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Abstract

Starting beginning of March 2013, the project proposes a Pilot1 of InGeoCloudS. It features a series of scientific geodata services relying on a cloud-based infrastructure. This document accompanies the prototype available on the Internet under the http://pilot.ingeoclouds.eu domain name. It summarizes what kind of services can be found in this prototype as well as some operational information.

Keyword List

Prototype, data publication, maps, WFS/WMS, CSW, OGC, boreholes, groundwater, landslides, shake-maps, ground acceleration, Cloud,

DOCUMENT CHANGE LOG

Document Issue	Date	Reasons for change
Version 1-Draft 1	2013-02-20	Creation of the document
Version 1-Draft2	2013-02-25	Doc structure completed and operations chapter contents
Version 1-FinalDraft1	2013-02-27	Integration of datasets descriptions/missing screenshots/ resuction of Operations chapter
Version1-FinalDraft2	2013-03-01	Last contributions from EPPO and BRGM
Version1-Approved	2013-03-04	Last proof-reading and edition for delivery.

APPLICABLE AND REFERENCE DOCUMENTS (A/R)

A/R and Reference	Title
[A1] ICT PSP Grant Agreement N° CIP 297300	InGeoCloudS Grant Agreement and its annex (including the description of work)
[A2] CA-INGC	InGeoClouds Consortium Agreement v1.0
[R1] D2.1-INGC	Use Cases for InGeoCloudS data and services
[R2] D2.2-INGC	Interface of Web services and models of data
[R3] D3.2-INGC	Cloud Architecture, configuration and data access implementation

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1. INTRODUCTION

This document describes the Deliverable D4.1 "*First implementation of InGeoCloudS Pilot*" which is of type "prototype".

InGeoCloudS infrastructure is first described in a synthetized form: technical characteristics, cloud-based nature, the different components and their deployment.

Finally, the document presents the different types of users and the possible interactions they can have with the system: main characteristics of the pilot are described in a summarized way according to various viewpoints:

- Users: different types of users supported; what they can do with the system
- Data and services: which datasets are available in this pilot and in which services are available around them.
- Main Operations: how the Pilot1 can be operated on a daily basis by consortium members.

A comprehensive documentation will be made available for the different types of actors in the frame of WP5 work (D5.1 "*InGeoCloudS Users documentation*" to be issued M14). Help pages will be incrementally elaborated in parallel.

2. INGEOCLOUDS DATA AND SERVICES

2.1. INGEOCLOUDS INFRASTRUCTURE OVERVIEW

In the figure below we show the component diagram of the InGeoCLOUDS platform. A more comprehensive description of the InGeoCLOUDS platform is given in D3.2 [R3].
At the bottom layer we have the cloud computing platform. Every cloud provider (e.g., Amazon) exposes a specific set of services to exploit the facilities of the cloud platform. On top of the cloud computing platform, there is a set of basic services, named InGeoCLOUDS middleware, that exploit the underlying cloud computing platform to provide reliable and scalable storage and computing facilities to the other components of the architecture. These interactions are transparent for the different types of InGeoCloudS users.

The Elastic File Server and the Elastic Database Server provide scalable services through standard mechanisms, such as ODBC/JDBC and NFS. These two components are at the core of the architecture as they are used by every other component, and specifically by the *data providers'* applications to store and manage their data. The use of such standard technical solutions makes it possible to have a smooth adaptation of the existing services from the data providers' in-premises infrastructures. Software components of the architecture are coordinated and monitored by the IGC Management component, while the IGC Administration component provides administration tools operating the whole system. Integration of data providers' applications into the InGeoCLOUDS architecture is mainly achieved through interactions with Data Publication, Data Integration & Linking, Data Import and the Web GIS Client components. Regular users consult and navigate in the Portal for accessing maps and other vizualisations and/or can consume the exposed OGC compatible Web services.

Regarding the deployment of Pilot 1, the Elastic DB and the Elastic File Server were specifically designed aiming at scalability. Both the Elastic DB and the Elastic File Server exploit a pool of servers to sustain a

possibly large volume of data requests. Indeed, they are very important for the development of every other service of the platform. Scalability features will be extended to other components as needed before Pilot 2. In the rest of this Section, data and higher-level services made available by the data providers are discussed.

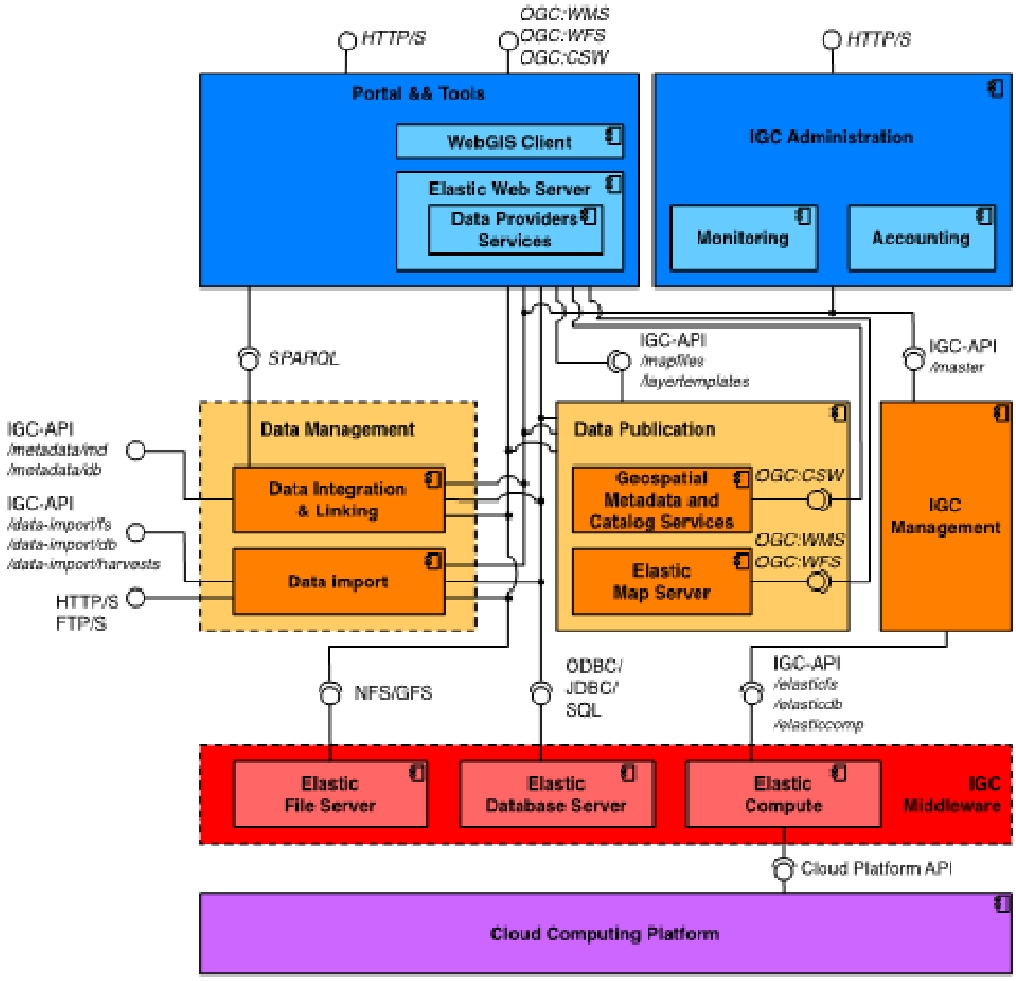

Figure 1 : Logical View of InGeoCloudS

2.2. INGEOCLOUDS DATASETS

2.2.1. GEUS DATA

The GEUS **groundwater dataset** consists of boreholes with a geographical location. For each borehole, there are classifications of the lithologic and lithostratigraphic layers the borehole penetrates. Within each borehole is one or more intakes from which groundwater can be extracted. All the intakes are hydrologically isolated from each other. Samples are periodically taken from each intake and analyzed for chemical and biological substances. In addition, the groundwater level for each intake is measured periodically.

2.2.2. GEO-ZS DATA

Aladin precipitation forecast are .asc files. All the other input data (precipitation values, landslide triggering threshold values) is raster format (GeoTiff or ArcInfo Binary Grid). The output format is also raster format

(GeoTiff or ArcInfo Binary Grid).The final result is **WMS service with landslide prediction** created from previous input files.

2.2.3. BRGM DATA

In the first version of the InGeoClouds pilot, the BRGM pushed 3 types of datasets in the project:

- the French groundwater database (10 Go) containing all groundwater quality measurements in France and groundwater level following by piezometric monitoring stations. The database contains more 20 millions of data and the content was indexed by FORTH in the context of the linked data process
- The French groundwater monitoring stations with their geospatial localization and in relation with the groundwater database. For some stations, the localization was blurred for security reasons.
- The geology dataset for France at the scale of 1 / 1 000 000 with information about lithology and age of rocks.

Moreover, the BRGM has developed and produced a WMS service as a “base” reference layer in Europe with the use of the OpenStreetMap data (www.openstreetmap.org/). The service could be used by all web GIS clients in the projet. The service will be pushed in the cloud infrastructure for the pilot 2.

2.2.4. EPPO DATA

The EPPO dataset includes ground motion and shaking intensity maps (shake-maps) for specific significant earthquakes. Shake-maps are grids of data of various physical parameters (like peak-ground acceleration, peak-ground velocity, intensity and spectral response) for an area around the earthquake source. For the calculation of each map the data used includes Greek Accelerometers Network descriptive data (station cites, sensors, geology), earthquake source data and strong motion data. Triggered by earthquakes, the accelerometers network produces strong motion recordings, which are then processed and used for the calculation of the shake-maps. The maps are produced in a variety of formats like images, geo-referenced maps and data grids.

2.2.5. EKBAA DATA

The datasets which came from EKBAA/IGME refer on two main topics. The first topic refers on **boreholes** and the second one refers on **chemical analyses**, which were carried out over samples taken from the aforementioned boreholes. The boreholes are located in two regions of Greece, one in the north of Greece and one in the central Greece namely, Mygdonia and Thriasio respectively. For each borehole, they store various features such as its coordinates, its depth, the aquifer and the water district it has drilled. They also store other information such as the pumping type, the topology (e.g., valley, hill) and the geology of the ground the borehole has drilled. In the topic of the chemical analyses, they connect each ground water sample analysis with the borehole it was taken from and the date of the analysis. Moreover, they have a set of chemical compounds they consider to be important (e.g., pH, Ca, Mg, Na, etc.) and they store the concentration of these compounds over their samples. The ground water samples, which were taken from Mygdonia, were analyzed by the EKBBA's Chemical Laboratory of Xanthi (Greece) and the samples which were taken from Thriasio were analyzed by the EKBBA's Chemical Laboratory of Athens.

2.3. USERS

2.3.1. DATA PROVIDERS

A *Data Provider* is a user willing to contribute with his own data or with a novel service. The registration process for data providers is supervised by an administrator who must check and authorize the *Data Provider* account request. The platform creates a *Workspace* for each *Data Provider*. A *Workspace* simply provides the possibility to store (and access) his own data in a private database of the InGeoCLOUDS

Elastic Database Server, or in a private folder of the InGeoCLOUDS Elastic File Server. The *Data Provider* can thus immediately take advantage of the scalability, reliability and potentially unlimited storage space features provided by the InGeoCLOUDS platform.

2.3.2. REGISTERED USERS

Registered Users are visitors of the platform that performed the registration process. These users can be recognized by InGeoCLOUDS, and they can thus potentially exploit some services that are not made available to the anonymous web user. Examples could be notification services and personalization of user experience. The registration in this case currently is unmoderated, meaning that each user can request for registered access to the InGeoCLOUDS platform.

2.3.3. PUBLIC

It designates all other types of users that browse the Portal without autnetication/identification. Public users are allowed to access most of InGeoCloudS applications, maps, views and data without restrictions.

2.3.4. INGC ADMINISTRATION

INGC Administration groups a role of users that are able to both monitor the status of the infrastructure and also execute some management tasks on its different components. The main facilities are described in chapter 3 below.

2.4. SERVICES USED BY DATA PROVIDERS

2.4.1. DATASETS PUSHED INTO INGEOCLOUDS

BRGM
The BRGM has created geospatial services with his datasets: groundwater monitoring station and geology layer at 1/ 1 000 000 scale.

GEUS
The GEUS groundwater database model has been extracted from GEUS internal database and implemented within the InGeoCloudS Elastic Database Service. A snapshot of the dataset has been extracted from GEUS and imported into the InGeoCloudS Elastic database service.
In a later version, this dataset will be maintained by periodically scheduled delta updates. The InGeoCloudS platform will initiate this procedure and receive the delta updates by harvesting services provided and hosted locally by GEUS.

GeoZS
All the data is pushed to the cloud through S3 Amazon management console:

- Precipitation forecast data (daily upload),
- Landslide susceptibility model (static: uploaded only once),
- Landslide triggering threshold values (static: uploaded only once).

After all data for predicting landslides is uploaded the data for creating WMS service needs to be uploaded (all the files that mapserver needs to create WMS service).

EPPO
Data used for the calculation of shake-maps can be considered as “static” and “dynamically produced”. The first category includes Greek Accelerometers Network descriptive data (station cites, sensors, geology) which is uploaded in InGeoCloudS platform once and used for service setup. The second category includes earthquake source data and strong motion data. As soon as this data is prepared it is automatically uploaded to the InGeoCloudS platform through the Data Import Service.

EKBAA

Data about groundwater resources management in granular aquifers has been pushed in InGeoCloudS triplestore implemented by the *Data Integration&Linking* component. No particular end-user services have been implemented for Pilot1 but, as for other datasets, the data and its representation according to the geo-scientific observation model presented in [R2] are available for queries through a SPARQL endpoint (see next section).

2.4.2. LINKED OPEN DATA SUPPORT

As various heterogeneous datasets from the same or different thematic fields can be supplied by data providers, there is a need of not only describing the meta-data of all of these datasets in a unified way, but also integrate them in a way that allows for minimal changes to the original formats and expands the ability to pose queries in a uniform way, while enabling posing and evaluating cross-provider queries for data-sets involved in the same semantic field.

To this end, a specific meta-model was created and described in RDF (Resource Description Language) accurately capturing the semantics of the thematic fields in which the InGeoCloudS providers' data-sets were involved. This model was created by extending the CRM standard meta-model for describing scientific/cultural data-sets (ISO 21127:20) through particular geo-spatial extensions that were based on ISO 19115, GML and other standard models; the model has been kept as much as possible compliant to the corresponding INSPIRE model. Apart from the proposal of this extended meta-model, the data/meta-data of the InGeoCloudS providers' datasets were automatically produced from the respective relational data stored in the InGeoCloudS platform database by exploiting the R2RML mapping language and Virtuoso RDF TripleStore.

The sole issue regarding this mapping, which is handled in a semi-automatic way, in Pilot 1 is that the relational data need to be copied from the InGeoCloudS platform database to the native database of the Virtuoso so as to enable their automatic mapping to RDF data that conform to the meta-model proposed – this is a onetime process though.

To this end, an alternative direct way of importing data and descriptions of data-sets to Virtuoso was made available through the Data Integration & Linking API. This latter way obviously requires manual intervention (through the use of the appropriate meta-data update method of the API) in order to keep synchronized the relational and RDF data. The Data Integration & Linking API exposes other important functionality, such as the ability to update the meta-data and export them in various formats as well as the ability to pose SPARQL cross-provider or provider-specific queries.

The exploitation of the meta-model and SPARQL language and querying facilities enables to pose in a uniform way cross data-sets' queries in contrast to the different SQL queries (with the same semantics/goal) that would have to be posed for different provider data-sets of the same thematic field. Finally, it must be noted that the geo-spatial query support is currently limited to returning the GML or WKT representation of the features that satisfy the SPARQL query. The exploitation of the GeoSPARQL OGC standard, which enables the posing of full-fledged geospatial queries will be examined in Pilot 2.

2.5. SERVICES AVALAIBLE FOR PUBLIC AND REGISTERED USERS

All users, Public or Registered, have access to the InGeoCloudS portal. From there, they are re-directed to the application of their choice.

2.5.1. PORTAL

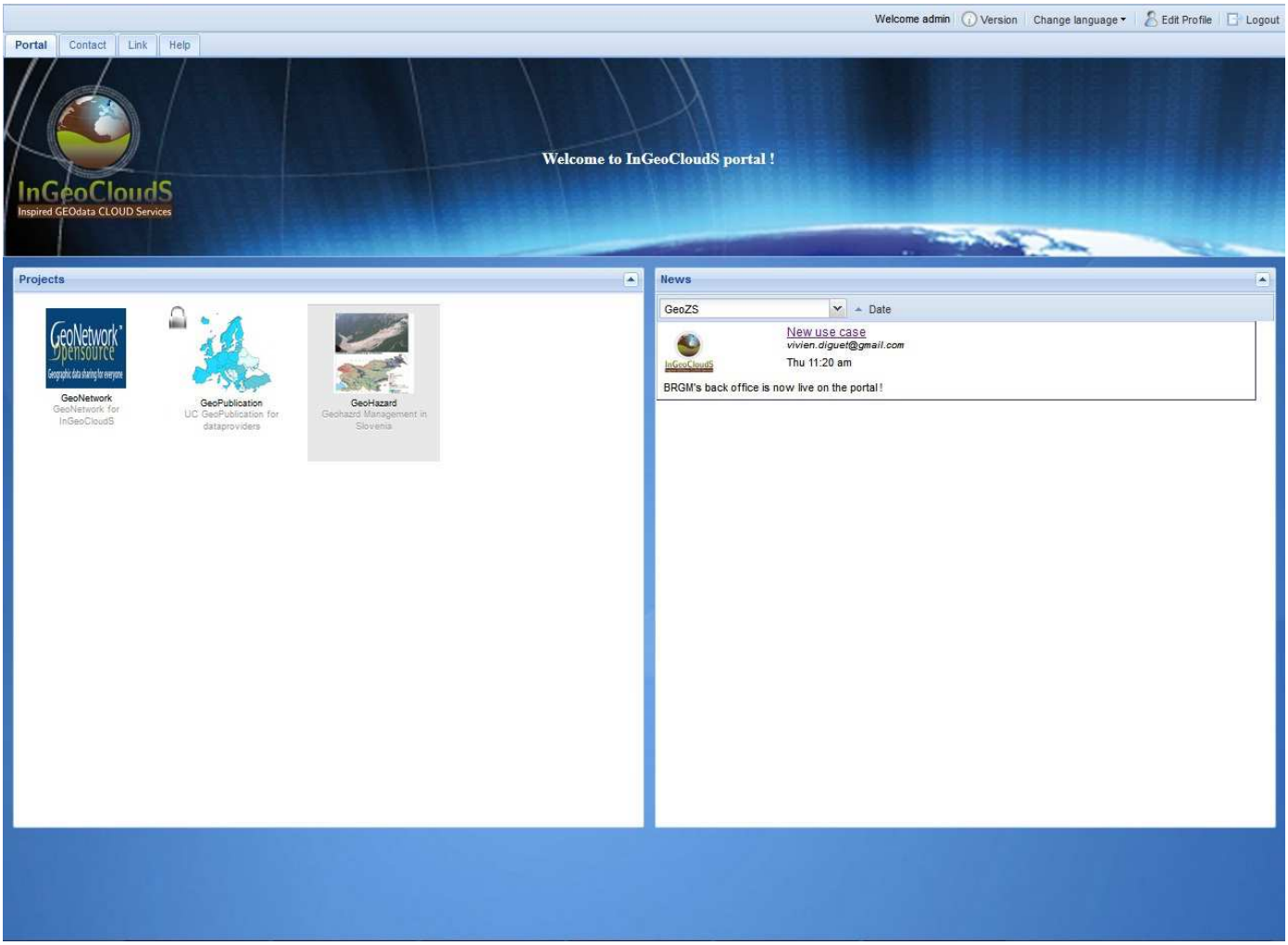

Figure 2 : Pilot1 Portal view

The portal provides ordered access to the different domains of services. As explained in [R3] the portal is based on *Sitools2 framework* and this is, for Pilot1, the only main feature of the framework which is used. The framework offer advanced back-office facilities for configuring and customizing the different "*Projects*" in the portal, help pages, simple roles management.
In Pilot1, three (3) main scenarios are taken into consideration for integrating a project into the Sitools2 portal framework:

- Integration of a "view" on an external application as an *iFrame*.
- Displaying background map and WMS-type layers on top
- More complete integration where application can be customized using panel templates developed and integrated in Sitools2 for integrating specific functionalities.

In pilot1, the following integration modes are used:

- iFrame integration: Shake-Maps and Web Mapping applications
- background maps and WMS-type layers: Landslides susceptibility Maps
- Use of panels templates and (more "complete" integration): Pesticides in GroundWater services

2.5.2. PESTICIDES IN GROUNDWATER

The GEUS application shows the locations of the boreholes with additional borehole information available as click info. One of the additional borehole information available is a graphical illustration of the lithologic layers through which the borehole passes. When the user selects compounds and/or rock types, boreholes where these are found are highlighted.
The user is able to filter these highlights even further by providing a time period and/or depth interval of interest. If one or more compounds are selected, the additional borehole information (click info) will also contain a time series graph of the found amounts for each of the selected compounds. If the user enables the water levels layer, the boreholes where groundwater level measurements are present will be highlighted. If water levels are enabled, the click info will also contain a time series graph of the water level for each intake. By selecting one or more boreholes, the user is able to download all the borehole data in csv format.

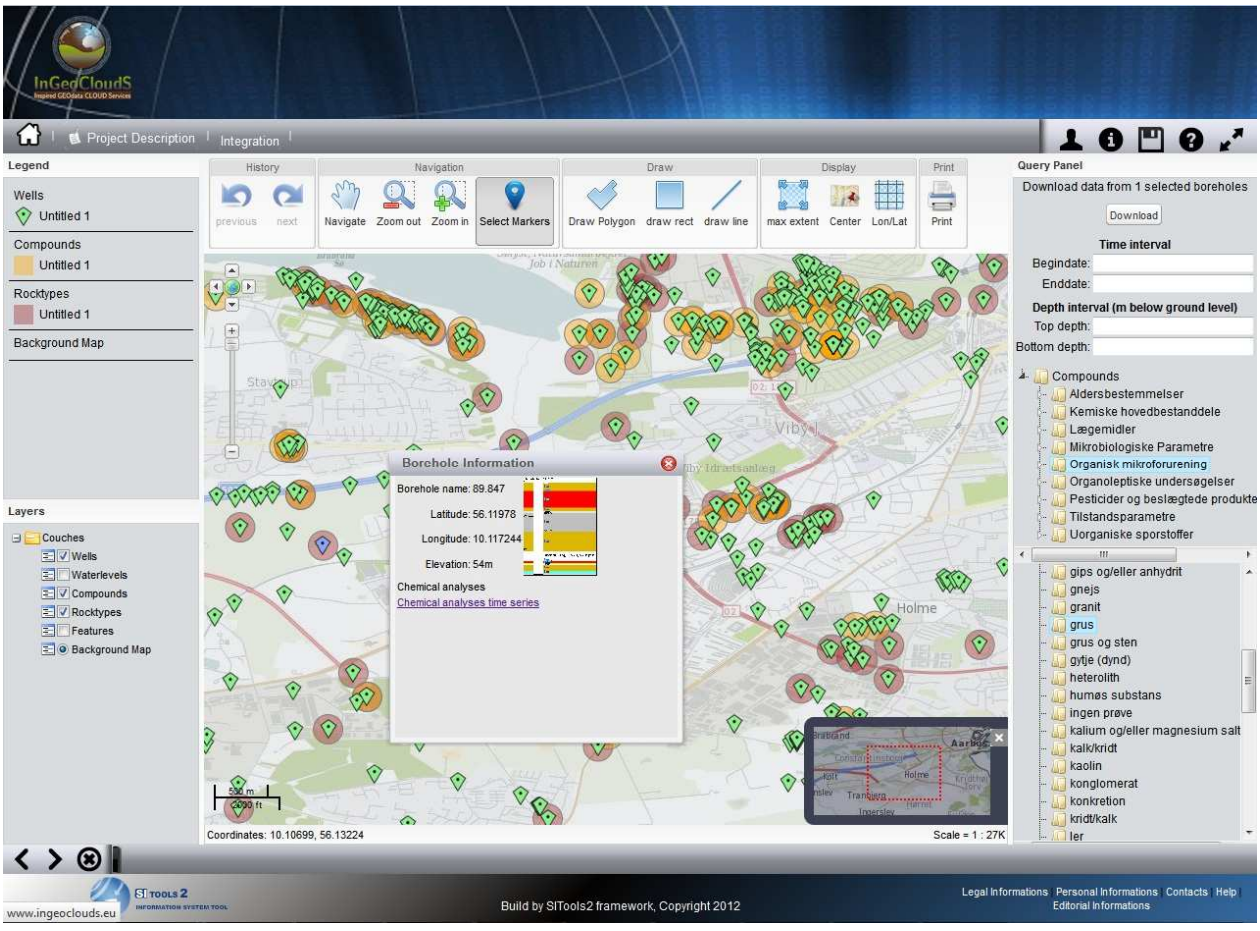

Figure 3 : Sample screenshot of the "Pesticides in Groundwater" Application

2.5.1. LANDSLIDES SUSCEPTIBILITY MAPS APPLICATION

GeoZS is building an early warning system that will be based on: expert analysis of existing landslide events, geology (landslide triggering threshold values) and optimization of model with forecast calculations for known events in the past.
The system will predict (in a best possible way) the areas where the probability of triggering of landslides will be increased due to higher precipitation levels.

Our main goal is to make fully automated system (automatically pushing data in to the cloud, GIS modelling for predicting landslide events, creating WMS map services and displaying WMS services in Web mapping application).

Overall functionality

Function	***Description***
Generate and display portal main page	Generate and display main-menu as entry to the different use cases
Generate and display general web GIS functionality	Generate and display a map including standard functionality like zoom, mooz, pan, select area of interest, select background map, select map projection, highlight coverage area, etc.

Data Publication functions

Function	***Description***
Zoom	Draw rectangle on map when user drags with left-mouse button pressed, Redraw map zoomed to selected area.
Mooz	Draw rectangle on map when user drags with left-mouse button pressed, Redraw map moozed to area reflecting size of area the user drew (small area drawn = high zoom-out factor)
Pan	Move origin of map when user drags with left-mouse button pressed, Redraw map with new center.
Select rectangular area	Draw rectangle on map when user drags with left-mouse button pressed
Display background map	
Select map projection	Redraw map projected according to specified map projection

IGC Application (in this case GEOZS web application) functions

Display Landslide prediction for specific area	Displays a prediction for landslides in selected area.

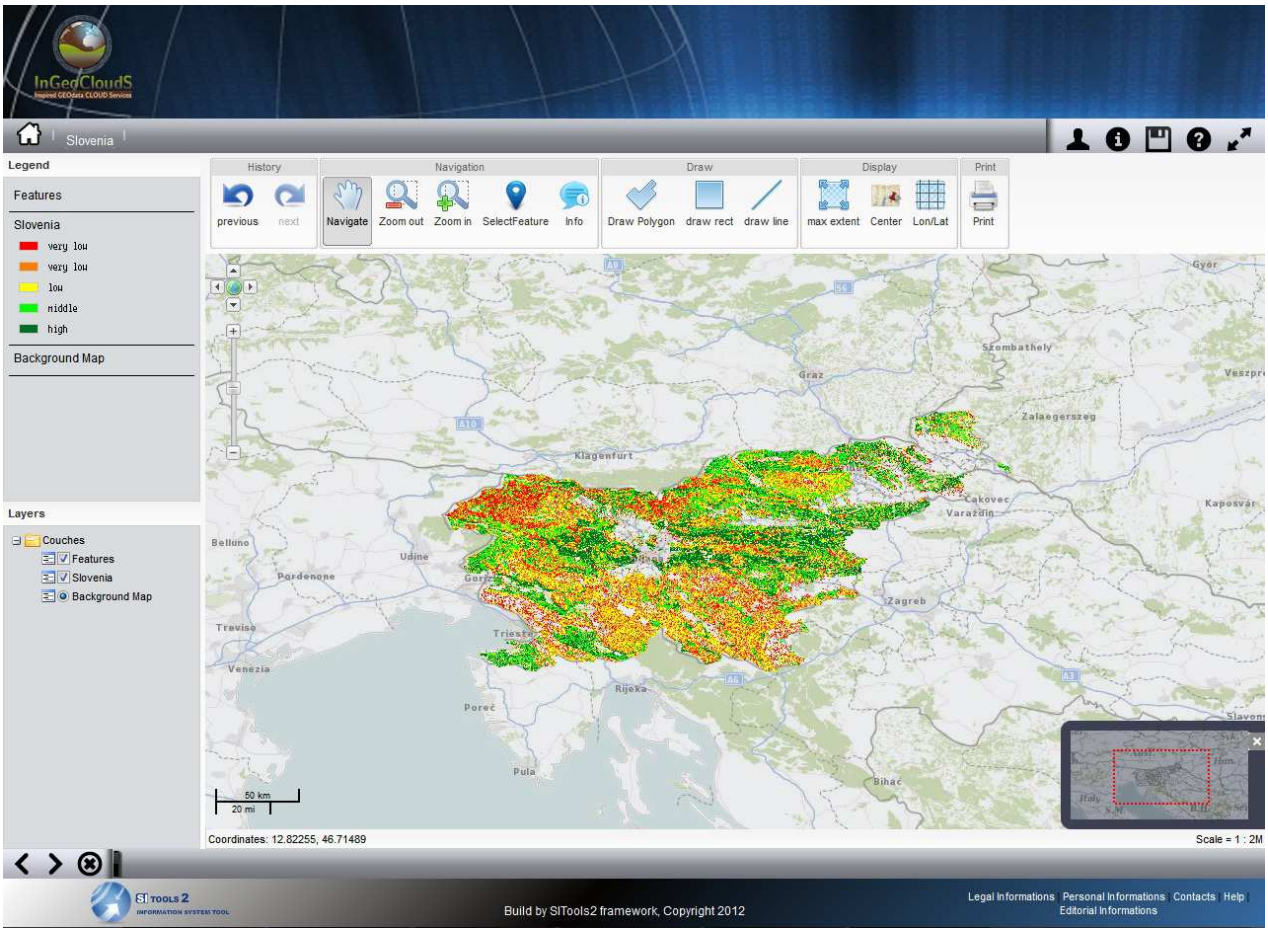

Figure 4 : Sample screenshot of the "Landslides Susceptibility Maps" Application

2.5.1. WEB MAPPING APPLICATION

The web mapping application developed by BRGM is integrated in the general portal as a link to the application. In the first version, the system allows to a register user (data-provider or others) to push his dataset (using InGeoCloudS API) and to create a map, defines the interface of the map (button, icon…) and publish services with the web-mapping editor. The map could be shared with a simple link (URL).

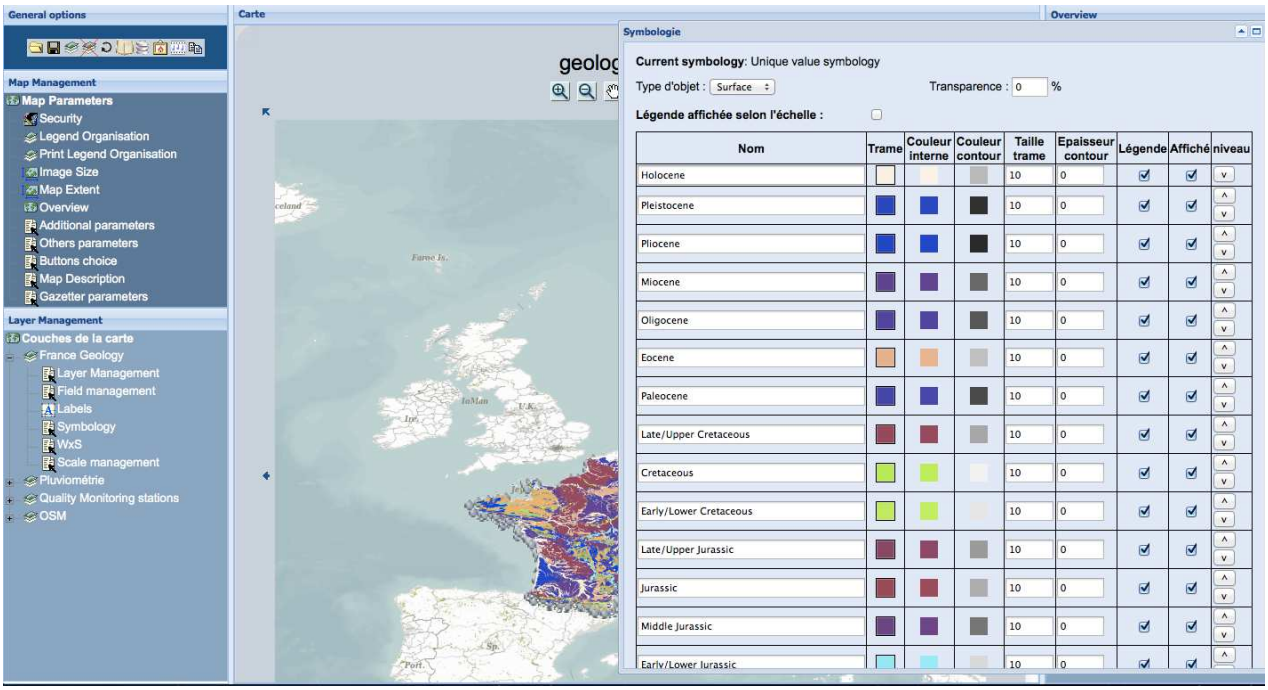

Figure 5 : GeoPublication backOffice interface (Creation of a geologic map)

The second part of the application allows for all users (public access) to display the interactive map with a "classical" web-mapping interface as show in the next figure:

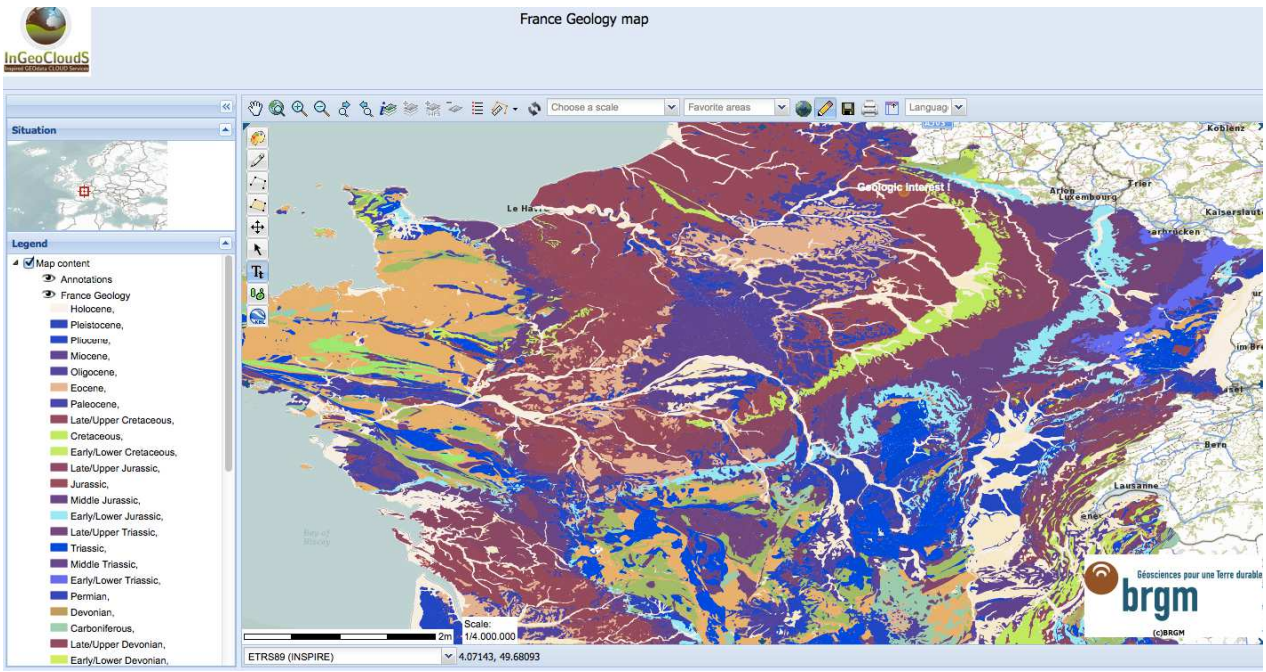

Figure 6 : Public Web-mapping access for geology map

2.5.2. SHAKEMAPS APPLICATION

The Shake-Maps application, displays a chronologically ordered archive of shake-maps for the Greek Region. The user can locate the desired shake-map by browsing through the archive. For each shake-map the visitor can select to display maps of different physical parameters (like peak-ground acceleration, peak-ground velocity, and intensity). Each map displays the distribution of the values of a specific parameter in an area around the earthquake source using iso curves. Moreover, the positions of the recording stations are drawn over the map and the user can select a station to see the specific recorded values.
The user can download shake-map data in various formats which include images, raw grid data in xml and ascii and GIS files (shape files, KML and ESRI raster files). Additionally, for each shake-map the user can download data about the recording network in ascii and xml format and metadata about the processing / production process.

The shake-maps application calculates and publishes a new shake-map each time data from a new significant earthquake becomes available. The new data is imported through the *Data Import* module and stored in the *Elastic File System* in EPPO's workspace. The calculation is performed by an *Elastic Compute* InGeoCloudS instance and the results are stored again in the *Elastic File* System. Finally, the new shake-map data is published through the InGeoCloudS *Web Server*.

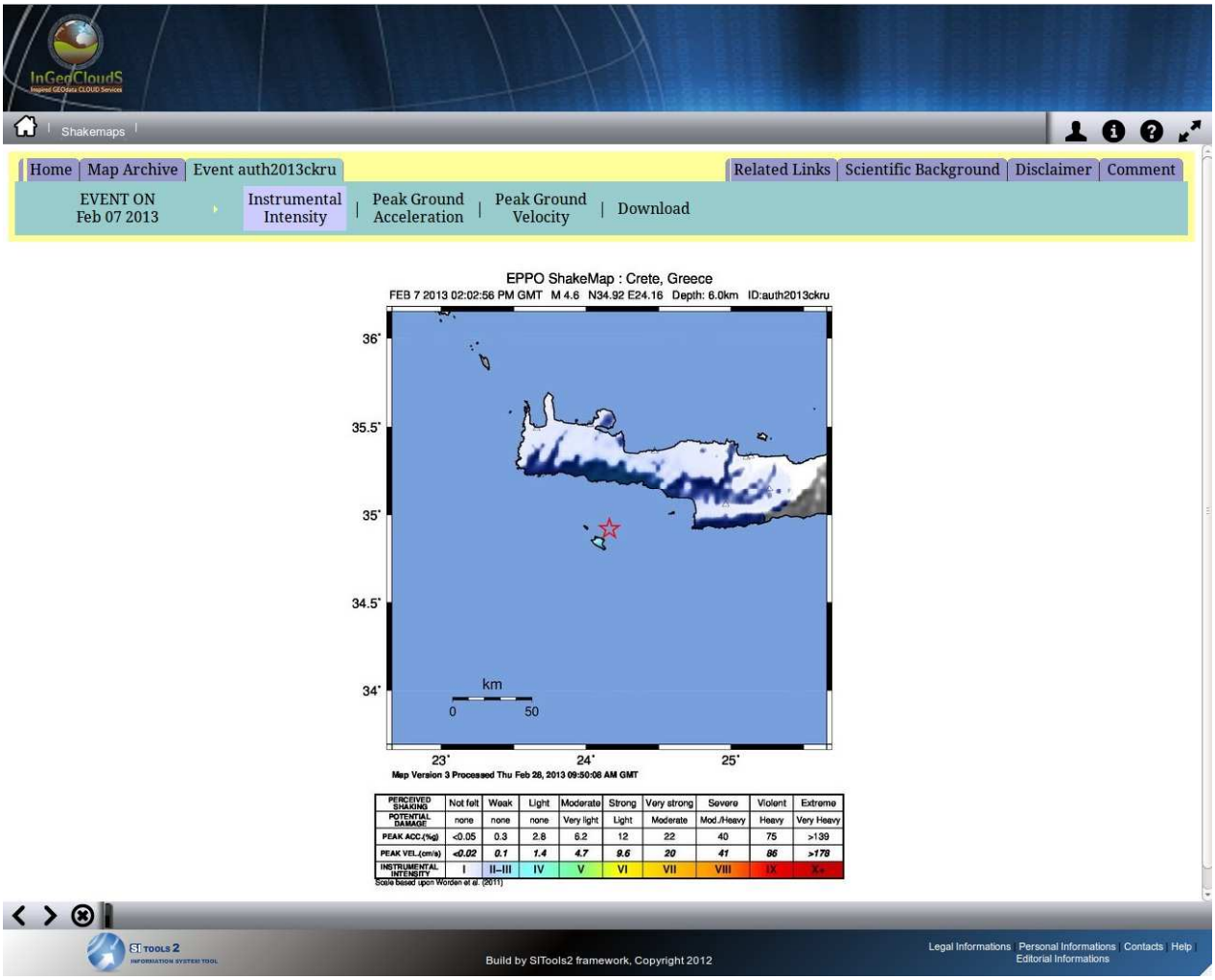

Figure 7 : Sample screenshot of the "Shake-Maps" Application

3. OPERATING PILOT1

3.1. USER MANAGEMENT

Users are POSIX accounts managed in a LDAP directory.
At the moment, Pilot1 does not provide yet a graphical user interface for managing user accounts directly in the LDAP directory. Any LDAP client software or LDAP utilities can be used to manage the users.
However, InGeoCloudS will provide before Pilot2 user management services to avoid exposing the LDAP directory and, more broadly to manage user's workspace and user's database at the same time. User related services will also incorporate subscriptions and notifications mechanisms as specified in [R2].

3.1.1. DATA PROVIDERS

Pilot 1 allows managing data providers using the master API. The API ensures user's workspace and user's database are created or deleted together with the data provider account. Full documentation of the API is available at http://ingeoclouds-api.isti.cnr.it/.

3.1.1.1. Creation

The RESTful web service **/master/provider** allows creating a new data provider. A dedicated workspace on file system and a database are created in the same time.

3.1.1.2. Deletion

The RESTful web service **/master/provider{id}** allows deleting a data provider. The dedicated workspace on file system and dedicated database are deleted in the same time.

3.1.1.3. Getting information

The RESTful web service **/master/provider{id}** allows getting information for a data provider.

3.1.1. REGISTERED USERS

InGeoCloudS shall support for data providers' applications the management of registered users for authentication. However, Pilot 1 does not provide yet any service or API to do it.
In case a data provider's application is configured to delegate authentication to the LDAP, the registered users shall be managed using LDAP client software or LDAP utilities. Managing authorizations is specific to each data provider's application.

3.1.2. PUBLIC

Public users can currently access the IngeoCloudS portal without restrictions. Only the Data Publication application requires authentication.

3.1.3. INGC ADMINISTRATORS

Whereas INGC administrators are intended to be managed by InGeoCloudS, Pilot 1 does not provide yet any service or API to do it.
For the moment, a single INGC administrator exists in the platform to allow accessing administration services.

As INGC administrators are POSIX accounts managed in a LDAP directory, LDAP client software or LDAP utilities can be used to add, modify or remove INGC administrators.

3.2. SUPERVISION OF SYSTEM HEALTH

Amazon provides useful services to supervise system health: monitoring EC2 instances with *CloudWatch* and ensuring reliability and stability of the system with *Elastic Load Balancers*.
Additionally, InGeoCloudS intends to provide monitoring services to focus on specificities of the platform, like fine-grained monitoring of **Elastic Web Server** or **Elastic DBMS**. See section 3.2.2 for an overview.

3.2.1. AWS MANAGEMENT CONSOLE

An *AWS Identity & Access Management (IAM)* is required to access the *AWS Management Console*.
You must sign in with user name and password assigned by the system administrator of the InGeoCloudS *AWS account*. Note that this user is not managed by InGeoCloudS, but by Amazon. The *EC2 Dashboard* summarizes the EC2 resources used by the InGeoCloudS *AWS account*.

3.2.1.1. CloudWatch

The supervisor user can select '*Instances'* that allows listing all EC2 instances. Filter with '*Pilot1'* keyword to see only the instances running the Pilot 1 platform. All instances have a comprehensive name which makes find an EC2 instance easy. For any EC2 instance, a 'Monitoring' tab displays alarms and metrics defined for the EC2 instance.

Metrics:
Metrics allow monitoring resources usage of the EC2 instances.
Standards metrics are already defined to compute statistics on resources usage like CPU, network or disk.
Frequency is defined by default to 5 minutes.

At the time of writing this document, Pilot 1 uses default frequency of 5 minutes. However, frequency can be modified to 1 minute when required to monitor temporary or continuously a specific metric on a specific EC2 instance.

Custom metrics can be published by any application running on an EC2 instance using the *CloudWatch* command `mon-put-data` (or its *Query API* equivalent `PutMetricData`).

At the time of writing this document, Pilot 1 does not publish custom metrics. However, we plan to publish custom metrics priority to monitor **Elastic DBMS**. Moreover, new custom metrics will be published by other EC2 instances if necessary.

Alarms:
Alarms can be configured to supervise a metric. A notification is sent to recipients when the threshold is reached. Optionally, action to stop or terminate the EC2 instance can be taken. The threshold is defined with a rule of type: *Whenever the specified statistic of the specified metric is less, equal or greater than the specified value for at least the specified number of consecutive period(s) of the specified amount of time.*

At the time of writing this document, Pilot 1 does not use alarms. However, we plan to create alarms priority to monitor **Elastic DBMS**. Moreover, alarms will be created if necessary to monitor temporary or continuously a specific metric on a specific EC2 instance.

3.2.1.2. Load Balancers

At the time of writing this document, Pilot 1 does not yet fully use load balancers. However, load balancers priority will be used to ensure reliability and stability of **Elastic Web Server**. Moreover, load balancers will be created if necessary to ensure reliability and stability of other specific InGeoCloudS service.

3.2.2. INGEOCLOUDS SPECIFIC MONITORING

Pilot1 specific monitoring relies on the InGeoCloudS API, which provides services to monitor the different elastic services of the InGeoCloudS platform. As explained in D1.3.1 and D3.2 [R3], our roadmap includes further development of the IGC-Administration for more comprehensive supervision facilities.

The RESTful web services developed for the API (http://ingeoclouds-api.isti.cnr.it/) include specific methods we developed for precise and customized monitoring of the technical components.
As examples:

- **/elasticcomp/instance** allows getting information on all the instances running in the cloud.
- **/elasticfs/status** method returns a description of the current status of the system, including storage capacity, number of servers (and if they are correctly running), and some other statistic information.
- **/elasticdb/status** returns various information about the database status including Number of DB exploited servers, current size of all databases (sum of all tables and all indexes), number of users created in Postgres Server
- etc.

3.3. SUPPORT AND HELPDESK

Users and partners are provided with three main instruments for reporting issues or for getting information about usage of Pilot1:

- An email address for helpdesk: ***ingeoclouds-support@ingeoclouds.eu***
- Help pages directly accessible from the Pilot's portal pages **http://pilot.ingeoclouds.eu.** The help material will be incrementally populated with reference pages, FAQs, documents to be downloaded etc.
- A bug and issues management tool available at: **http://atlas.akka.eu**. This tool is open to project's partners only.

**** End of the document ****