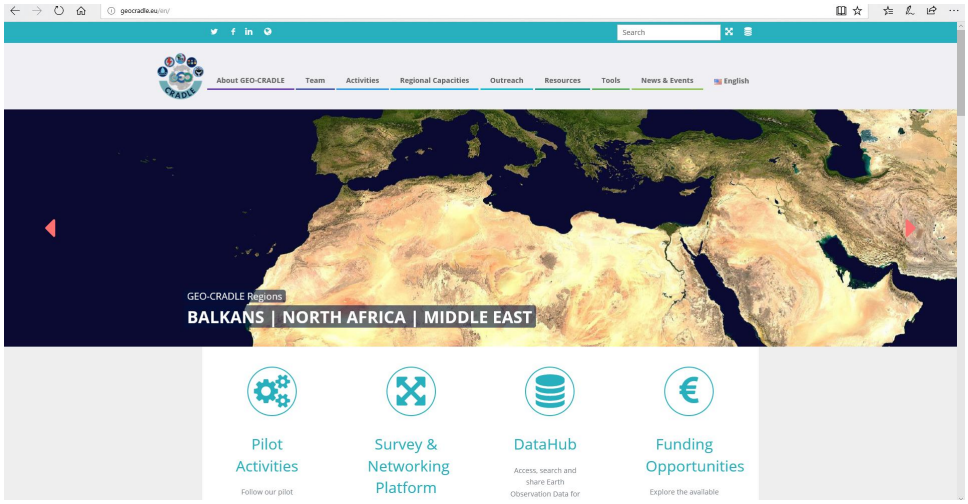
2.1) Website

All the menus and the basic content of the website are now available in 5 languages: English, Arabic, Serbian, Albanian and Turkish. This was implemented inextricably linked to the need of GEO-CRADLE as a coordination project to communicate its actions taking into account the particularities of the three different RoIs - Regions of Interest (e.g. language), and optimise its visibility. In the following subsections, screen shots of the different versions are presented.



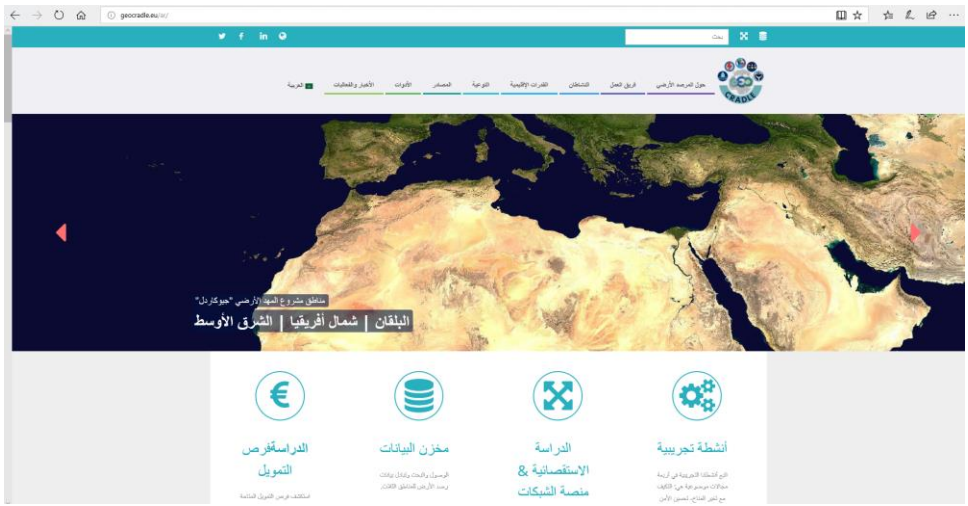
2.1.1) English version

http://geocradle.eu/en/



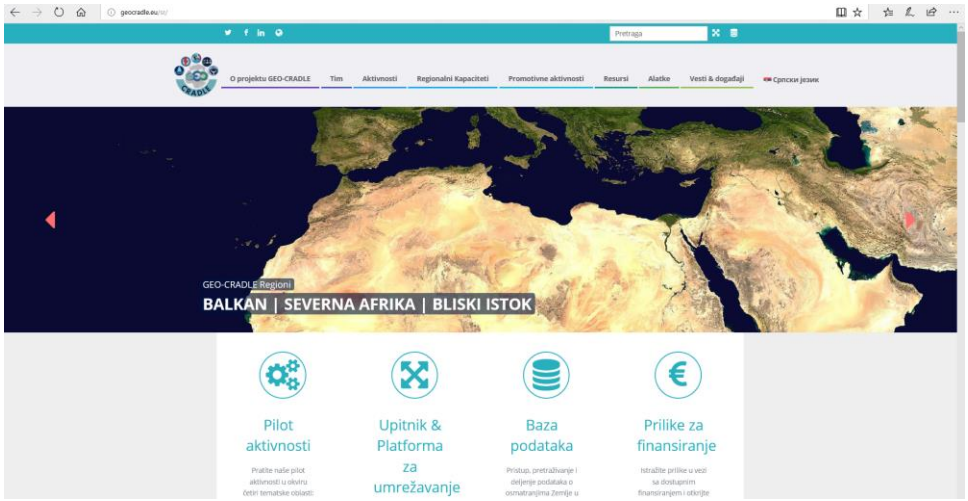
2.1.2) Arabic version

http://geocradle.eu/ar/



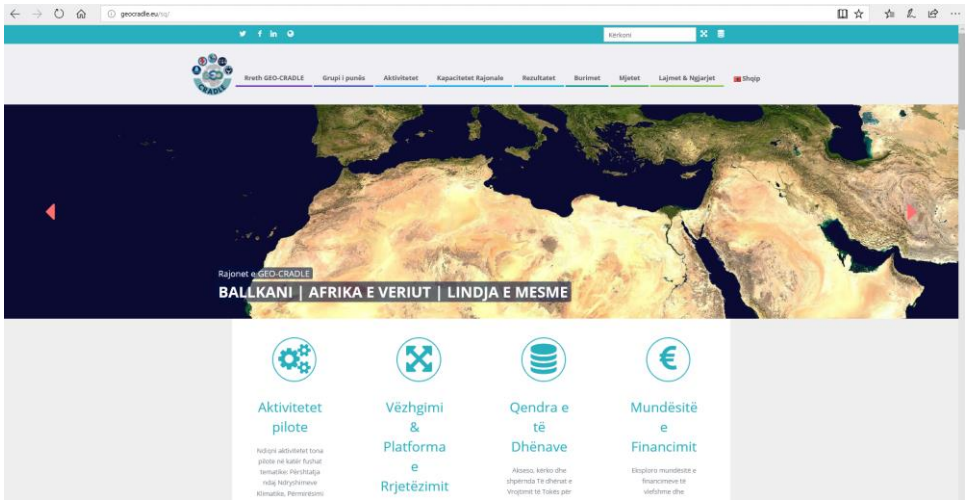
2.1.3) Serbian version

http://geocradle.eu/sr/



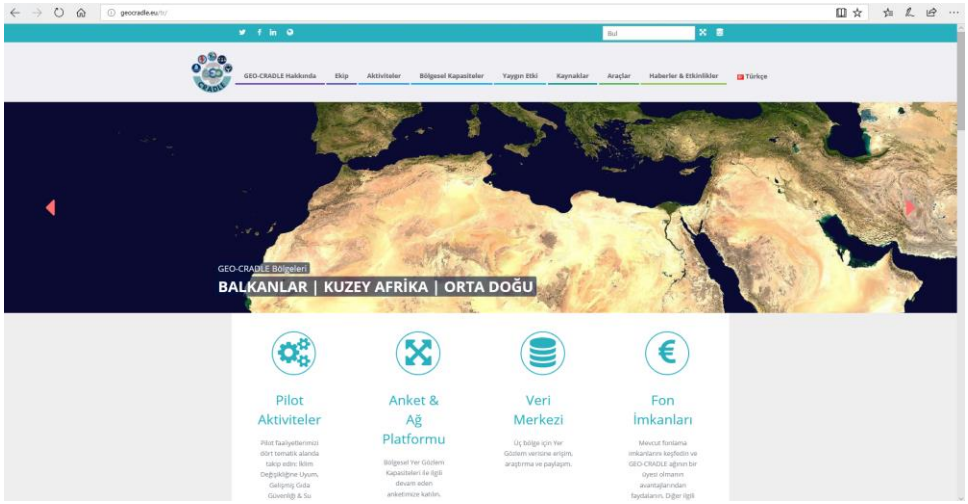
2.1.4) Albanian version

http://geocradle.eu/sq/



2.1.5) Turkish version

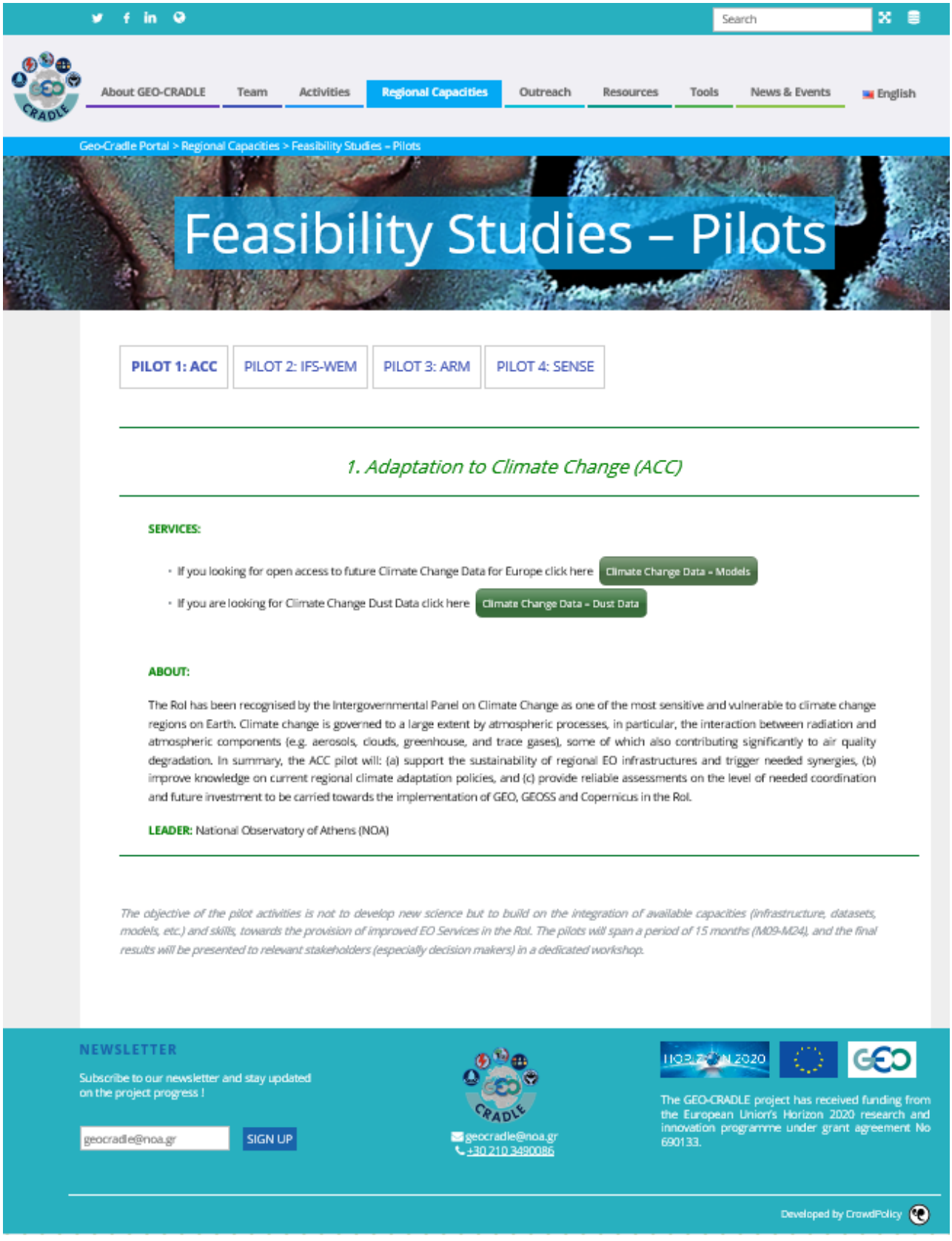
http://geocradle.eu/tr/



2.2) Pilot Activities

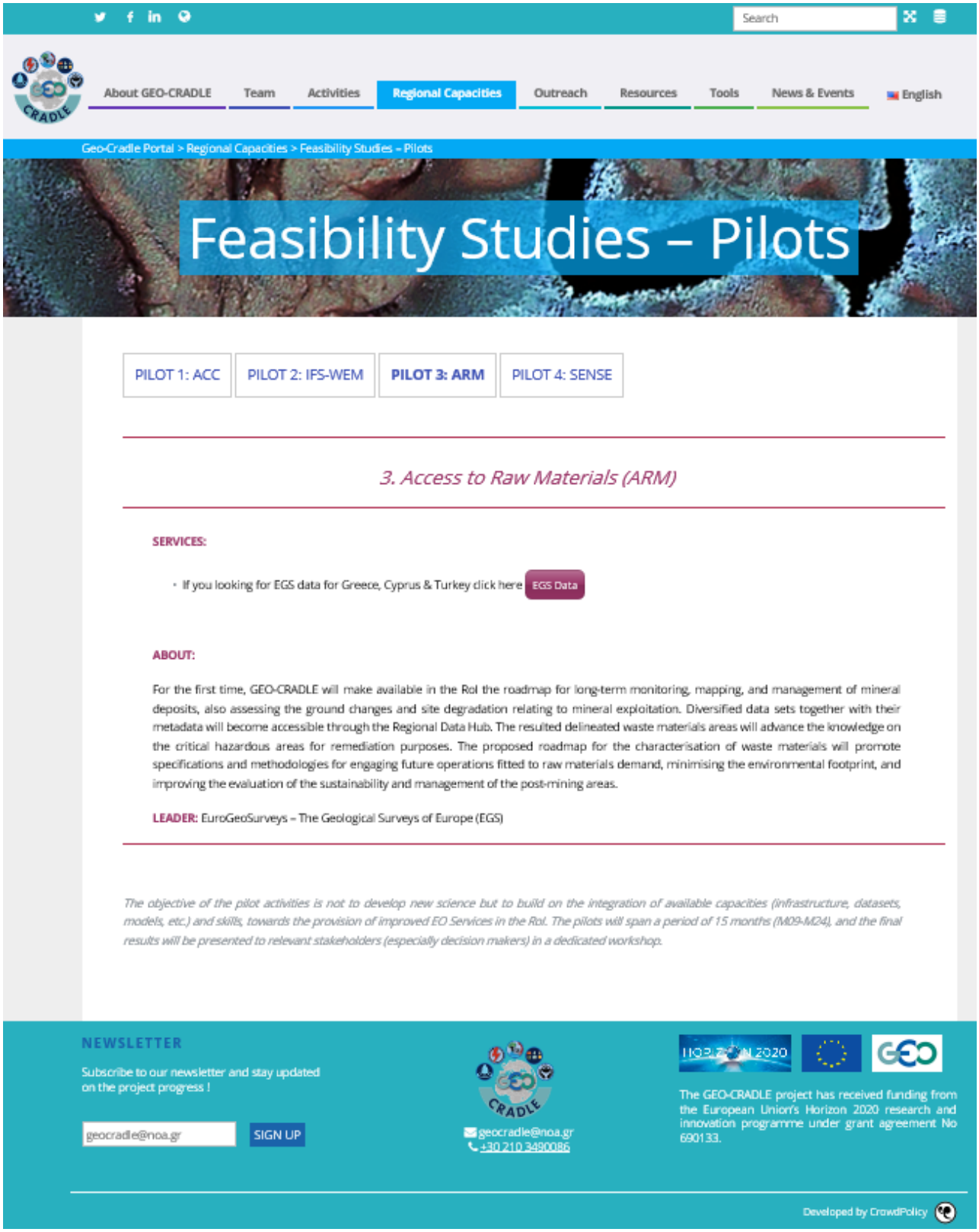
The main outcomes deriving from the implementation of the four feasibility studies/ pilots have been uploaded on the website, with links to the relevant products/ services/ applications.

2.2.1) Adaptation to Climate Change

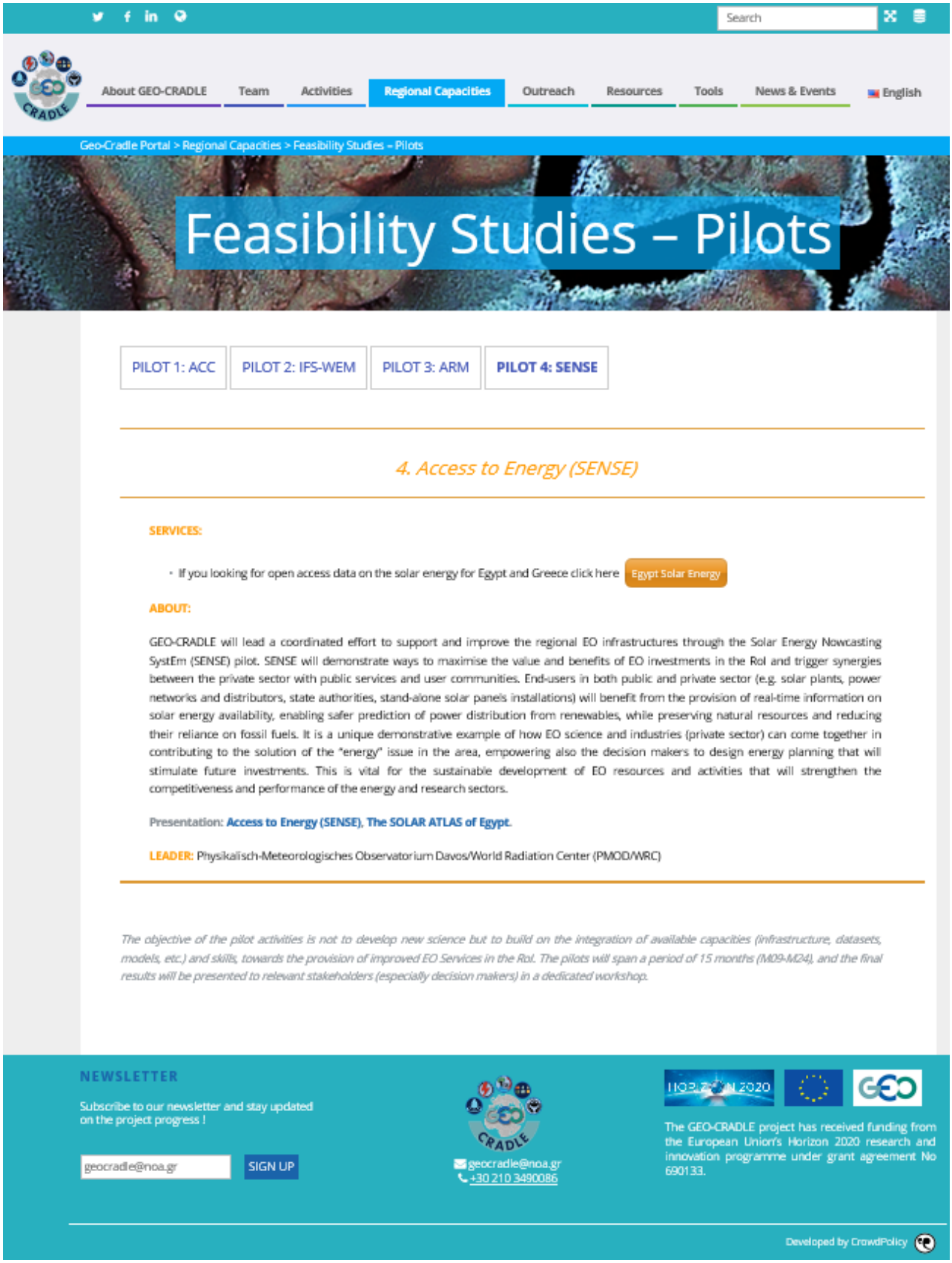


2.2.2) Improved Food Security - Water Extremes Management

2.2.3) Access to Raw Materials



2.2.4) Access to Energy

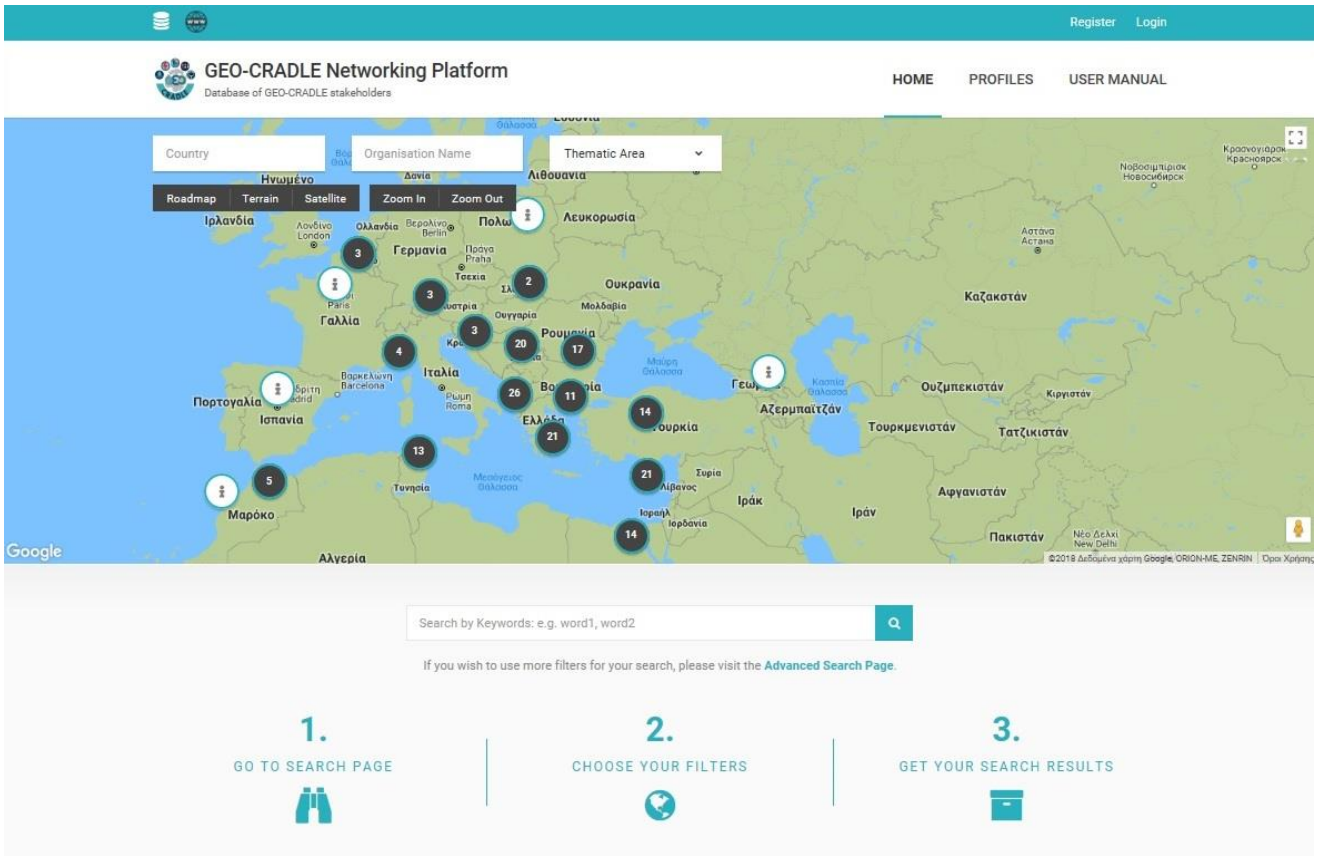


2.3) Networking Platform

2.3.1) Content

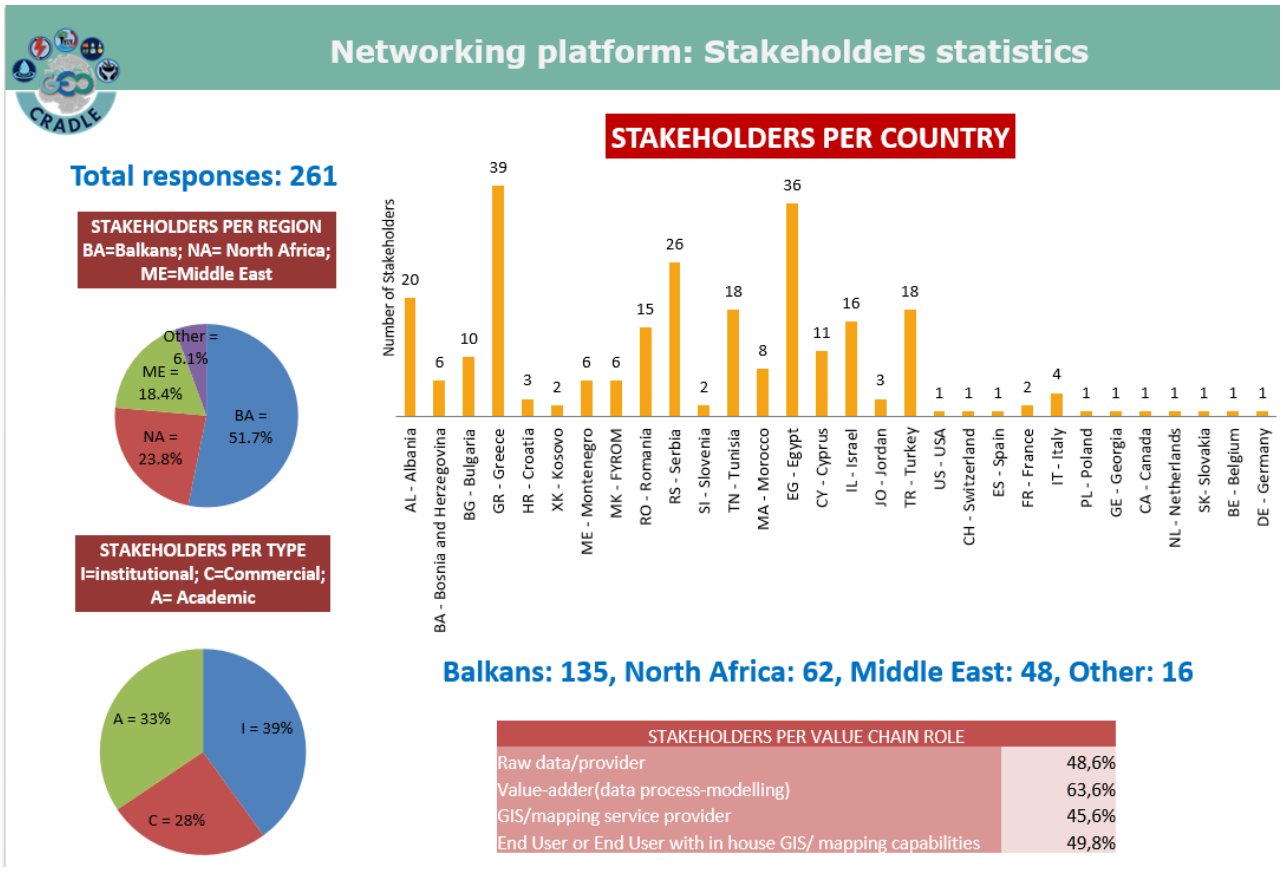
The GEO-CRADLE makes available, for the first time in the RoI (Balkans, Middle East and North Africa), a Networking Platform (http://geocradle.eu/platform/) which:

- ✓ incorporates a rich inventory of regional capacities
- ✓ publishes comprehensive profiles of stakeholders
- ✓ provides a first assessment of countries EO maturity
- ✓ facilitates potential partnerships between various stakeholders



The profiles of all stakeholders who have filled in the GEO-CRADLE survey are validated and uploaded on the Networking Platform, in a fully functional mode, following open access principles. The profiles include exclusive and specific information collected via the GEO-CRADLE Survey. After their registration, the stakeholders can login at anytime and edit their profiles.

2.3.2) Stakeholders statistics

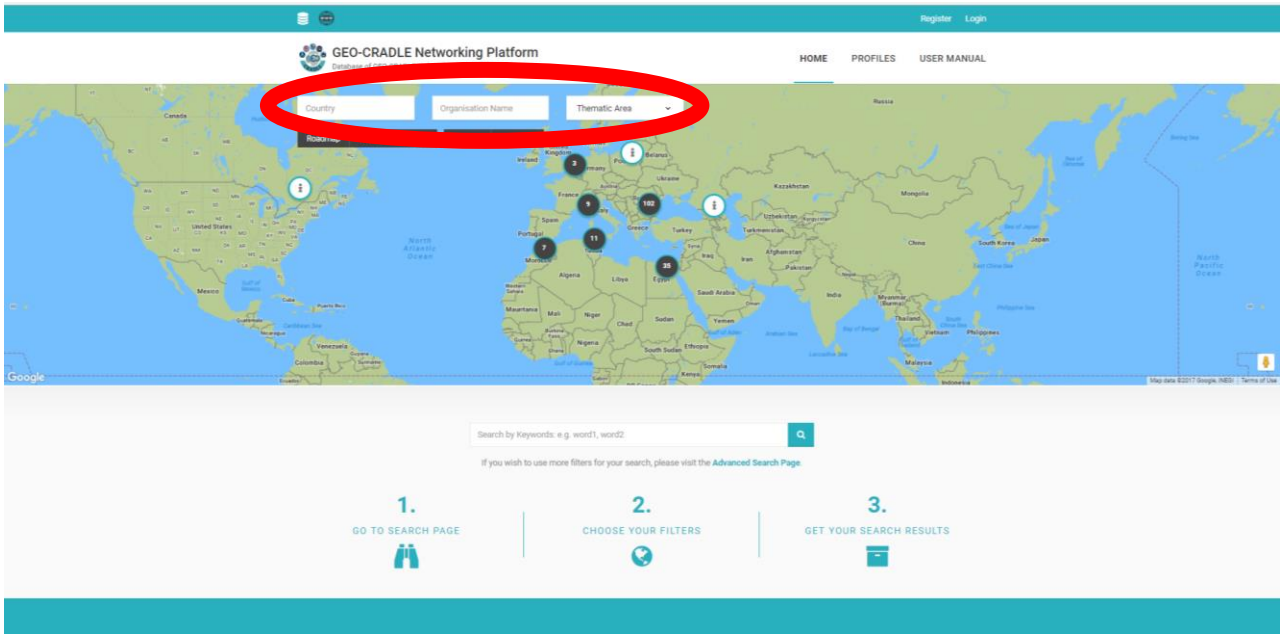


STAKEHOLDERS PER VALUE CHAIN ROLE	
Raw data/provider	48,6%
Value-adder(data process-modelling)	63,6%
GIS/mapping service provider	45,6%
End User or End User with in house GIS/ mapping capabilities	49,8%

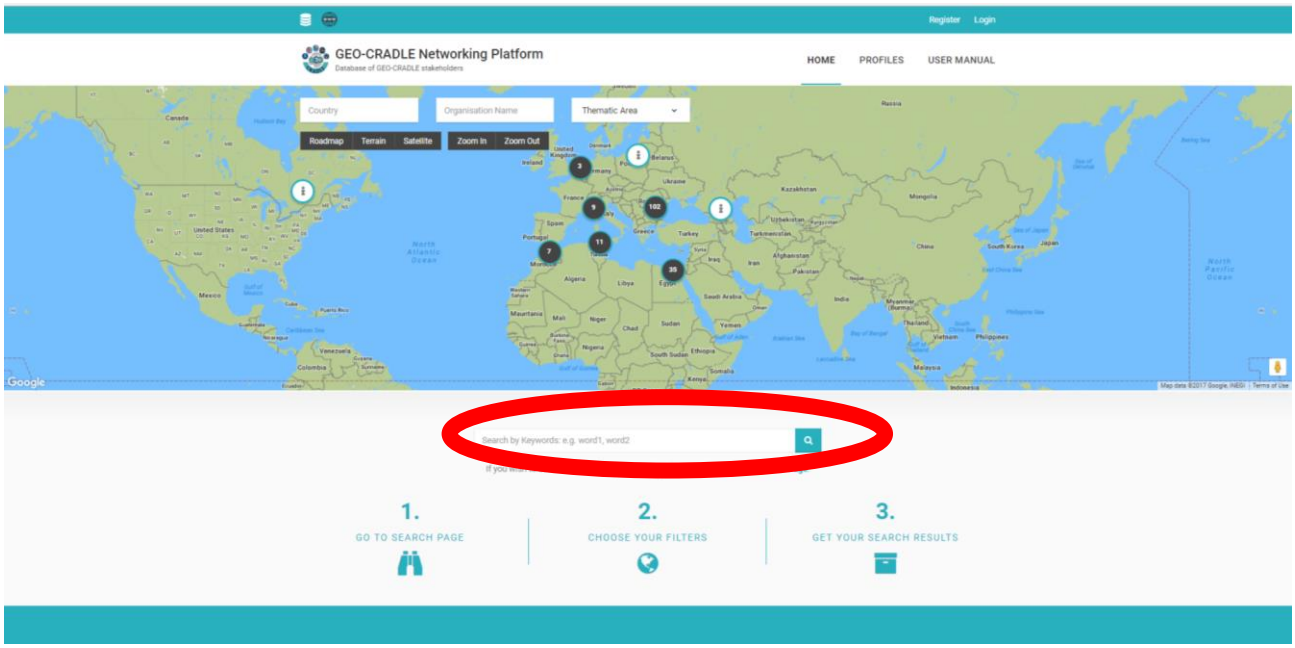
2.3.3) Filtering / searching mechanisms

The Networking Platform provides three different mechanisms for filtering/ search:

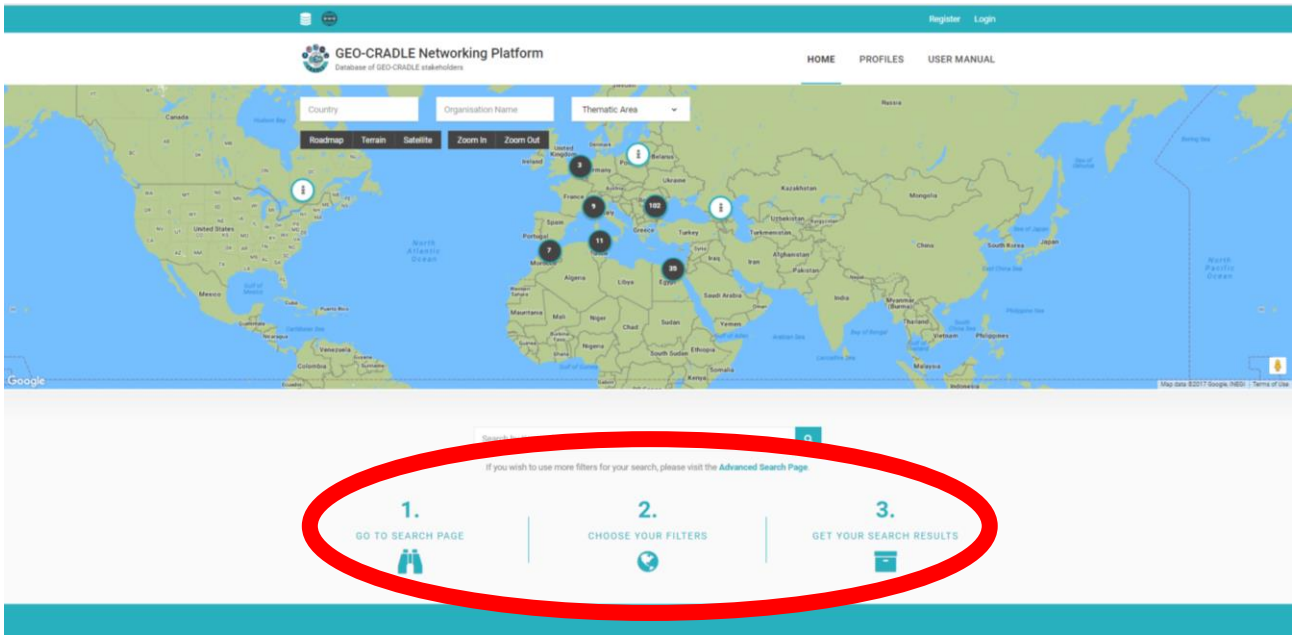
i. Map search: 3 filters to search the database & displays results on the map

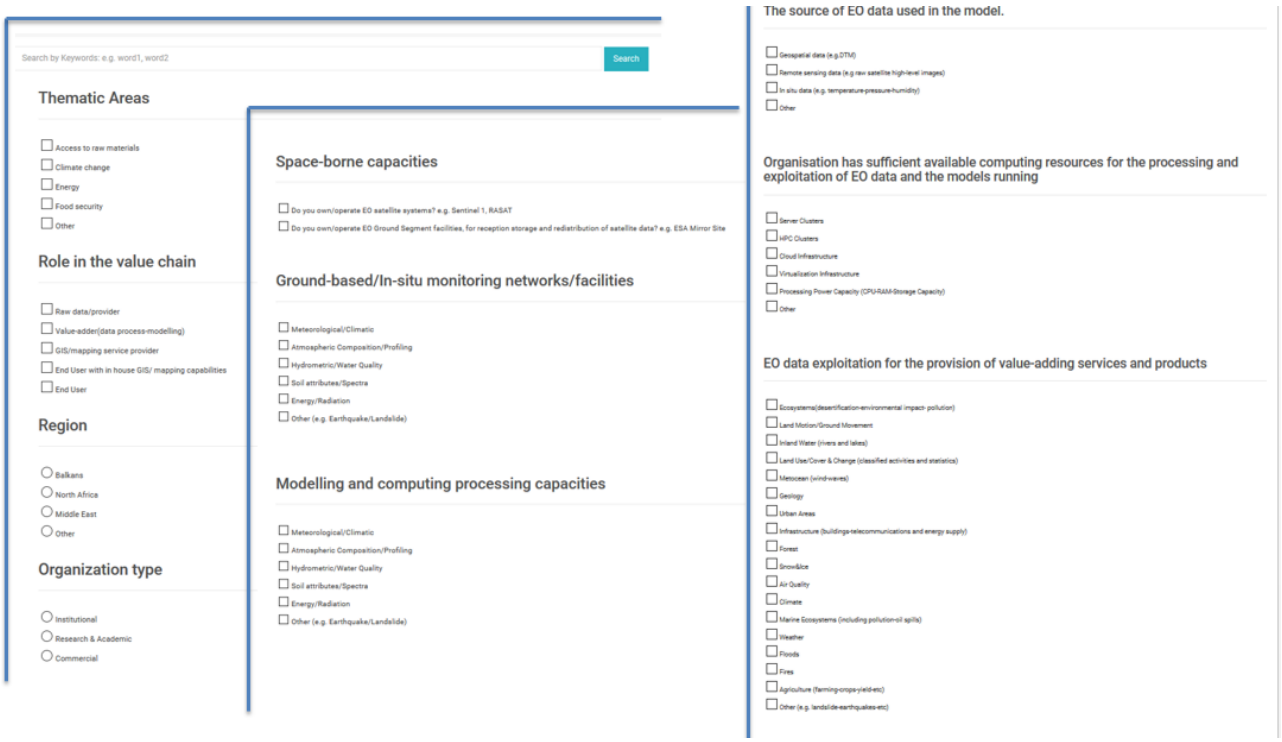


ii. Keywords search: search by one or more keywords (for quick search)



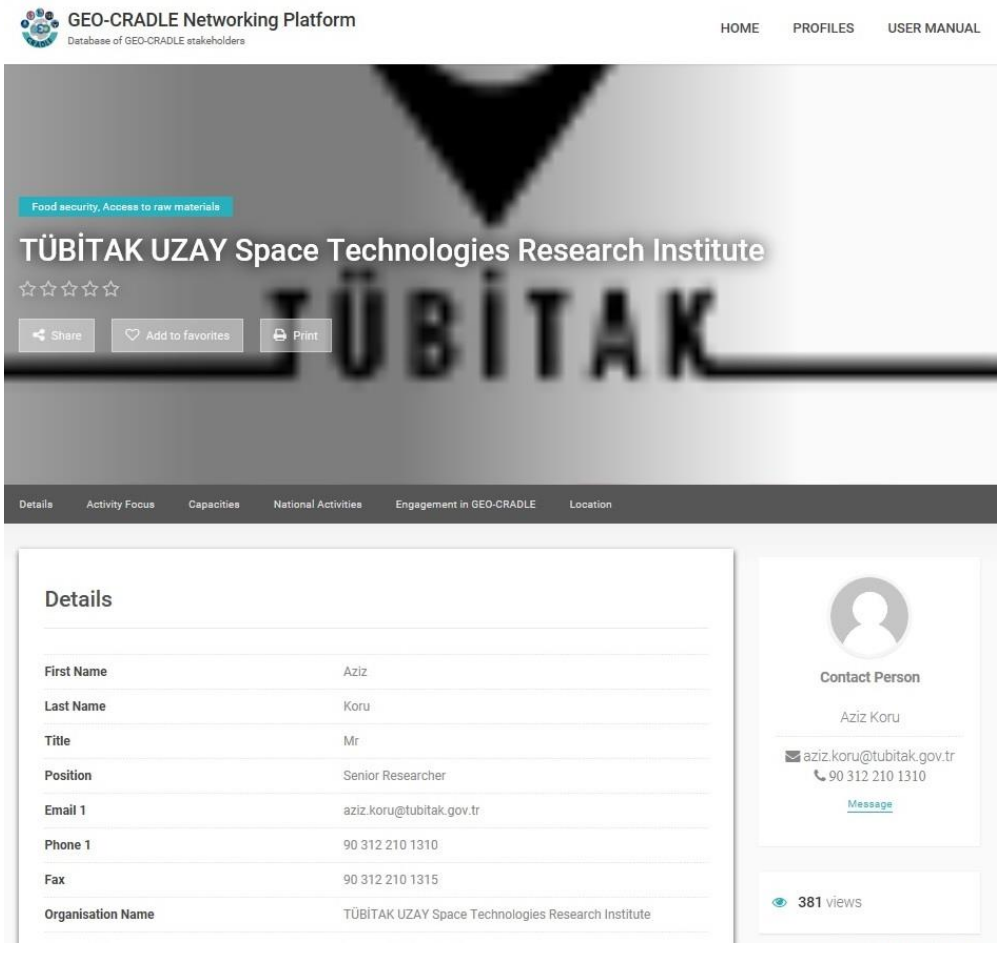
iii. Advanced search page: 10 filters combined with a “search by keywords” option





2.3.4) Stakeholder Profile

The Stakeholder Profile includes the following sections: Details, Activity Focus, Capacities, National Activities, Engagement in GEO-CRADLE, Location. Information on the views of each specific profile is also provided. An example profile is shown here:



2.4) Regional Data Hub (RDH)

2.4.1) Introduction

The Regional Data Hub (http://datahub.geocradle.eu/) is an Earth Observation (EO) service designed as a de facto "one-stop-shop" for region specific data, information, and knowledge access for EO players, service providers, and end users. A comprehensive description of the RDH is given in the following excerpt, taken from the vision of the GEO-CRADLE project:

> *Another key output of GEO-CRADLE that can contribute to the long-term uptake of EO activities in the region is the operation of the Regional Data Hub. By providing access to region-related datasets and services, directly fed from the GEOSS-portal, and at the same time being the centralized gateway for regional data providers to contribute easily and timely their products to GEOSS, the Regional Data Hub is designed to become the focal node in the region in the context of GEOSS and Copernicus implementation.*

The RDH, apart from being a service that allows its users to search for (**discovery**), view (**access**) and download (**request**) data related with the region of Balkans, Middle East and North Africa, it is also currently utilized as a gateway/ interface for registering data GEOSS, and has been highly considered by Geo Secretariat as a significant pilot operation of a Regional GEOSS Portal.

The RDH is a stable service with full interoperability with the GEOSS Common Infrastructure (GCI) resources and GEO DAB APIs, and serves as well as a repository of the data becoming available through the project pilots.

2.4.2) The software

For the implementation of the RDH service, an open data management platform was developed using DKAN and Drupal CMS. The platform is **Web-based** and **online** and runs in the server facilities of the National Observatory of Athens (NOA). Everyone can access the platform through http://datahub.geocradle.eu/ using a Web browser[1].

DKAN is a complimentary offering to CKAN in the effort to make data more open and accessible[2]. The reasons for choosing DKAN instead of CKAN are the following:

- Integrates open data catalog features into Drupal CMS, which is built upon PHP. PHP powers a significant percentage of the Web, while Drupal powers ~2% of the Internet as a whole with a wide community of active users and developers.
- Offers a powerful ready to use administration panel with several features that allow a site administrator to (a) manage users and user roles, (b) define content types, (c) add content, (d) extend platform's functionalities installing other modules, etc.
- Offers ready to use and customizable search and view functionalities for the data (e.g. Facet API, Views, Search API, Panels, etc.).

Using DKAN and the Drupal API, which is part of the Drupal content management framework, a Web software application was developed for the implementation of the RDH service. This application, which is called **GCRDH**, is actually a Drupal module bundled with the DKAN platform and extending the platform's functionalities.

[1] Or any other software package for retrieving files using HTTP, HTTPS, FTP and FTPS the most widely-used Internet protocols (e.g. wget).
[2] Read http://dkan.readthedocs.io/en/latest/introduction/dkan-ckan.html for more information.

The development of the GCRDH module started in December 2016. In April 2017, a pre-alpha version was set up and demonstrated during the 2nd GEO Data Providers workshop, (20th-21st April 2017, Florence, Italy). In July and August 2017, two alpha versions were released and were running at NOA Servers. In October 2017, a beta version with massive code refactoring was released, and its features were thoroughly tested and validated in real conditions during the following months of actual operation.

To sum up RDH is implemented via a DKAN platform and the GCRDH module. DKAN provides several ready to use functionalities such as: (a) an administrator panel, (b) a search engine, (c) view, preview and download capabilities for the stored content (i.e. datasets and resources), etc. Once DKAN is installed and properly configured in a Web server, a full-fledged and ready to use open data management platform is made accessible through an IP address[3]. With the GCRDH module, the DKAN platform is extended with further functionalities that satisfy the service requirements as described in the following section. Since DKAN is built upon Drupal 7.x and Drupal is a content management framework developed with PHP, HTML, CSS and JavaScript, the GCRDH module is also developed with the same technologies and uses the Drupal API.

2.4.3) Service Requirements

During the design analysis of the RDH service, several requirements were taken into account. Those requirements were not abstract; on the contrary they resulted from well recognised and documented needs: (i) the integration of GEOSS, which is a huge system with approximately 100 million registered resources at this very moment and around 25 million resources for the RoI, (ii) the relative underdevelopment of countries in the RoI with regard to EO services and open data policies, (iii) the fact that GEO-CRADLE was not intended to build new infrastructure capacities (e.g. archives, catalogs, etc.) but mainly to utilize the existing ones.

Hence, the following requirements were considered:

1. RDH shall be **online** and **Web-based**.
2. RDH shall be **efficient** and **scalable**.
3. RDH shall support in a **user-friendly** way **two kinds of users**. The types of users are: (a) unauthorized users[4] and (b) authorized ones (i.e. administrators, content authors, group owners, etc.). The 1st type is more interested in the search, view/preview and download functionalities, whereas the 2nd type is related with an administration panel (i.e. crud functions, content organization, user management, publishing options, etc.).
4. RDH shall **integrate multiple datasources**, also known as **multi-site search**. This is an obvious requirement that stems from the fact that the RDH is going to act as a *"one-stop-shop"* for region specific data, information, and knowledge access for EO players, service providers, and end users.
5. RDH shall **display on-the-fly remote data**, i.e. **no data replication**. The data discovered in remote datasources due to requirement (4) should not be replicated, i.e. copied in a storage owned by RDH.
6. RDH shall **connect with GEOSS**. Current requirement is also covered by requirement (4).
7. RDH shall be **modular** and **extensible**.

[3] For the implementation of DKAN the following DKAN version is used: https://github.com/GetDKAN/dkan-drops-7
[4] The unauthorized users are also known as anonymous users.

Some of the above requirements are supported by DKAN itself (e.g. requirements (1) and (2)), but for the rest a new software had to be developed (GCRDH).

2.4.4) Features

For the GCRDH module several sub-modules were developed introducing many interesting features. Actually GCRDH is both a module and a group of modules depending on each other; it is an **ecosystem**, comprised of the following modules:

a. GCRDH
b. GCRDH Default Content
c. HTTP Client
d. Remote Data
e. Validate
f. ATTL
g. GEOSS

Of course, the GCRDH is also dependent by DKAN modules such as DKAN Datasets and third party modules such as Entity Cache, Redis, etc. A brief description of each module is provided here:

a. GCRDH

The GCRDH module is the main module. It is the module that enables the discovery and access of data located to remote data sources, such as GEOSS, and their eventual display in the search results of the DKAN platform. Since the RDH is built upon DKAN, the search mechanism provided by the RDH is the DKAN's default search mechanism. The default search mechanism looks up for data in a local database, namely: (i) builds the proper SQL query using the user search criteria, (ii) executes the query against a local database, (iii) fetches the records and (iv) in the end renders those records in an HTML page. GCRDH hooks between step (iii) and (iv) and transparently repeats steps (i) to (iii), allowing the RDH to look for data in remote data sources, fetch any data the satisfy the user search criteria and render them along with the local data during step (iv).

For the GCRDH module to be able to search for data in a specific remote datasource and append any discovered data in the results of a user search, a module had to be provided implementing the communication between the RDH and the remote datasource. The communication currently supported is through HTTP; hence the remote datasource should provide a Web service for discovering and accessing its resources implemented through a specific API[5] (e.g. RESTful API).

Thus GCRDH module supports requirement (4).

b. GCRDH Default Content

This module is inspired by the DKAN Default Content module and is depended by DKAN Fixtures module. It creates the basic groups of datasets that will be available through the RDH. The basic groups correspond to the GEOSS group, which is the one containing the GEOSS datasets, and the pilots groups that contain data generated from the GEO-CRADLE pilots.

c. HTTP Client

This is a rather interesting module since it provides a very important feature which is the caching of the HTTP requests.

[5] The API schema must also be available in order for the module to implement the discovery and access mechanism.

As mentioned in the GCRDH description section, the access and discovery of data in remote datasources is done through HTTP using the source's Web Service. This is being implemented via external API calls, made through HTTP GET requests and the drupal_http_request method is used. However many of these calls are very frequent and tend to return the same HTTP response. Instead of making the same HTTP requests over and over, flooding the network between RDH and the remote datasources, a simple HTTP caching mechanism is implemented and provided by the HTTP Client module.

The way this mechanism works is the following: whenever an HTTP request to a remote datasource is sent, the returned response is saved in an in-memory cache. Subsequent identical requests are served by the cached response. The cached response is used for a Time-to-Live (TTL) equal to an hour and when this TTL expires the response is validated. During validation the request is forwarded to the remote datasource and returns a response that replaces the cached one (**refresh**).

The current module greatly satisfies service requirement (2).

d. Remote Data

This module is maybe the most important because it addresses requirements (2), (4), (5) and (6).

The Remote Data module provides several helper functions as well as the *Remote Data Entity Wrappers,* that allow for the discovery and access of remote data[6], and the subsequent creation, indexing and caching of the corresponding Drupal/DKAN entities.

Every remote datasource has its own data model. Similarly DKAN has its own data model based on the Drupal Entities[7]. For the remote data to be displayed in the search results of the RDH, which is implemented through DKAN platform, it must be properly "*translated"* into Drupal/DKAN datasets. It's not adequate to have a mechanism that knows how to discover and access data in remote datasources; there must also be a mechanism that knows how to convert remote data in the data model recognized by DKAN. This mechanism is provided by the current module and in particular the Remote Data Entity Wrappers which are classes providing not only the **translation**, but two more **core** mechanisms: the **indexing** and **caching** mechanisms.

The **indexing mechanism** stores a record in the database that contains the ID of the entity corresponding to a remote datum and information about retrieving that. This information is called *remote data index* and helps the system to recognize an entity created from remote data and recreate this entity in case the entity is lost due to a cache flush or a cache replacement policy.

The **caching mechanism** is similar to the one implemented by HTTP Client but with some further elaboration. It is used to cache an entity created from remote data and is dependent by Entity Cache and Redis modules. The combination of Entity Cache and Redis modules create an in-memory cache for Drupal/DKAN entities.

The caching mechanism implemented by Remote Data modules works simply enough. Instead of creating the corresponding entities every time remote data are fetched as part of a user request, those entities are created only the first time (i.e. when they are not found in the cache) and then are cached satisfying subsequent requests for the same data through the cache.

The current cache mechanism, combined with the cache mechanism implemented by the HTTP Client module, support greatly the requirement for efficiency and scalability as they reduce

[6] Data fetched from remote datasources.

[7] Read https://www.drupal.org/docs/7/api/entity-api/an-introduction-to-entities for more information.

significantly the network traffic and bandwidth consumption between the RDH and the connected remote datasources.

e. Validate

The Validate module is dependent by the Remote Data module. It assures that the Remote Data module will not deliver *"stale"* data to the RDH users.

Since the Remote Data module caches the entities that were created due to data fetched from remote datasources, there must also be a way to check the consistency of the cached data with the original ones.

If the data in the remote datasource is modified, the corresponding entity that is cached in GCRDH's cache must be properly updated. The Validate module provides a TTL policy, similar to that of the HTTP Client module. It assigns to every cached entity a TTL (equal to one day) and serves all the requests to an entity until the TTL expires. When the TTL expires, it validates the cached entity checking its validity against the remote datasource; if the corresponding data in the remote datasource have changed, the cached entity is updated.

f. ATTL

When ATTL is enabled, it overrides the default TTL policy of the Validate module. The Validate module by default assigns fixed TTLs of one day; that is not very efficient. The ATTL module provides the ATTL policy which stands for Adaptive TTL, a policy that is currently the state of the art in the Web caching.

In the ATTL policy the last modification time of an object is taken under consideration for assigning a TTL. The most common formula used is the following:

$$TTL = \min\left(a * \left(now - last_{modified}\right), threshold\right), where\ a \in [0,1]$$

So, the formula assigns (to every object) a TTL that is a fraction of the time past from the last modification time, limited by an upper bound which assures that even those objects that are modified rarely will be validated at some point.

This formula ensures that objects modified a long time ago will take large TTLs, whereas objects modified recently will take small TTLs. It also ensures that if an object that was not modified for long time is eventually modified will take a very small TTL.

With the ATTL policy the validation mechanism is greatly improved. This module provides great benefit to requirement (2) as well.

g. GEOSS

The GEOSS module is the one integrating GEOSS into the RDH. The GEOSS module utilizes the OpenSearch API of the GEO DAB APIs suite in order to discover and access data from GCI and eventually create, index and cache the corresponding Drupal/DKAN entities.

The GEOSS module extends the *Remote Data Entity Wrappers* of the Remote Data module providing the interface for creating, indexing and caching a DKAN dataset from a GEOSS report, a DKAN resource from a GEOSS resource and a Drupal taxonomy term from a GEOSS term Frequency object.

The GEOSS module is also responsible for parsing the search criteria extracted from a user search made through RDH and create the corresponding API call to GCI using these criteria and the OpenSearch API.

Finally, the GEOSS module is the module that allows the GCRDH module to fetch GEOSS data during a user search and append them in data discovered from other sources (either the local database or other remote datasources).

2.4.5) Enhancements

Several enhancements are provided via the GCRDH module:

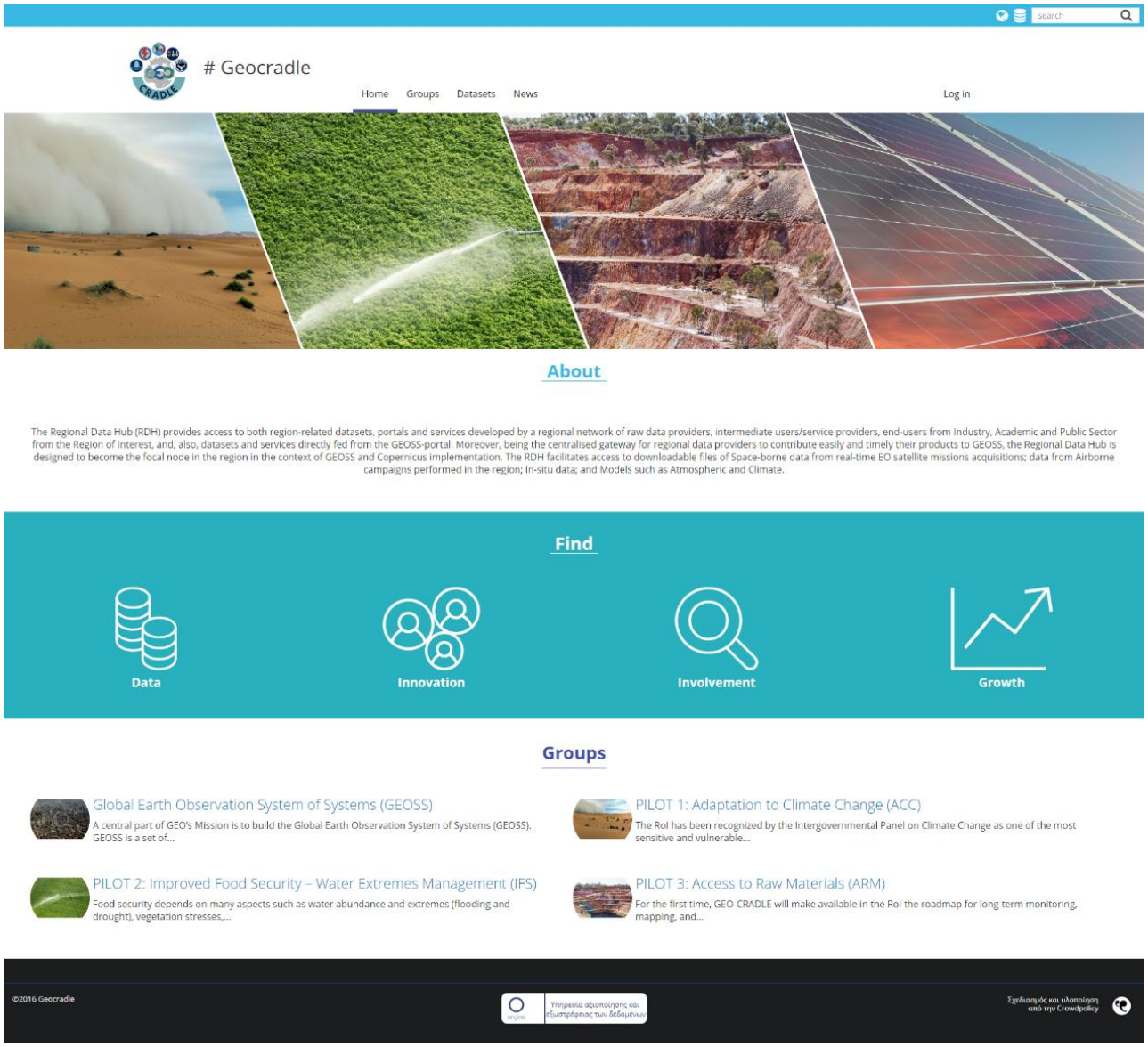
- Improved user interface for the search results.
- Improved WMS and WFS previews. In the case of WFS preview, the GCRDH is able to preview every WFS layer in every EPSG. Also, it supports feature popups for better visualization of the layer information.
- Preview capabilities for GEOSS data (WMS/WFS preview, PDF, CSV preview, etc.).
- Cleaning of GEOSS data; removing/merging duplicate resources for a GEOSS report, assigning titles to resources without titles, detecting formats for resources that have not format information through HTTP HEAD requests.
- URL cleaning; discovery of URLs that have changed or that are not working anymore, discarding data with invalid URL schemes.
- Access of a GEOSS report in RDF and Project Open Data Schema formats.

2.4.6) Regional Data Hub Review

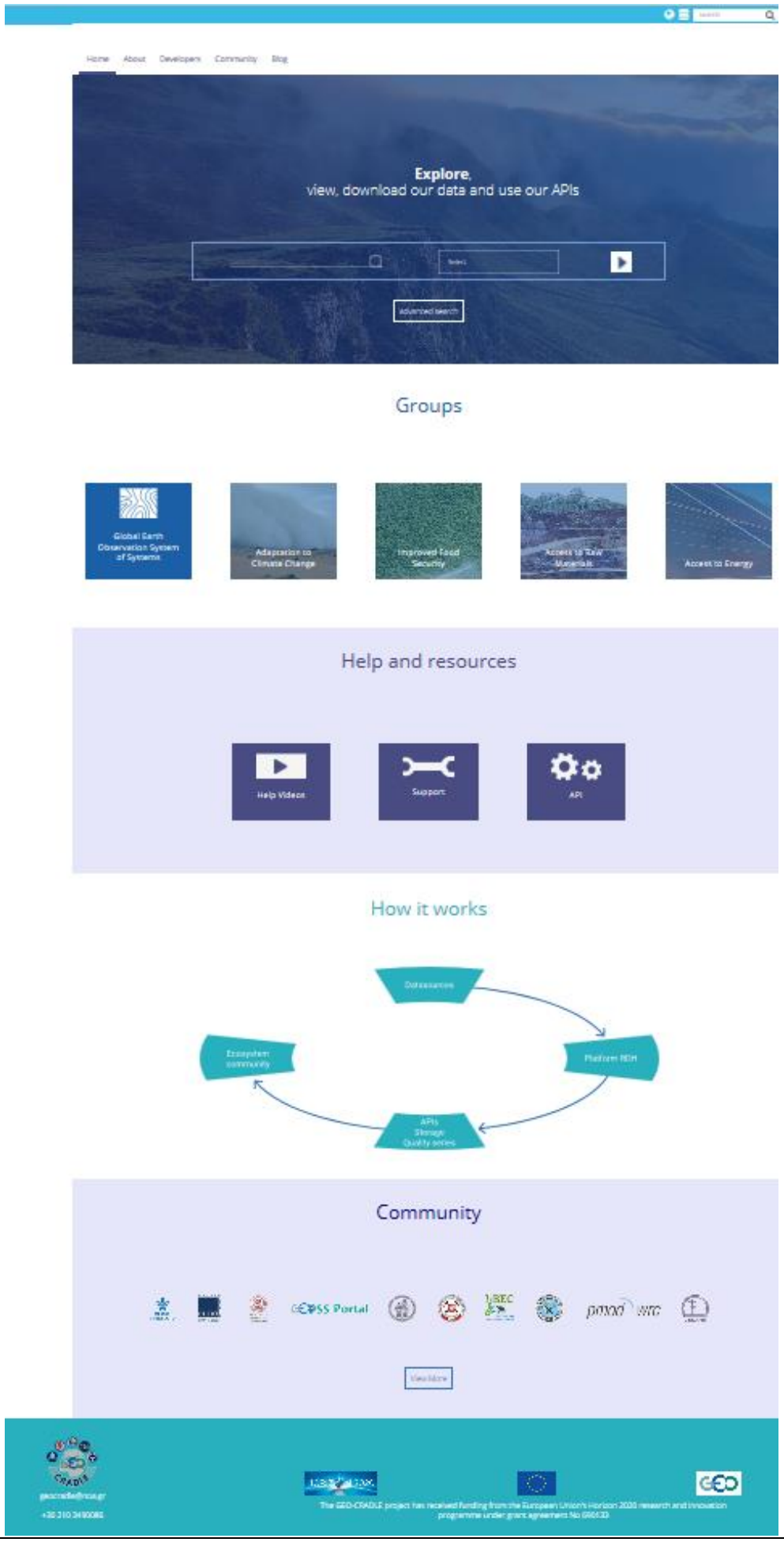
The RDH provides access to both region-related datasets, portals and services developed by a regional network of raw data providers, intermediate users/service providers, end-users from the Industry, Academic and Public Sector within the Region of Interest, and, also, datasets and services directly fed from the GEOSS-portal. Moreover, being the centralised gateway (focal node) for regional data providers to contribute easily and timely their products to GEOSS. The RDH facilitates access to downloadable files of space-borne data from real-time EO satellite missions acquisitions; data from airborne campaigns performed in the region; in-situ data; and model results such as in the domains of Atmosphere and Climate.

- **RDH Landing Page**

Based on the project scope the first version of RDH was developed, available at http://datahub.geocradle.eu/. The platform's first page is shown below.



A second platform version was developed, available at http://noadev.oengine.crowdapps.net/. The second platform version is actually a template improvement in order to simplify the platform's UI. The updated template is shown below.


Home
About
Developers
Community
Blog
Explore,
view, download our data and use our APIs
Advanced search
Groups
Global Earth Observation System of Systems
Adaptation to Climate Change
Improved Food Security
Access to Raw Materials
Access to Energy
Help and resources
Help Videos
Support
API
How it works
Community
GEOSS Portal
View More

From the top header the GEO-CRADLE Site (http://geocradle.eu/) and the GEO-CRADLE Networking Platform (http://geocradle.eu/platform/) are accessible. Also, more information is available about the platform via the header menu.

The first section of the landing page allows the user to search data based on the available groups provided. The user chooses the group and uses keywords in order to set his/her search prerequisites. Moreover the user can use the advance search mechanism (http://noadev.oengine.crowdapps.net/search/type/dataset?query=), which allows him/her to use more filters such as tags, dataset format etc.

The second section of the landing page shows the groups used in the platform in order the datasets to be categorized.

The third section of the landing page provides more information to the users. The user by clicking on each icon can view help videos, support information or information about the API used.

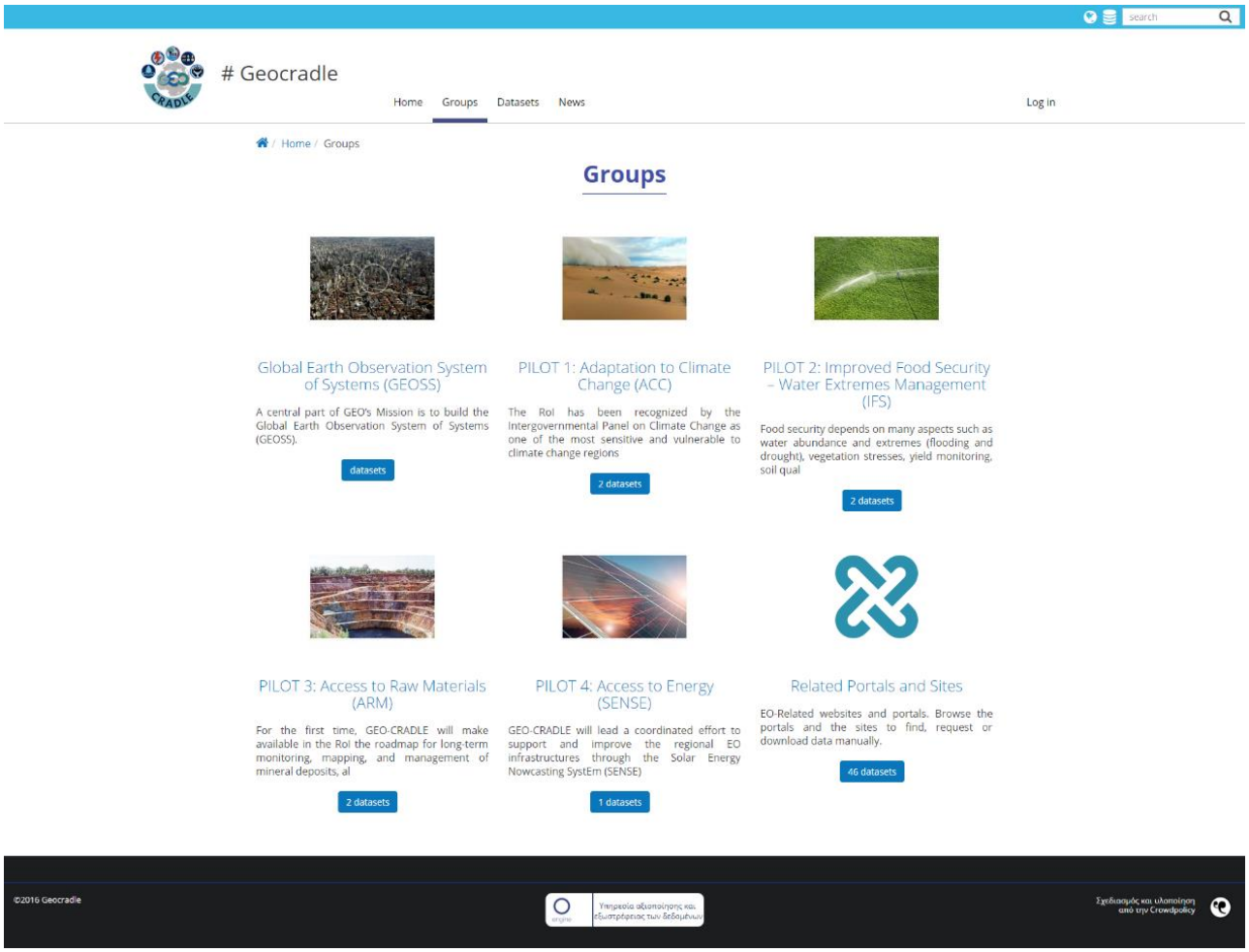
The forth section is actually an infographic which shows the process used in the RDH community.

Moreover, the fifth section shows some of the stakeholders who participate and provide data to the RDH platform.

Finally, the footer shows some useful information, such as the contact details, acknowledgment about the project's funding, and also allows users to subscribe to the project's newsletter.

- **RDH Groups' Preview Page**

From the platform menu the groups preview page is available, where all the available dataset groups used in the platform are gathered. Moreover further information are provided about each group and the datasets provided by them. The groups preview page is available at http://datahub.geocradle.eu/groups as shown on the picture bellow.

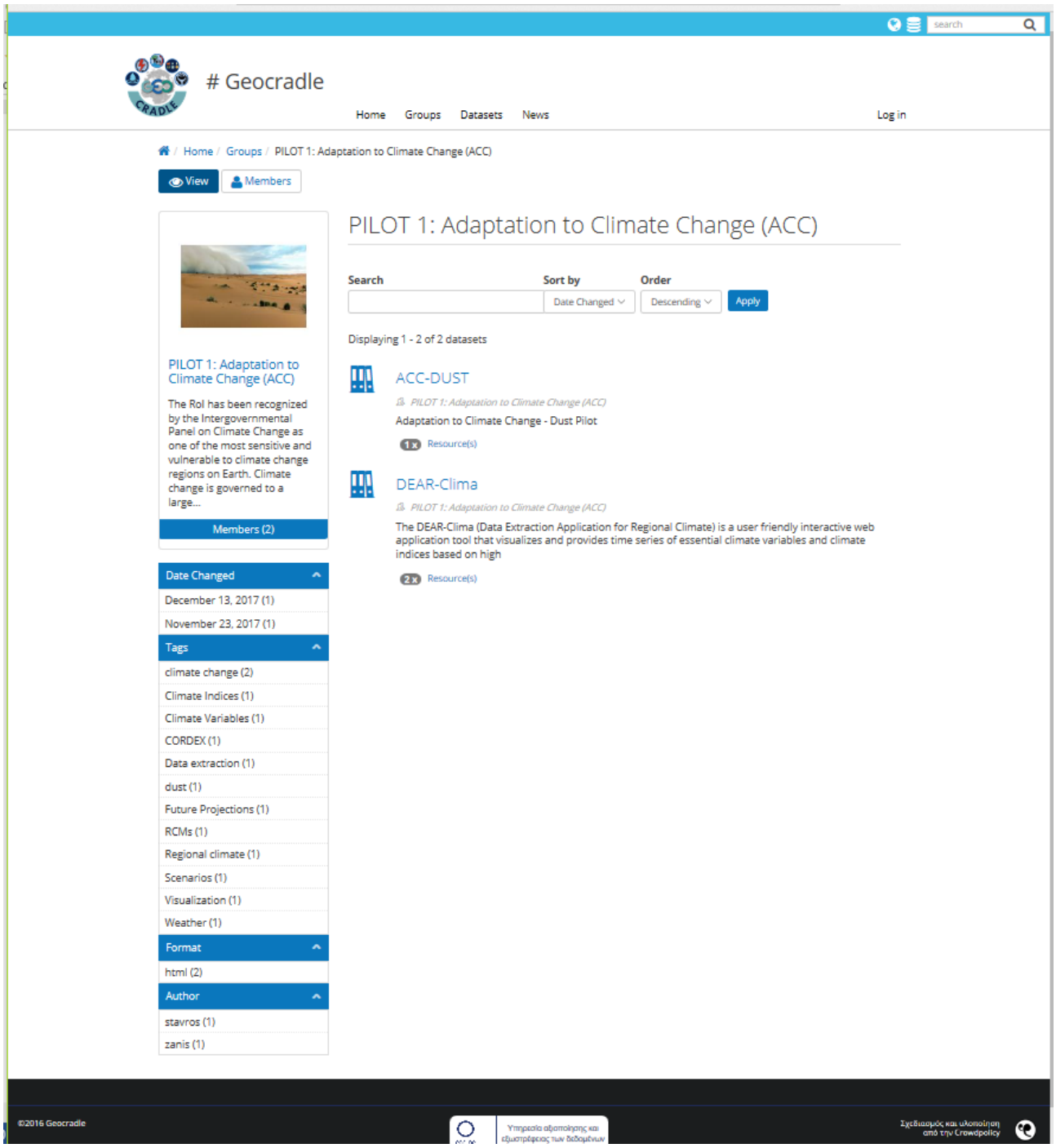


- **RDH Group's Single Page**

Each group single page, for example http://datahub.geocradle.eu/group/pilot-1-adaptation-climate-change-acc shows more detailed information about the group, the datasets under each group, the tags used, the datasets' format and the authors. The available groups in the RDH platform are listed below:

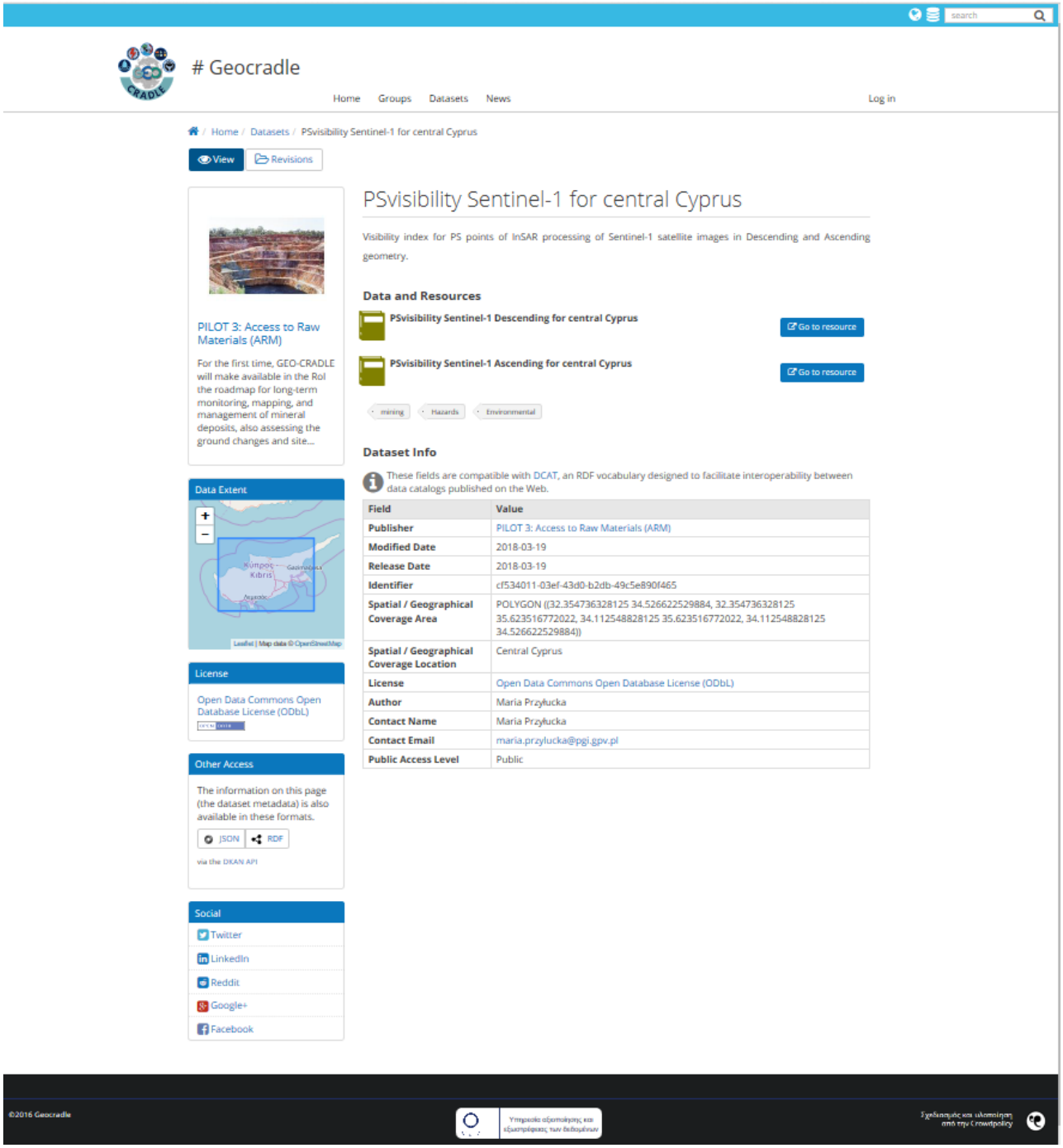
- Global Earth Observation System of Systems (GEOSS)
- Pilot 1: Adaptation to Climate Change (ACC)
- Pilot 2: Improved Food Security – Water Extremes Management (IFS-WEM)
- Pilot 3: Access to Raw Materials (ARM)
- Pilot 4: Access to Energy (SENSE)
- Related Portals and Sites

An example of a single group page, Pilot 1: ACC, is shown in the picture below:



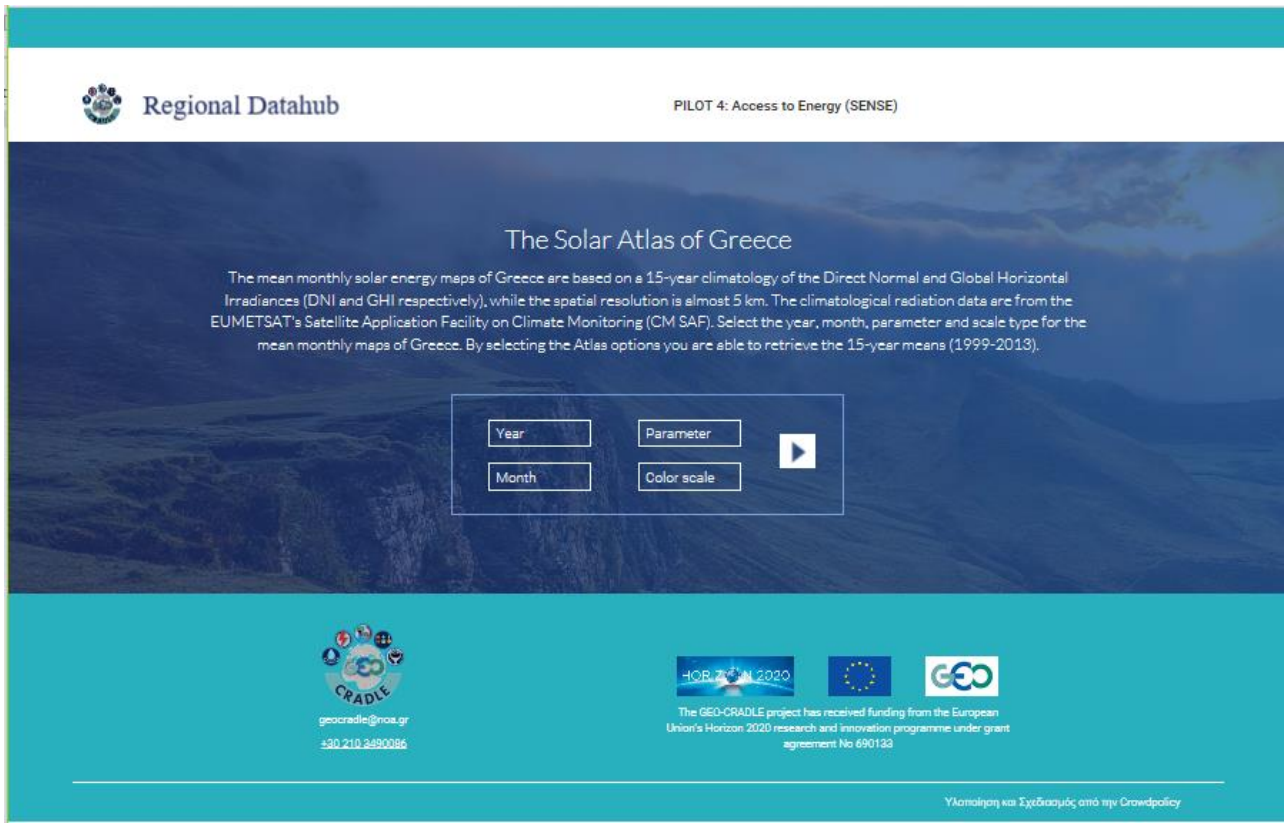
- **RDH Dataset Page**

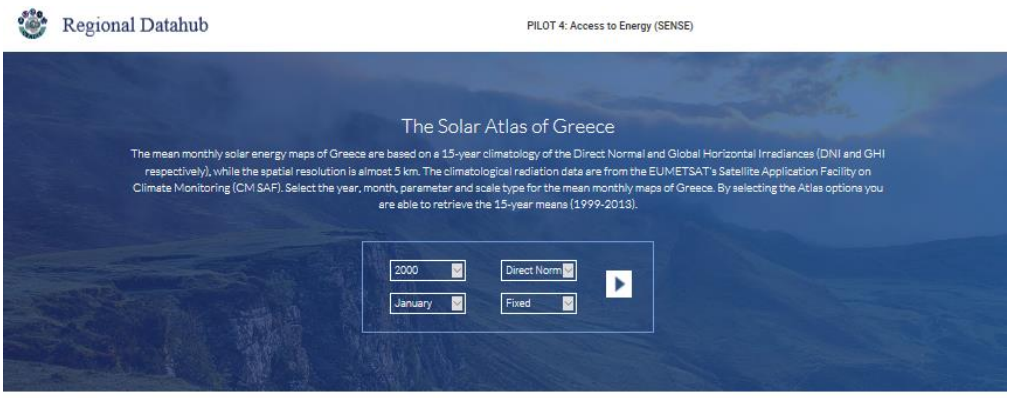
The dataset page, for example PSvisibility Sentinel-1 for central Cyprus, developed in the framework of Pilot 3: ARM, shows detailed information about the specific dataset. The dataset page is shown below.

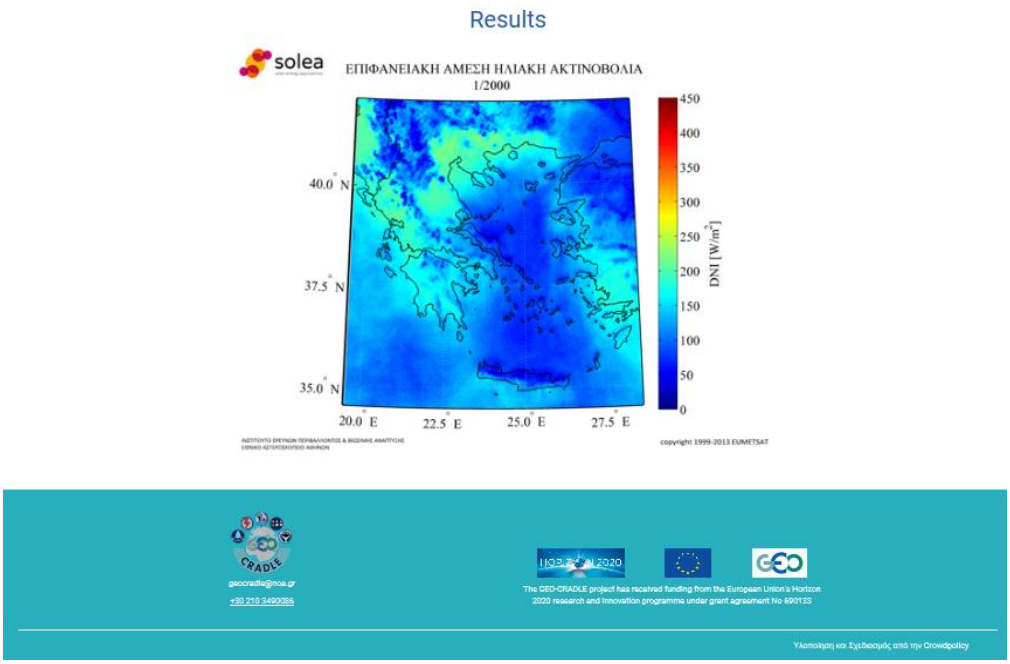


- **RDH Solar Atlas Module**

The Solar Atlas module, developed in the framework of Pilot 4: SENSE, is actually an independent advanced search mechanism, developed in the framework of the GEO-CRADLE project. The user can use four different filters (year, month, parameter, color scale) in order to view maps, as shown in the picture below.


Regional Datahub
PILOT 4: Access to Energy (SENSE)
The Solar Atlas of Greece
The mean monthly solar energy maps of Greece are based on a 15-year climatology of the Direct Normal and Global Horizontal Irradiances (DNI and GHI respectively), while the spatial resolution is almost 5 km. The climatological radiation data are from the EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF). Select the year, month, parameter and scale type for the mean monthly maps of Greece. By selecting the Atlas options you are able to retrieve the 15-year means (1999-2013).
Year
Parameter
Month
Color scale
geocradle@noa.gr
+30 210 3490086
The GEO-CRADLE project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 690133
Υλοποίηση και Σχεδιασμός από την Crowdpolicy


Regional Datahub
PILOT 4: Access to Energy (SENSE)
The Solar Atlas of Greece
The mean monthly solar energy maps of Greece are based on a 15-year climatology of the Direct Normal and Global Horizontal Irradiances (DNI and GHI respectively), while the spatial resolution is almost 5 km. The climatological radiation data are from the EUMETSAT's Satellite Application Facility on Climate Monitoring (CM SAF). Select the year, month, parameter and scale type for the mean monthly maps of Greece. By selecting the Atlas options you are able to retrieve the 15-year means (1999-2013).
2000
Direct Norm
January
Fixed


Results
solea
ΕΠΙΦΑΝΕΙΑΚΗ ΑΜΕΣΗ ΗΛΙΑΚΗ ΑΚΤΙΝΟΒΟΛΙΑ
1/2000
40.0° N
37.5° N
35.0° N
20.0° E
22.5° E
25.0° E
27.5° E
450
400
350
300
250
200
150
100
50
0
DNI [W/m²]
copyright 1999-2013 EUMETSAT
geocradle@noa.gr
+30 210 3490086
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