InGeoCloudS Project BLUEPRINTS

USE CASE PRESENTATION

- Kriging as a Web process following the Web Processing Service (WPS)
- Ground water resources management in granular aquifers application
- The Active Landslide Inventory Mapping and Susceptibility Zoning application
- Shake-Maps application
- The Susceptibility map of triggering landslides due to rainfall forecast application
- Pesticides in Groundwater application

1. Brief project presentation

The InGeoCLOUDS project aims at demonstrating the feasibility of employing a cloud-based infrastructure coupled with the necessary services to provide seamless access to geospatial public sector information, especially targeting the geological, geophysical and other geoscientific information.

Geodata information possesses interesting characteristics like the size of the available data, the existing metadata descriptions (mostly according to the European Directive INSPIRE) and the current availability of related services that can be moved to the cloud.

On top of the basic cloud services such as OGC WMS, WFS and CSW, the project demonstrates the ability to build more intelligent services by using and combining data seamlessly integrated through the cloud. Linked Open Data principles and technologies are used. Based on the gained experience, the project provides guidelines in order to support the partners and other stakeholders of public information in their efforts to move more of their services and data to the cloud in order to decide the best possible roadmap, the requirements of the underlying infrastructure that will be chosen as a host, the requirements for the services and the possible pros and cons of these choices. In summary we are providing the necessary documentation, the related analysis, the roadmap and a set of working services to support organizations that need to move large amounts of public sector information to the cloud.

2. FIND GUIDANCE/HELP/SUPPORT

- When you register for your free trial, a dedicated tutor will be assigned to you in order to answer all of your questions and concerns about getting started with InGeoCloudS?
- For comprehensive documentation, visit the Users Documentation section of our Website: www.ingeoclouds.eu
- If you find something going wrong with InGeoCloudS, visit first our known bug list: http://www.ingeoclouds.eu/?q=wiki/getting-help#Known%20Bugs
- If the known bug list does not solve your problem, you can either send an email to ingeoclouds-support@ingeoclouds.eu or report it thanks to the feedback panel provided on the portal.
- To get more acquainted with some of InGeoCloudS features, watch tutorial videos on How to create your first map (https://www.youtube.com/watch?v=W2_Jr_EMivc&feature=youtu.be) and How to create INSPIRE web services? (https://www.youtube.com/watch?v=q4c-IgC6U3Y&feature=youtu.be) …More videos to come!
- If you feel that you need more specific and dedicated support and/or training, get in touch with InGeoCloudS team!

3. GIVE FEEDBACK/ CONTRIBUTION TO PLATFORM IMPROVEMENT

- We are willing to engage as many users as possible in the discussions about how to improve InGeoCloudS to best match their needs. Thus, if you have remarks, concerns, or advice, do not hesitate to get in touch with InGeoCloudS team. You can share your views with us by sending an email to contact@ingeoclouds.eu
- Please also notice that a users' questionnaire has been made available online to collect your opinion on the platform. Take a few minutes to answer it: https://docs.google.com/forms/d/1oQvBdFn0sqiM9NUeRA3dmZSAhsrUdGgorNlFLfuFi-g/viewform

4. CONTINUE TO USE THE PLATFORM AFTER END OF FREE TRIAL

- InGeoCloudS will remain available for free until the end of July 2014 while the platform still undergoes some development.
- At the end of the project phase, the platform will become fully implemented and, in order to make it grow and last, InGeoCloudS services will have to be charged. However, as an early adopter, you will benefit from very advantageous pricing offers after the end of the free trials.
- Note that if you subscribe to InGeoCloudS after your trial has ended, all the work you have done until then will be saved from your trial account and transferred to your new paid account.

Kriging as a Web process following the Web Processing Service (WPS)

1. What do I do with Kriging as a Web process Application?

Kriging is a moderately quick interpolator that can be exact or smoothed depending on the measurement error model. It is very flexible and allows you to investigate graphs of spatial autocorrelation. Kriging uses statistical models that allow a variety of map outputs including predictions, prediction standard errors, probability etc. The flexibility of kriging can require a lot of decision-making. Kriging assumes the data come from a stationary stochastic process.

Geoprocessing refers to ordinary kriging interpolation and is implemented as a WPS service within the InGeoCloudS project. The service was coded using the open source 52 North WPS java implementation (deployed by tomcat server), which follows the OGC-WPS 1.0.0 standard . According to the standard, input/output of the WPS are in general described by XML documents. Kriging is performed on a set of points in the form of [x, y, value] format (input data) and requires a number of parameters for fine-tuning the interpolation process. The result is a grid filled with a predicted value per grid point. 52 North WPS implementation supports vector data input in a number of formats, including ESRI-Shapefile (zipped) and GML2.0/3.0 . Those data are embodied in the input XML which is posted to the service. Input XML includes, in further, kriging parameters. In current implementation the resulting XML consists of temporary links to a) a file with the input data in csv format, b) the predicted values in csv format and c) the preview of kriging result as a png image. Internally, kriging is performed using the open source library gstat for R. Two of its main advantages are that gstat implementation is fast enough (even if it is executed in the framework of R) and has the ability to perform kriging on unprojected data and thus no re-projection is needed. The interconnection between java code and R is provided by the Rserve TCP/IP server.

A client WPS web application is now built which is based on OpenLayers and gives the user the ability to a) receive input data, b) provide kriging parameters, c) perform kriging on input data by calling the OGC-WPS and d) download through temporary links the output files of the service.

2. What can I use Kriging as a Web process for?

Kriging is a geostatistical method which relies on the fact that as distance between points increases, their similarity, defined by the covariance or correlation between points, decreases. Kriging predicts the unknown value Z(x0) at a location in question x0 based on the data values in a neighborhood of this location.

3. How do I use Kriging as a Web process?

You can find Active Landslide Inventory Mapping for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://portal.ingeoclouds.eu/sitools/client-user/Geoprocessing/project-index.html

4. Integration with the InGeoCloudS Infrastructure

The kriging WPS is located in the Elastic Web Server. Input data are fetched from the Virtuoso Triple Store using SPARQL queries through the ldquery method of the LinkedDataServiceImpl and the result of the method are transformed (if necessary) to the appropriate geo-format (e.g. GeoJSON) using the method geoldtransform of the GeoLinkedDataServiceImpl API.
Retrieved data are displayed by new methods implemented in the WebGIS Client. That client also contains a panel which gives the ability to the user to provide kriging parameters. Kriging OGC WPS is a service which is meant to be used for interpolating input data of other data providers apart from EKBAA and therefore, its implementation is included in the so called Default WebGIS Client. In addition, the OGC WPS service would be used by other, external clients.

The EKBAA files represent the storage that should be reserved for (source, executable etc.) implementation files if needed from the development or usage of the WPS. However, it is noted that data providers will have the ability to store the resulting files of the WPS to their storage in the Elastic File Server.

5. Specific services

In the Ordinary Kriging method of analysis, the Kriging interpolation consists of two steps:

1. The covariance, or semivariance modeling based on the set of locations with known values. Kriging uses semivariance to express the degree of relationship between points on a surface. The semivariance is half the variance of the differences between all possible points spaced a constant distance.
2. The prediction of values for a number of points in question. Prediction may involve the overall set, or a subset of points with known values (figure 2).

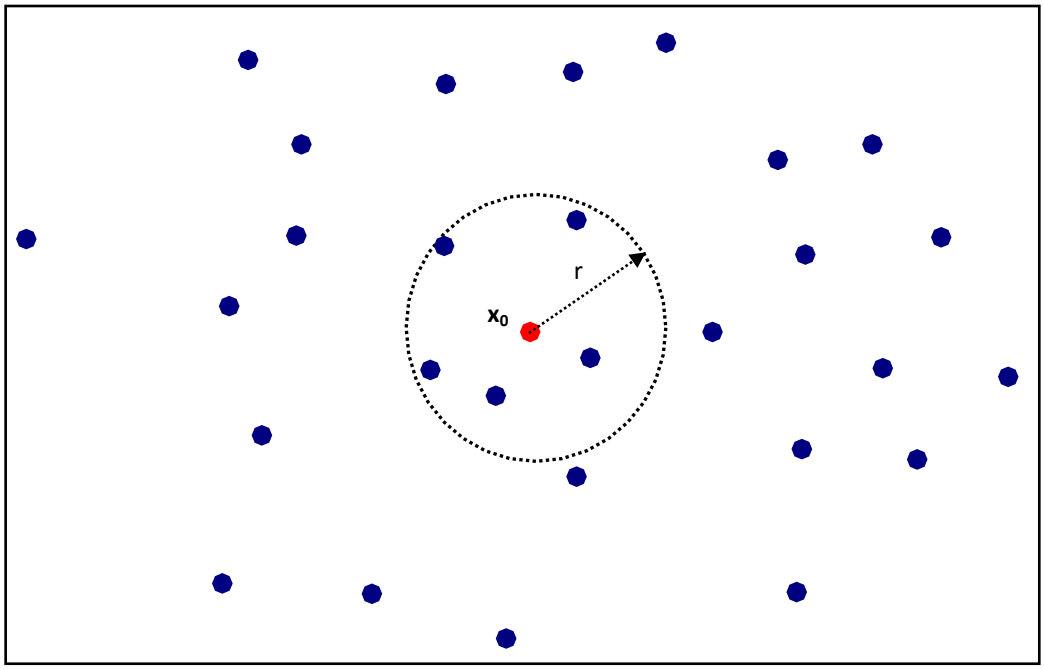

Figure 1: Local neighborhood prediction for the red point in question (x_0), using the five blue points with known values, which are placed in SearchRadius equal to r from x_0.

In most cases, interpolation refers to the prediction of values in locations of a grid that includes the points with known values (figure 2).

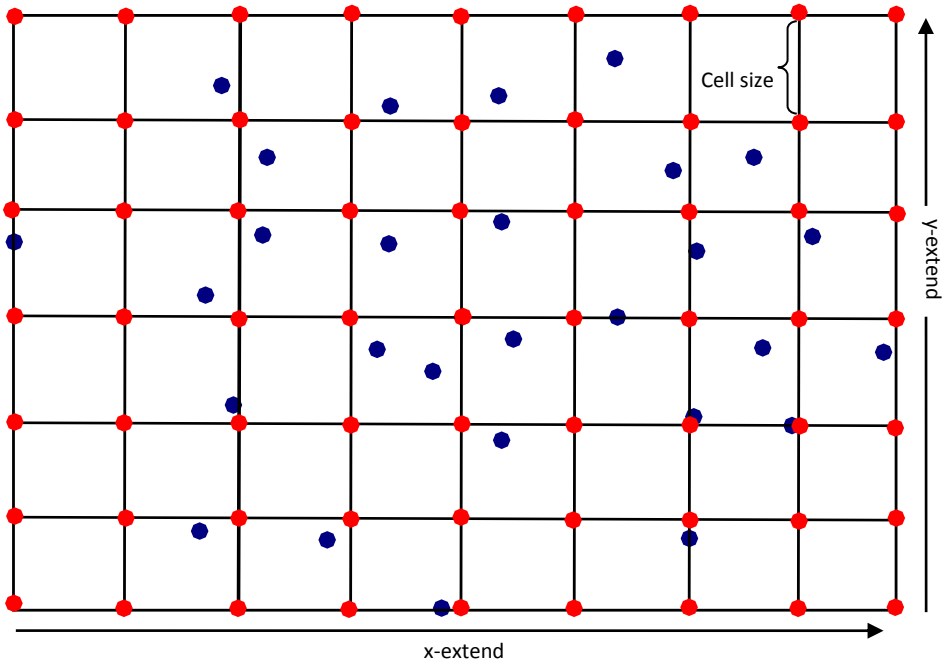

Figure 2: Prediction for the unknown locations of the grid (red points) with user-defined cell size and automatically computed extent by the locations of input (blue) points with known values.

Ground water resources management in granular aquifers application

1. What do I do with Ground water resources management Application?

The use case creates web based GIS applications for the water balance estimation, for the creation of hydro chemical and salinization maps and for the regional contamination. Also geo-processing tools on the fly has been developed and used for Ordinary Kriging prediction for specific compounds according not only to specified available data but for external data too. The processing results are map services (like WMS, WCS and WMS) which share geo-referenced data, describes discovery, query, or data transformation operations and serve geo-referenced map images.

2. What can I use Ground water resources management for?

It is common practice to present the results of hydrogeological investigations in the form of thematic maps, geological sections, chemical charts, diagrams and tables (contour maps of the aquifer's upper and lower boundaries, water table contour maps, iso-pach maps showing the thickness of aquifers and confining beds, water table and piezometric maps, hydraulic conductivity and transmissivity values, iso-chemical maps).

At central or even regional level, it is essential to know the quality of the groundwater. For that reason, the existence of chemical analysis for certain compounds or better time series of chemical analysis helps the planning and use of this resource information. This information, to be more helpful, is usually presented in maps (salinization maps, groundwater pollution/contamination maps).

National and local authorities (technical agencies of municipalities) could be helped by inventory map of possible pollution sources, salinization maps and hydro chemical maps and propose remediation actions. End users could also use the above maps as indicators of site contamination providing an estimation of possible damage

3. How do I use Ground water resources management?

You can find Active Landslide Inventory Mapping for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://portal.ingeoclouds.eu/sitools/client-user/Groundwater_OK/project-index.html

4. Integration with the InGeoCloudS Infrastructure

The implementation of the "groundwater resources management in granular aquifers" use case within the InGeoCloudS infrastructure impacted on the following components:

- EKBAA web services: These are data services exposed to the web GIS client. The web GIS client fetches borehole data as described above. Data is retrieved from the Triple Store using the method *ldquery* of the LinkedDataServiceImpl API and the result of the method is transformed (if necessary) to the appropriate geo-format (e.g. GeoJSON) using the method geoldtransform of the GeoLinkedDataServiceImpl API.
- EKBAA files: This is the storage that should be reserved for (source, executable etc.) implementation files, if such a need arises for the development of the use case.

Furthermore, we have implemented components to the importing of a part of EKBAA 's groundwater PostgreSQL data to Virtuoso TripleStore. Data import has been performed in three steps:

- First, Virtuoso was connected to the relational data indirectly by copying the relational data from that source.
- Secondly, the concepts and relationships contained in the relational data were mapped into corresponding concepts and relationships from the Geo-Scientific Observation Model along with explanations over the mappings that were performed from notions of EKBAA 's relational data to those of the model.
- Thirdly and after have created the mappings, they were formalized using the R2RML language and registered in the TripleStore using the method addR2RMLMappings from the LinkedDataServiceImpl API.

5. Specific services

The use case provides data from both field measurements (groundwater table fluctuation, pumping tests and pollution sources) and chemical analyses (major ions and trace elements). A database has been developed which also consists of various geospatial data. All the above data and the knowledge of geological, hydrological, hydro-geological and hydro-chemical characteristics and properties of the study areas, can conduct to important conclusions such as: Water balance estimation and assessment, Piezometric surface maps for dry and wet periods' piezo maps, Hydro chemical maps.

We provide chemical analysis for major elements and hydro chemical diagrams as map services: Salinization maps (where there is seawater intrusion) and Groundwater pollution iso-curves for specific contaminants (NO3 etc). Also every day availability of the: contour maps, water table contour maps, water table and piezometric maps, hydraulic conductivity and transmissivity values plots, iso-chemical maps of various chemical compounds, salinization maps and groundwater pollution/contamination maps in INGC system.

The Active Landslide Inventory Mapping and Susceptibility Zoning application

1. What do I do with Active Landslide Inventory Mapping Application?

The use case provides an active inventory map of the occurred landslides (location, classification, volume, activity, date of occurrence of landsliding etc) updated after every new event recorded in the database. The user can retrieve data concerning the landslides' characteristics and any available information for the region of occurrence. Simultaneously a landslides' density map is available and it is possible for the users to select one or more specific parameters or characteristics and calculate the frequency of landslides accomplishing the previously selected criteria. Beyond these, a susceptibility zoning map is also available to the system. The map is the result of the analysis between the spatial distribution of the landslides (landslides' density) and a group of generative causes (geological, topographical, hydrological etc characteristics of the area) based on the fact that landslides in the future will occur under the same circumstances that they occurred in the past. Maps used for the above analysis will be also available. Inventory, density and susceptibility maps are available for general public, Land use planners, Insurance companies & risk managers (civil protection agencies at national or/and local level) and building companies.

2. What can I use Active Landslide Inventory Mapping for?

End users need to integrate different landslide hazard maps, e.g. a density map and a susceptibility map, in order to become resilient to any potential catastrophic event. More precisely, land use planners need scientific support to establish priorities between different landslide hazards that exhibit different spatial and time scales and various triggering factors.

Public and private organizations can chose between different land use options to minimise the risk once the infrastructure is built, or even it is even possible to reduce the hazard itself through a mitigation measure e.g. reforestation. Land use planners should be assisted by hazards experts to take the best decision before planning new infrastructures in high risk areas.

End users need risk maps as improved indicators offering a combination of hazard and vulnerability and providing therefore an estimation of a level of damage. The risk depends on the hazard, but also on the elements at risk and their vulnerability.

All these users need to know which elements and populations are at risk, and to estimate their vulnerability to various events. The lack of information received by exposed populations is a socio-economical component of vulnerability and can strongly increase the risk.

3. How do I use Active Landslide Inventory Mapping?

You can find Active Landslide Inventory Mapping for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://portal.ingeoclouds.eu/sitools/client-user/Geohazard_GR/project-index.html

4. Integration with the InGeoCloudS Infrastructure

There are different services supporting the landslides use case of EKBAA which are located in the INGC system and which interfaces they use. The services are the following:

- EKBAA web vector data display services and WMS: These are data services exposed to the WebGIS client. The WebGIS client fetches landslides data as described above. Data is planned to be retrieved from the Triple Store using the method ldquery of the LinkedDataServiceImpl API and the result of the method will be transformed (if necessary) to the appropriate geo-format (e.g. GeoJSON) using the method geoldtransform of the GeoLinkedDataServiceImpl API.

WMS service is exposed to the WebGIS client to display EKBAA's density, inventory and susceptibility maps and to others who want to download the maps as WMS to use them in other applications.

- EKBAA files: This is the storage that should be reserved for (source, executable etc.) implementation files, if such a need arise from the development of the use case. In addition, the storage is used to store files that will become available as the output of kriging WPS, in grid data format. In order for the WebGIS Client to access the gridded data, a service has implemented which create WMS services from our files.
- Finally,the components involved to the importing of a part of EKBAA ‘s landslides PostgreSQL data to Virtuoso TripleStore are the following:
- First, Virtuoso was connected to the relational data indirectly by copying the relational data from that source.

- Secondly, the concepts and relationships contained in the relational data were mapped into corresponding concepts and relationships from the Geo-Scientific Observation Model along with explanations over the mappings that were performed from notions of EKBAA ‘s relational data to those of the model.
- Thirdly and after have created the mappings, they were formalized using the R2RML language and registered in the TripleStore using the method addR2RMLMappings from the LinkedDataServiceImpl API.

5. Specific services

A WebGIS Client application has built in the InGeoCloudS platform with the ability to fetch landslides vector data through queries using the Data Linking component and display them on a map. The user have also the ability a) to call kriging WPS in order to produce inventory and susceptibility maps in the InGeoCloudS infrastructure and b) to fetch and display other maps available as WMS/WFS through the Elastic Map Server and the Geospatial Metadata and Catalog Services components. The density map is static.

Shake-Maps application

1. What do I do with ShakeMaps Application?

The Shake Maps application is about viewing and downloading shaking intensity distribution maps for important earthquakes that occur in Greece. The application produces automatically a new shakemap dataset a few minutes after the earthquake. Data is available to the user for viewing and for downloading. In the "Shake-maps" use case, implemented by EPPO, strong motion recordings from the EPPO's Strong Motion Networkis processed and a collection of ground motion and shaking intensity maps are produced, in various formats, after significant earthquake events. These include images for public and media use as well as geo-referenced maps and grids for scientific and operational use.

2. What can I use ShakeMaps for?

State and regional organizations have a need for real-time maps of ground motion and shaking intensity following significant earthquakes. This information is required for post-earthquake response and recovery as well as for preparedness exercises and disaster planning.

3. How do I use ShakeMaps?

You can find the Shake Maps for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://shakemaps.ingeoclouds.eu

You can browse the recent earhquake events or go to the Maps Archive
(http://shakemaps.ingeoclouds.eu/archive)

4. Where do I find the information?

1. Wiki (http://www.ingeoclouds.eu/?q=wiki/shakemaps-greek-region)
2. Platform/pilot2 Shake Maps Use Case (http://shakemaps.ingeoclouds.eu)

The Susceptibility map of triggering landslides due to rainfall forecast application

What do I do with Susceptibility map Application?

The system is predicting (in a best possible way) the areas where the probability of triggering landslides will be increased due to higher precipitation levels. The endangered zones are predicted using the combination of:

- The landslide susceptibility map,
- The precipitation forecast and
- The landslide triggering threshold values.

1. What can I use Susceptibility map for?

The development of a real-time alert system will certainly be beneficial for various infrastructure (roads, railways, gas/oil pipelines, buildings, electrical power systems) owners and planner, civil agencies, local authorities, relevant government agencies and the citizens in the most exposed and highlighted areas. This system will inform infrastructure owners, civil agencies, and operators of an increased landslide hazard as a consequence of heavy precipitation that would exceed the landslide triggering values and enable them to mitigate risks.

Furthermore this will improve quality of life of citizens living on hazard areas, as well as their property and lives. First responders will have an early warning system that will give them enough time to safe property, lives and also predict negative effects of landslides on infrastructure.

Planners will have a susceptibility map developed in order to assist them when planning new infrastructure.

Insurers and risk managers can use this system to assess the risk in a portfolio of exposures. This might help guide an insurer's underwriting strategy or help them decide how much reinsurance to purchase.

2. How do I use Susceptibility map?

You can find the Shake Maps for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://portal.ingeoclouds.eu/sitools/client-user/GeoHazard/project-index.html

3. Integration with the InGeoCloudS Infrastructure

In order to support Susceptibility map use case within InGeoCloudS, you have to import the Susceptibility map database into the InGeoCloudS platform. The initial import was done in four steps:

1. Create a local PostgreSQL database and a snapshot of the database.
2. Create GeoZS as a provider within InGeoCloudS and getting the DBMS connection info through the INGC API Master Service and Elastic Database Service.
3. Create the same tables of the local PostgreSQL database into the InGeoCloudS platform.
4. Insert the last version of the 2 static tables (Landslide triggering threshold values and landslide susceptibility map) in the InGeoCloudS postgreSQL database. Other tables will be automatically inserted with the daily "Susceptibility map of triggering landslides due to rainfall forecast" calculation service.

In order to keep the data within the PostgreSQL database up-to-date, we have created a service which runs daily and updates the database with a new data. The first part is a locally hosted service, which collects precipitation forecast data from Slovenian Environment Agency ftp server. The second part is a provider "Susceptibility map of triggering landslides due to rainfall forecast" calculation service running at INGC, which fetches the records from the first service and performs the "Susceptibility map of triggering landslides due to rainfall forecast" calculations and necessary database operations (INSERT into database). The second part was uploaded to the INGC platform using the INGC API Data Import Service and is scheduled using the INGC Scheduling service.

In order for the web GIS (SiTools) to access the data, we had to implement a service (with map server) which creates WMS service from our PostgreSQL / PostGIS database.

4. Specific services

The Susceptibility map Use Case is a service that calculates and publish Susceptibility map of triggering landslides due to rainfall forecast. The calculation and publishing of a new Susceptibility map will be triggered by a rainfall forecast data upload event. The result of the calculation is a grid of values that will be stored in the IGNC Elastic Database Server. The end-user is able to access results through a Web GIS client and WMS/WFS services.

1. Precipitation forecast data Upload is a service which runs daily and updates the database with a new data. This locally hosted service collects precipitation forecast data from Slovenian Environment Agency ftp server. Data upload triggers the calculation and publication of a new Susceptibility map.
2. Susceptibility map Computation is triggered by the "Precipitation forecast Data Upload" process. The result of the calculation is a Susceptibility map of triggering landslides due to rainfall forecast stored in the IGNC Elastic Database Server and published as WMS/WFS services.

Pesticides in Groundwater application

1. What do I do with Pesticides in Groundwater Application?

Users can find areas where there are high concentrations of pesticides in the groundwater. It could be either pesticide in general or specific pesticides.

It is also possible to restrict the output to pesticides found at a certain depth interval and/or from certain geology (lithology or lithostratigraphy). Combining these data with the land use or information about the amounts of pesticides applied to the same areas and the surface geology (or even better 3D geological models) can give important information about the vulnerability of the aquifers..

2. What can I use Pesticides in Groundwater Application for?

User can restrict the output to pesticides found at a certain depth interval and/or from certain geology (lithology or lithostratigraphy). Combining these data with the land use or information about the amounts of pesticides applied to the same areas and the surface geology (or even better 3D geological models) can give important information about the vulnerability of the aquifers.
Potential users include NGOs, EEA, national environmental authorities, national or European environmental portals and researchers.

3. How do I use Pesticides in Groundwater application?

You can find the Shake Maps for Greece application through the InGeoCloudS Pilot2 portal (http://portal.ingeoclouds.eu/)

or directly at http://portal.ingeoclouds.eu/sitools/client-user/Groundwater/project-index.html

4. Integration with the InGeoCloudS Infrastructure

In order to support the Pesticides in Groundwater use case within INGC, we had to import a part of the GEUS groundwater database into the INGC platform. The initial import was done in four steps:

1. Create a local PostgreSQL database with the GEUS data-model and a snapshot of the database.
2. Create GEUS as a provider within INGC and getting the DBMS connection info through the INGC API Master Service and Elastic Database Service .
3. Upload a dump of the local PostgreSQL database unto the INGC platform through the INGC API Data Import Service.
4. Access the instance using Amazon Console, to import the dump into the PostgreSQL database from within INGC.

In order for the web GIS client to access the groundwater data, we had to implement web-services to communicate through. We choose to use REST-style services implemented in PHP and returning either JSON data, csv data, HTML code or an image which then could be integrated within the web GIS client. These PHP scripts were deployed on the INGC web server through the INGC API Data Import Service .

In order to keep the data within the PostgreSQL database up-to-date, we have created a synchronization scheme which utilizes delta updates. The first part is a locally hosted web-service, which exposes the records required for synchronization. The second part is a provider specific program running at INGC, which fetches the records from the web-service and performs the necessary database operations. The second part was uploaded to the INGC platform using the INGC API Data Import Service and is scheduled using the INGC Scheduling Service .

5. Specific services

The services are grouped into the following:

- GEUS web services: These are data services exposed to the web GIS client. The web GIS client can fetch borehole data and other data as described above. The services are written on PHP and use direct JDBC connections to query data within the PostgreSQL database.
- GEUS data synchronization: This program is responsible for updating the database within INGC. GEUS has exposed a locally hosted web service (the Delta update service) from where this program can fetch delta update records for the database within INGC. The harvest module executes this program daily on workdays. The program use direct JDBC connections to access the data within the PostgreSQL database.
- GEUS source files: This is the storage for the java executable file, java log files and the PHP script files.
- GEUS database: Here resides the PostgreSQL database containing the GEUS data on the INGC system.
- Delta update service: This service is responsible for exposing records of new, updates and deleted data in the local database at GEUS.