HERCULES

Sustainable futures for Europe's HERitage in CULtural landscapES: Tools for understanding, managing, and protecting landscape functions and values

GA no. 603447

D7.1 Repository of spatial and alphanumerical datasets

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Executive summary

Deliverable 7.1 “Repository of spatial and alphanumerical datasets” is the first goal towards design and implementation of the Knowledge Hub for Good Landscape Practice, a joint platform for interaction with the wider landscape community.

Across Europe, a multitude of approaches have been developed to protect and develop heritage values in cultural landscapes. Current approaches, however, are mostly concerned with a particular feature or are limited to particular region. The Knowledge Hub is meant to overcome this problems, allowing for learning and exchange on landscape practices on pan-European scale not limited to a particular feature type.

Figure 1: Illustration of what is Knowledge Hub and how it can connect various target audiences.

Figure 1 shows how the Knowledge Hub will act as a toolkit for communication of (HERCULES’) insights while at the same time provide the means for collecting feedback and input from professionals (landscape practitioners, managers and policymakers) and the general public.

Following the gathered requirements from other work packages the web geographic information system (GIS) platform with underlying repository was built allowing processing and storing of large amounts of spatial data. The architecture implements current state-of-the-art in cloud computing and allows efficient collecting, archiving, using, sharing, and distributing of data amongst project partners, stakeholders and the general public.

Being the basis of the dissemination and modelling platform, this deliverable is expected to develop further throughout the project, based on specific requirements of the project partners and especially project use-cases.

The Knowledge Hub has been made available to HERCULES partners and the general public via

http://www.test.geopedia.info/KnowledgeHub.html (testing instance)

and

http://www.world.geopedia.info/KnowledgeHub.html (main instance).

The final URL of the platform should reflect the hercules-landscapes.eu web-page and will be made available after agreement with HERCULES partners.

For the Knowledge Hub to become (successfully) operational it is essential to become filled with data and stories. This is expected first and foremost by HERCULES partners and selected stakeholders from other work packages, while later on also by the general public and even other research groups and projects. Therefore this document focuses to technical capabilities of the platform, hoping to sparkle ideas on how it could best be used and developed further.

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Abbreviations

HERCULES	HERitage in CULtural landscapES
CRS	Coordinate Reference System
EPSG	European Petroleum Survey Group
GIS	Geographic Information System
ETRS89	European Terrestrial Reference System 89
DEM	Digital Elevation Model
ELO	European Landowners' Organization
URL	Uniform resource locator
GPX	GPS Exchange Format
WMS	Web Map Service
WP	Work package

1 Introduction

We have designed and implemented the Knowledge Hub for Good Landscape Practice (Knowledge Hub), which will ensure efficient collecting, archiving, using, sharing, and distributing of data and project results amongst project partners, stakeholders and the general public.

A multitude of approaches have already been developed to protect and develop heritage values in cultural landscapes. However, they are mostly localized to a particular region, or concerned with a specific feature (type). The Knowledge Hub is meant to be completely open in this concern: it is not limited to region and scale, nor does it impose a constraint on feature or data types, as long as they do carry locational information. The Knowledge Hub provides the means for collecting feedback and input from professionals (landscape practitioners, managers and policymakers) and the general public and will act as a toolkit for communication of (HERCULES') insights between various parties, as shown in Figure 1. It also shows the duality of the Knowledge Hub that allows both the contribution and use of experience-based local insights and scientific knowledge, illustrated by arrows leading to and from the Knowledge Hub.

In order to fulfil these objectives, we have gathered requirements from other work packages (WP), analysed user requirements and current state-of-the-art in geographic information system (GIS) and cloud community. Based on that knowledge we have built hardware and software specifications and implemented the Knowledge Hub upon them.

The resulting two-part system (data repository and web GIS) has been made available to HERCULES partners and general public via

http://www.test.geopedia.info/KnowledgeHub.html (testing instance),

and

http://www.world.geopedia.info/KnowledgeHub.html (main instance).

The final uniform resource locator (URL) of the platform should reflect the hercules-landscapes.eu web-page (responsible: ELO – European Landowners' Organization) http://www.hercules-landscapes.eu/ and will be communicated ELO on how to establish the sub-domain (e.g. kh.hercules-landscape.eu).

For the Knowledge Hub to become operational it is expected first and foremost from HERCULES partners and selected stakeholders from other work packages to fill the Knowledge Hub with data, while later on the data would come also from the general public and even other research groups and projects.

The following report documents the specifications and main implementation details of the Knowledge Hub, hoping to sparkle ideas on how it could best be used and developed further.

2 From the Vertical to the Horizontal towards a Solution

Author

Pip Howard

2.1 The HERCULES Knowledge Hub - 'The Tool to Consolidate Landscapes in Europe'

Aim: Combining landscape practice, land use, land cover, biodiversity, soils and geology, social issues and existing policy, legal constraints and history and archaeology into an interactive map-based freely available online site for anyone to hone in on their landscape.

The need for an as comprehensive as possible online hub superimposing the myriad of existing online data (be it spatial, research or simple commentary) as well as able to absorb new data is clearly recognised, as useful data on landscapes spreads about the internet, but is often lost and difficult to find in the wider ether. A hub only works if it is at the hub of something, which there is plenty of already and thus it will be hugely beneficial to all those with an interest in landscape to have, finally, their own platform linking all those interests that have for so long been separated, but which in turn will help empower all those interests.

Finally all landowners, practitioners, public and other stakeholders will have access to a common, a standardized, system with regards planning within their landscapes.

The Vertical is the title given towards the procedure of gathering relevant information on a specific location for land management purposes.

The Horizontal is the procedure of gathering the wider 'holistic' issues from the location; to include the results from public engagement in particular and an aesthetic element that transcends physical property boundaries.

2.2 The Vertical

A complete set of overlays of all interests, of all issues, crossing boundaries both physical and political, helps create a 'definitive map' for all with interests to work from a common platform.

Maps and more recently satellite or aerial images have always been a key in providing the overlays of data required to define the boundaries of all the available information towards defining the general characteristics of a site and the boundaries to be worked within – a Land Information Search.

The vertical is a comprehensive 'Land Information Search'. It should be able to be completed remotely, but the range of information has been spread widely on the internet – those with an interest in forestry will not easily be able to find data on cultural heritage. Previously this has meant that each interest, professional or otherwise, has to wait for the incorporation of other interests, particularly from the academic angle to be designed specifically for their interest. This is time consuming and costly and at odds with a true landscape approach, which must

take account of what is on the other side of both the physical and political boundary within any given landscape.

The Knowledge Hub will be able to combine all interests instantly, expanding a blinkered approach of the gathering of information to 360°.

There are gaps in the information, with no standardised method of data collation. These gaps have been identified with the assistance of local stakeholders and systems of incorporating information to complete the picture, the map, will be created. Most importantly there is a need for a method to incorporate biodiversity data and incorporate the boundaries themselves, which are so often landscape features of high value to many but previously excluded from much planning simply because, by definition, they are at the edge.

2.3 The Horizontal

Moving from the vertical axis onto the horizontal is a step that if done badly can result in conflict. All protest costs money and all too often protest could have been easily avoided by simply allowing the time to listen. If the vertical is open to everybody protest is limited in the first place. But to then progress to a solution, resulting in good landscape practice, there needs to be a ‘view from the ground’ stage which allows the voice of any and all to be included.

The Knowledge Hub can help eliminate many concerns before entering this stage, simply by illustrating the many factors at play and which will exist in any given landscape. The past is of great importance as many less tangible values are contained within the history of the landscape and the lives of those who live in it.

GIS and images play a vital role in illustrating the past and the future and any and all case study sets examples which limit time wasting and further empower all those who work on landscape, without excluding the vital opinions of those who share that landscape.

Furthermore an exploration of the past techniques, those skills and knowledge which created a sustainable landscape, are more easily identified and any new work can be added to this completely in line with what already exists.

2.4 Incorporating Ongoing Research

One principal objective with the Knowledge Hub is to incorporate in the first instance research from other work packages and member organisations involved with HERCULES, then all relevant peripheral research results.

No matter where this research is based the Knowledge Hub allows for an easy process of matching both social and earth science data to any other landscape in Europe, thus enabling rapid dissemination for site specific planning: a ‘one stop shop’ for land management practitioners prior to any planned operations as well as a platform to mark personal 'good practice' after operations.

3 Knowledge Hub Technical Specifications

Authors

Matej Batič and Grega Milčinski

The following section lists technical specifications for the sake of consistency. Alongside each specification the information whether the implementation of the Knowledge Hub satisfies the item, or a short explanation why not is given.

3.1 General software requirements

- System has to support large number of end users (min. 200 concurrent users)
- System has to provide satisfactory response time for all the users no matter of type of user or amount of content used in every day work
- System has to provide access to the content, regardless of their location, according to the specifications of the HERCULES project about data dissemination
- System architecture must optimize maintenance costs and upgrades of the system with new versions and minimize time to remove any faults in the system
- System must enable integration of software modules with existing modules in system with consistent view and control for end-users
- System must use multilayer architecture that enables scalability and expandability and integration to other components of System

Knowledge Hub implementation fulfils these requirements.

3.2 General Knowledge Hub spatial data repository requirements

Database

The proposed system has to be fully integrated with existing infrastructure:

- PostgreSQL/PostGIS

Platform and Industry Standards

- Supported on UNIX, Linux and Windows platform
- Provide out-of-the-box integration with market-leading application servers and portals
- Provide support for J2EE technology, XML and Web Services

Knowledge Hub implementation fulfils these requirements.

3.3 General Requirements

- Application should run within a web-browser without any additional installation or plug-ins required.
- Application should support at least last two version of all common web browser (Internet Explorer, Firefox, Chrome)
- General Scalability Requirements
- Architecture shall provide provisions for scaling up (vertical scaling) and/or scaling out (horizontal scaling)
- Provide inherent load balancing between servers if clustering is employed

Knowledge Hub implementation fulfils these requirements.

3.4 General GIS functionality

Coordinate reference system (CRS)

- Spatial data
  a) Spatial data in Knowledge Hub spatial repository should be in European Terrestrial Reference System 89 (ETRS89)
  b) KH spatial repository should allow stored data to have specific CRS, providing that necessary transformations are in place
  c) Support for specific CRS on request
- Data projection on GIS viewer
- Spatial data is projected to EPSG:3857 – WGS84 Web Mercator, which is used in many popular web mapping applications (Google, Bing, OpenStreetMap, etc.).

Knowledge Hub implementation fulfils these requirements. We removed the constraint that the data should be in ETRS89, and may now be in any supported CRS. For full list of currently supported additional CRS, please refer to Table 2 in section 4.3.

3.5 View and analysis

- Raster layers
  a) Raster images in GeoTiff can be pre-processed to be used within the system
  b) Open GIS tiled Web Map Service (WMS) is supported (just missing tiles of raster images are downloaded during the movement in the map window)
- Vector layers
  a) Switching on/off individual vector layers
  b) Setting of parameters for displaying the vector layers (manually set or default view)
  c) Lines: colour, type, thickness

d) Polygon: colour and/or pattern, level of transparency (1-100 %)

e) Dot/symbol: type, colour, size (fixed/changing with the scale)

f) Text: value, font, size (fixed/changing with the scale), colour, position, text rendering on path

g) Display of descriptive data of a selected vector layer object (selection by clicking or entering coordinates)

h) Searching by descriptive (attribute) data

i) Zoom to selected

– Coordinate conversion

– Measuring of distances and areas should be supported on the screen

– Selection of objects

a) User should be able to create a selection set, combining layer features

b) Based on query attributes

c) Manual selection with the mouse clicking

d) Selection of features which are within the drawn area

– Creation of filter layers

a) Create layer based on query parameters

b) Create automatically a list of filter layers based on a field with limited amount of values

c) Export data in Microsoft Excel and/or Esri shapefile (shp)

– Querying objects

a) User should be able to set parameters for querying the data within the user interface

b) Free-text search conditions for expert users

c) User should be able to export the results of the querying

– Display of current status in the status line:

a) Position of mouse

b) Scale

c) Progress bar or activity status

d) Quick help

Knowledge Hub implementation fulfils these requirements.

3.6 Editing of vector layers

- Vector editing should support polygon, line and point geometries
- Geometry editing should allow to add, edit and delete geometry
- Polygon geometry editing should be optimized for large polygons (composed of hundreds of points)
- Point editing should allow entering the coordinates in the respective coordinate system,
- Entering the coordinates using mouse
- Additional descriptive data the users enter manually or selects from a set of values
- Additional user-defined updating criteria should be possible to support necessary adaptations according to findings of the pilot projects
- Control of geometrical adequacy of changes must be available when performing standard geometrical data editing. The user must be notified (or not be allowed to make changes) if individual operations (adding points, shifting points, etc.) are incorrect
- Control of the adequacy of entered/corrected graphics must be carried out before data is committed to the central database

Knowledge Hub implementation fulfils these requirements.

3.7 3D capabilities

- Web client should be able to present 3D objects using standard HTML5/WebGL technology without any additional browser add-ons or installations
- 3D browsing should facilitate digital elevation model (DEM) and available raster and vector data to depict the terrain model with other content drawn on top of the terrain
- Level-of-detail tiling should be supported

Knowledge Hub implementation satisfies these requirements, but due to unavailability of the data (sufficiently accurate DEM data of larger – EU or worldwide – area) the feature is currently available only for smaller area (Slovenia). In case we will be able to gather DEM data for larger (EU-wide) area, the feature will be available on larger scale.

3.8 Printing tools

The software must allow the printing of an image of a selected area at a selected scale with the settings (colour, font types, etc.) from the software itself on a printer of any format. The software must also allow the printing of selected descriptive data for selected data of individual layers.

Following functionalities must be supported:

- User selected descriptive data printed on the image (scale, orientation, title, date of printing)

- Selection of the size and orientation of paper
- Printing of the legend
- Plotting on several sheets forming a logical whole, by optimizing the number of sheets used and with presentation of index map

Knowledge Hub implementation fulfils these requirements. Additional functionality (e.g. printing template specific for HERCULES project) will be added upon request and agreement on what should such template consist of.

4 Knowledge Hub implementation

Authors

Matej Batič and Grega Milčinski

The implementation of the Knowledge Hub as a two-component system (spatial and alphanumerical repository and web GIS application) followed the specifications given in chapter 3.

Although specified that the Knowledge Hub should cover Europe (area), we decided to extend it globally to make the system more widely useful. Consequently, data from anywhere in the world can be viewed, added to the Knowledge Hub.

4.1 Basic idea

The overall idea of the Knowledge hub is to act as a general repository of data in all forms. These datasets could then be used by different stakeholders to present their stories in a quick and efficient way, as shown in Figure 2.

The main point of the central repository is to allow use and re-use of the datasets and therefore increase their reach and, through re-using, improve their quality.

Figure 2: Illustration of the Knowledge Hub as data repository and web GIS portal providing a platform for the HERCULES project.

4.2 System architecture

The hardware identified below represents the required capacity of a stand-alone solution, given in general (hardware) requirements, focused to normal operation of at least 200 users connected at the same time. We believe the existing infrastructure to be based on blades and that the described hardware capacity can be constructed within existing system.

The infrastructure solution is hosted by a 19 inch 42U rack, secure both in terms of stability and access to equipment within. To ensure the availability of the system even in case of

failure of power supply, the rack will be equipped with redundant uninterruptible power supply (UPS) solution, able to provide power backup of all proposed equipment for a period of at least 15 minutes at a 50% load. The solution architecture is presented in Figure 3 below.

In terms of hardware and software, this system currently boils down to following specifications (see Table 1):

Table 1: Hardware and software specifications

Software	**Hardware**
Cloud storage cluster	
OpenStack Swift (http://www.openstack.org/)	Proxy server (2x), each: - CPU 2x Intel Xeon X5650 - 32GB RAM - 2x Gbit eth (user side) - 2x 10Gbit eth (storage side)
	Cluster side switch (2x), each: - 2x10Gbit uplink (for proxy) - 24x1Gbit for cluster node connection
	Cluster node (5x), each: - CPU 2x AMD Opteron 6344 - 48GB RAM - 24x 2TB HDD - 2x 1Gbit eth
Load balancer	
HaProxy (http://www.haproxy.org/)	Load balancer (2x), each: - CPU 1x Intel E5-1620 - 8GB RAM - 2x 10Gbit eth
Database	
PostgreSQL 9.3 + PostGIS (http://www.postgresql.org/) **1x master (primary database) + 2x read-only slave databases, all in active:active:active configuration**	Database server (3x), each: - 2x Intel Xeon E5-2630 - 64GB RAM - 16x 450GB@15kRPM HDD RAID10 - 2x 10Gbit eth
Web server	
Various software	Webserver (14x), each: - CPU 2x Intel E5620 - RAM 32GB

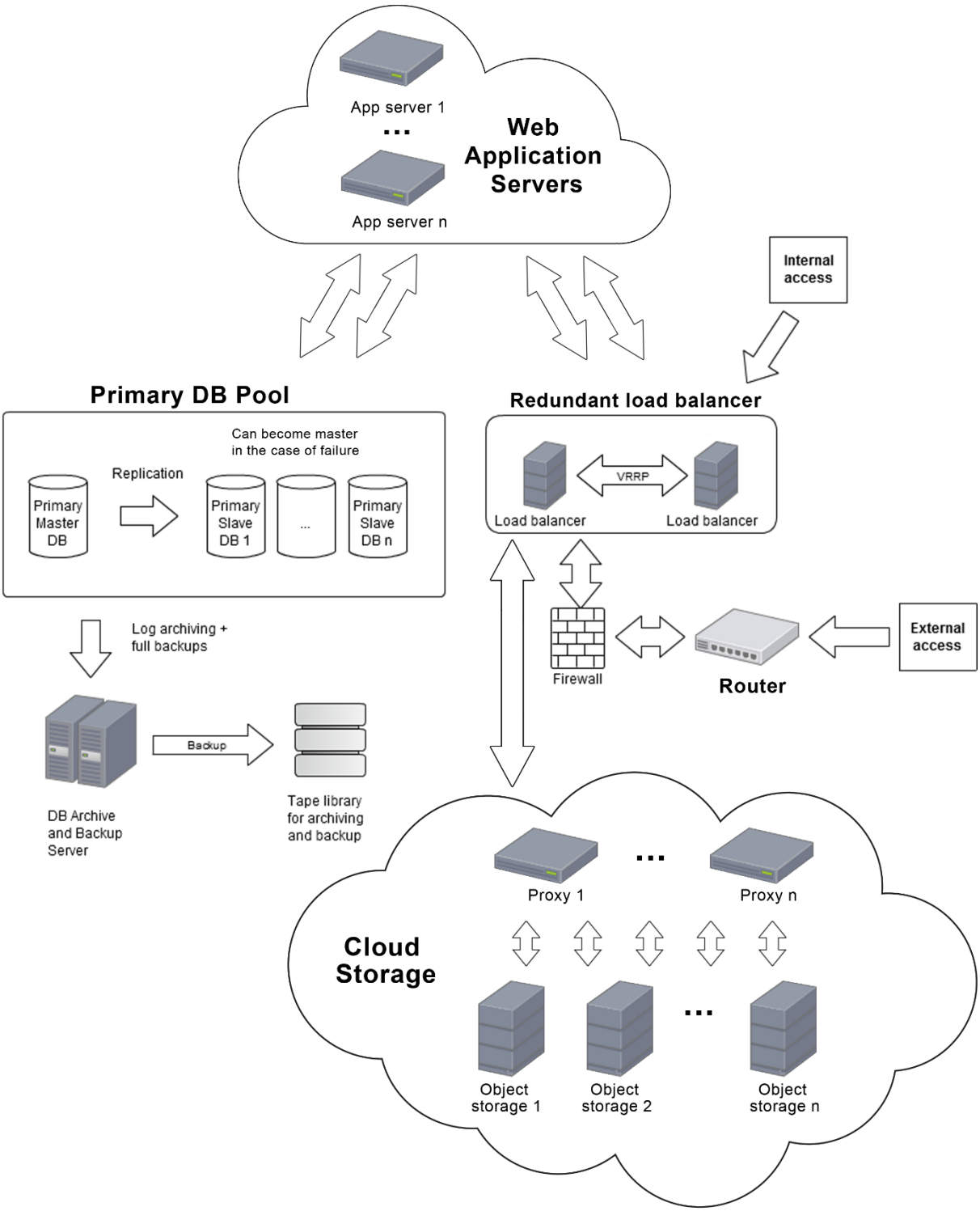


Figure 3: Logical hardware architecture presentation of the system.

4.3 Coordinate reference system

Although specified that spatial data in the repository will be in the ETRS89, we have implemented the repository to allow data in other CRS systems as well. We have removed the constraint when data is imported (e.g. from vector datasets of other projects) that the data should be in ETRS89, thus allowing the data input to the Knowledge Hub to remain in its original CRS to prevent reduction of the data quality. For the system to be able to visualise the data in a centralised way (mash-ups), the transformation between the CRSs need to be implemented.

Currently allowed CRS are given in Table 2. Additional (specific) CRS will be added on request from Hercules partners and other users.

Table 2: Available CRS

CRS name	EPSG code
WGS84 - World Geodetic System 1984	4326
ETRS89	4258
WGS 84 / Pseudo-Mercator	3857
ETRS89 / LAEA Europe	3035
MGI 1901 / Slovene National Grid	3912
RGF93 / Lambert-93	2154

Spatial data from the repository is projected to WGS 84 / Pseudo-Mercator, used in web GIS part of the system, allowing simple integration of other maps (e.g. OpenStreetMap http://www.openstreetmap.org/) via WMS or other services (e.g. Google static maps https://developers.google.com/maps/documentation/staticmaps/).

4.4 Web GIS – Knowledge Hub

Although the Knowledge Hub as a name represents both aspects of the system (web GIS and underlying repository), we believe the name will be used more in reference to the web GIS (portal). In the period before this deliverable is due, the Knowledge Hub will be alive on test instance:

http://www.test.geopedia.info/KnowledgeHub.html,

while later on the main site will be:

http://www.world.geopedia.info/KnowledgeHub.html.

As domain names are in a sense a live entities, fixed entry to the Knowledge Hub will be through the Hercules main web site, something similar to (a matter of a final decision by dissemination partners): http://kh.hercules-landscapes.eu/, which we will update in case the link to the Knowledge Hub changes.

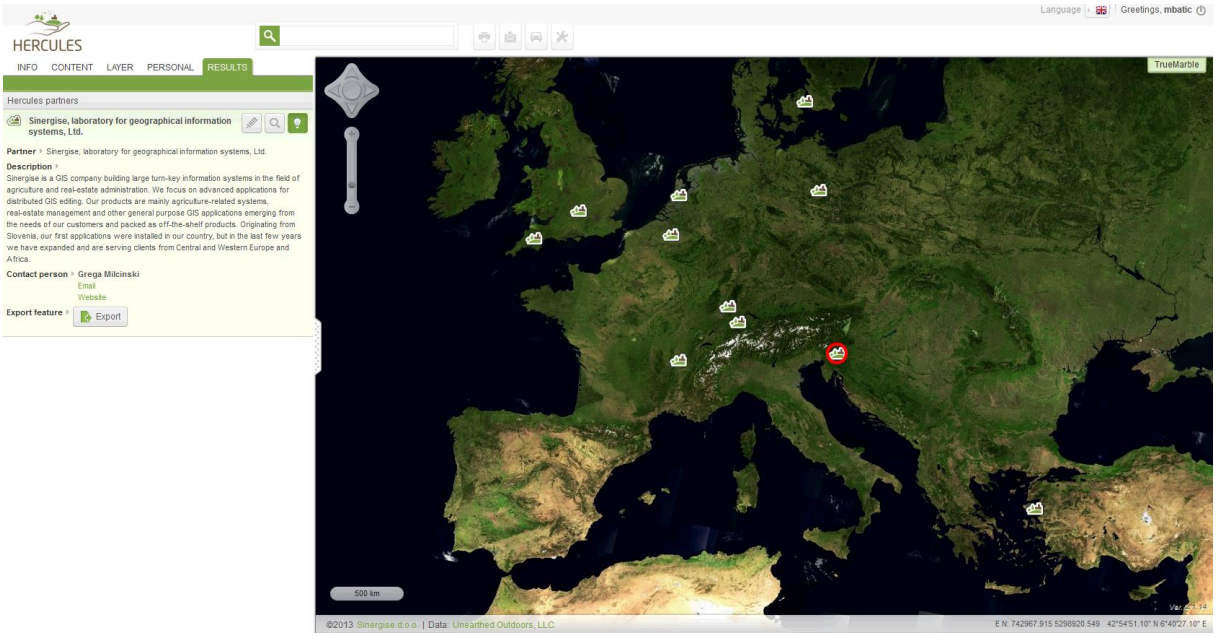


Figure 4: Knowledge Hub, showing layer with HERCULES partners.

In Figure 4 Sinergise is selected. In the left side-bar short information and contact details are given. Notice that points, representing partners, are small HERCULES logos.

4.4.1 Web GIS application overview

User interface of the Knowledge Hub web GIS is displayed in Figure 4. The entire content window of the web browser is taken up by the application; the left side of the screen is taken by the application control panel, and the right side is reserved for the map view.

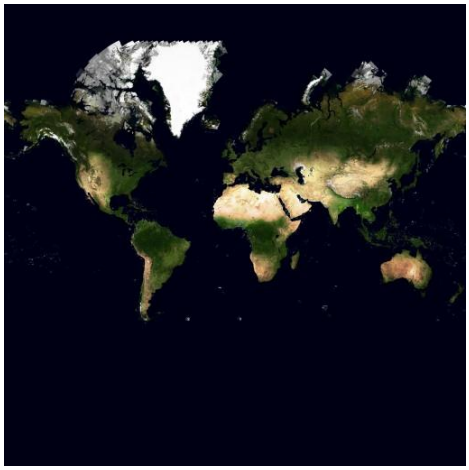
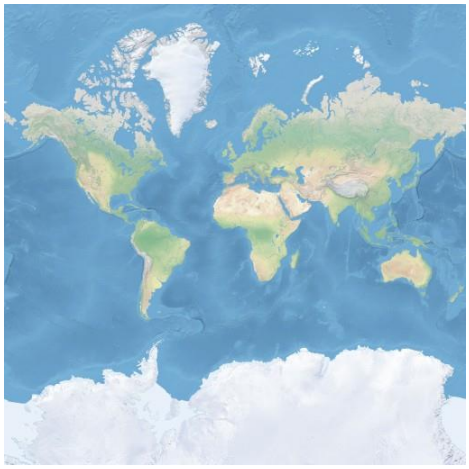
The control panel will usually contain various components supporting configuration of the map window and the use of various tools. These components are organized in tabs (e.g. Info, Content, Layer, Results); The map view can, in addition to the spatial data, contain various floating components, such as navigation buttons, zoom slider, buttons for managing the display of selected layers or layer groups, scale bar, coordinate display bar, status line, etc.

The width and height of various panels in the use interface can be adjusted by the user; collapsible panels enable components to be shown and hidden as needed for efficient completion of various tasks.

4.4.2 Raster layers

To use as background we have pre-processed a few publicly available datasets and added OpenStreetMap WMS and Google static maps layers (see Table 3).

Table 3: Currently available raster layers

Layer	**Preview**
TrueMarble – Link: http://www.unearthedoutdoors.net/global_data/true_marble/ – Low resolution	
Natural Earth II with Shaded Relief, Water, and Drainages – Link: http://www.naturalearthdata.com/downloads/10m-natural-earth-2/10m-natural-earth-2-with-shaded-relief-water-and-drainages/ – Low resolution	
Night Lights 2012 – Link: http://visibleearth.nasa.gov/view.php?id=79765 – Low resolution	

OpenStreetMap WMS – Link: http://www.openstreetmap.org/ – High resolution	
Google static maps – Limit: 25000 image requests per day – Support for hybrid, sattelite, roadmap and terrain maps – Link: http://visibleearth.nasa.gov/view.php?id=79765 – High resolution – NOTE: Google maps were added for test purpose and are not meant to be used in production environment. In case partners would decide to	
Ljubljana, Slovenia – High resolution orthophoto raster layer	

Processing of additional raster images will be done upon request and delivery of said raster images (e.g. high resolution orthographic imagery of specific area/country). Any kind of RGB raster image provided in standard format (e.g. GeoTiff) can be imported. For faster delivery of images to users, raster layers are processed to final CRS (WGS 84/ Pseudo-Mercator). For best quality, it is desired that the input raster data are also projected to this CRS.

4.4.3 Vector layers

All layers, be it raster or vector, can be switched on or off, allowing users to build comprehensive maps from the available data.

The repository and web GIS application support the following vector data types (see Table 4):

Table 4: Supported vector data types

Vector data type	Parameters
Text	Value, font, size, colour, position, text rendering on path
Point	Dot/Symbol: type, colour, size selectable, Multipoint data also supported
Line(string)	Colour, type, thickness Multiline(string) also supported
Polygon	Colour and/or pattern, transparency level, border colour Multipolygon data also supported

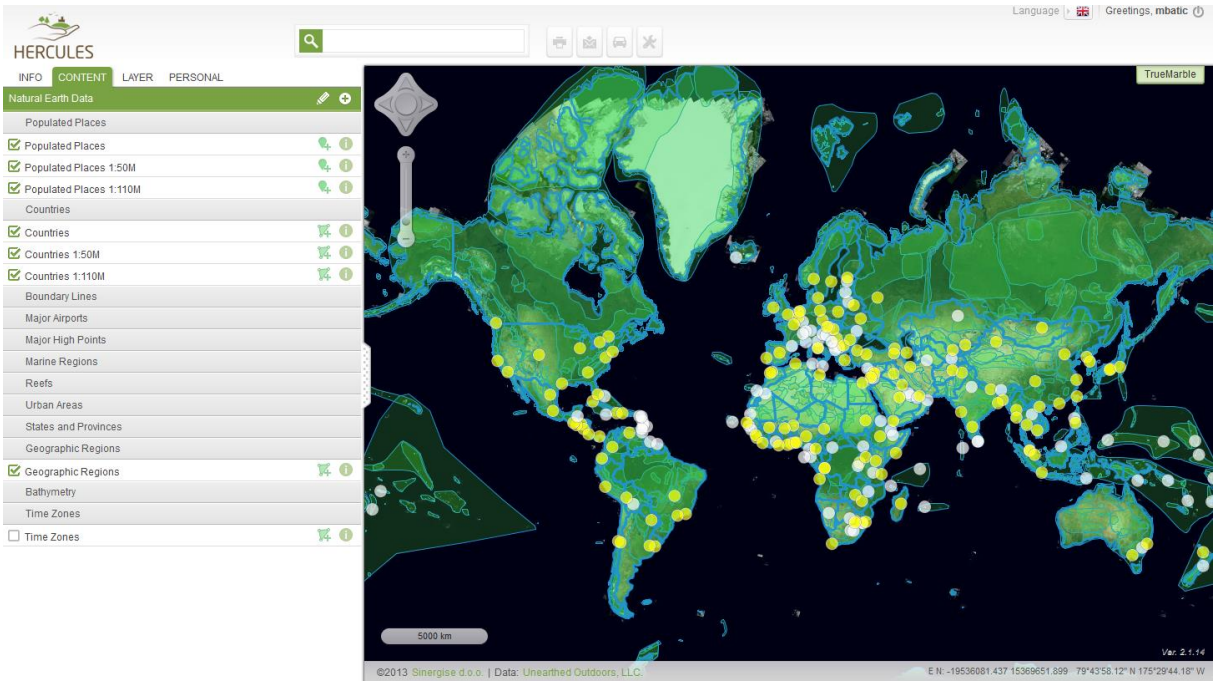


Figure 5: Example, showing points (populated places, colour varying according to population of the city), polygons (countries, transparent polygons with blue borders) and polygons (geographic regions, semi-transparent polygons with thin borders).

Figure 5 shows various vector types on the map, while Figure 6 shows editing descriptive data of one particular point. Geometry editing of vector data allows users to add, edit and delete geometry. Although web GIS displays data in WGS 84 / Pseudo-Mercator projection, in fact the edited data is transformed back to the primary CRS of the geometry. Additional descriptive data is manipulated in the side-bar.

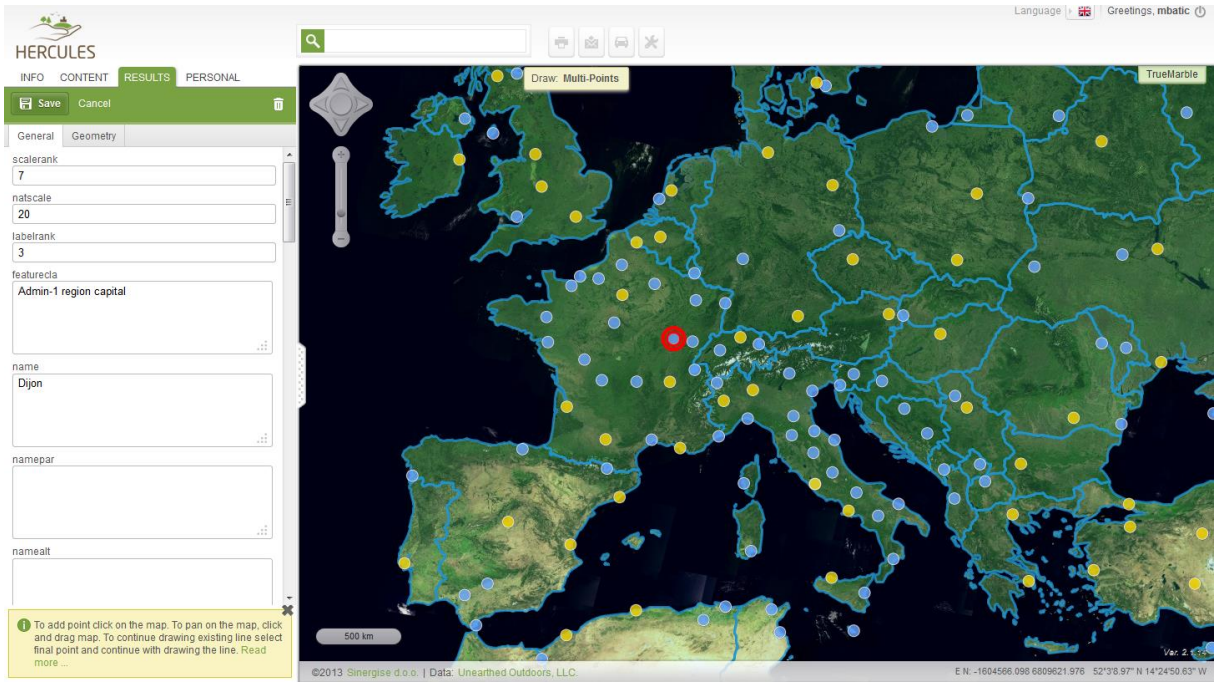


Figure 6: Editing data and (point) geometry of Dijon.

4.4.4 Feature info

Feature info functionality of the Knowledge Hub is integrated and constantly available: by clicking on the map, data from the currently visible layers are queried and displayed in the results tab in the left side-bar (see Figure 7).

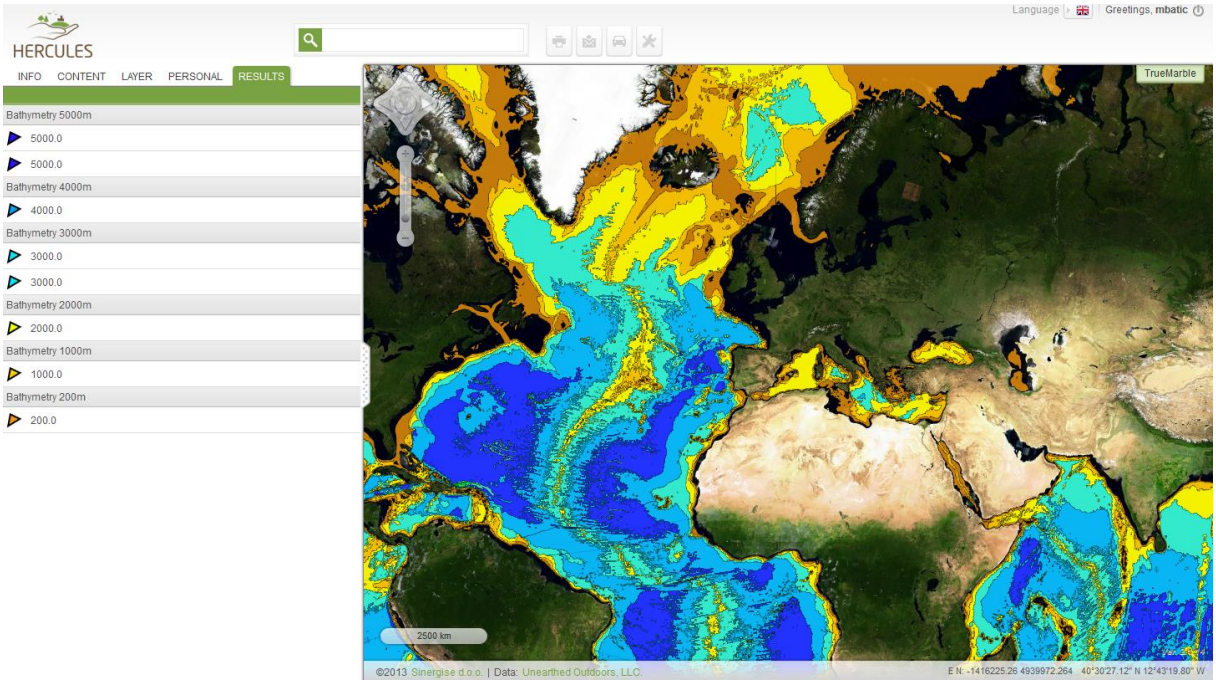


Figure 7: By clicking west of Spain coast, bathymetry results for that point are shown in the result tab.

By clicking a specific result, the feature is highlighted and the user is given options to zoom to the result, edit it (if he or she has editing privileges) and export it (see Figure 8).

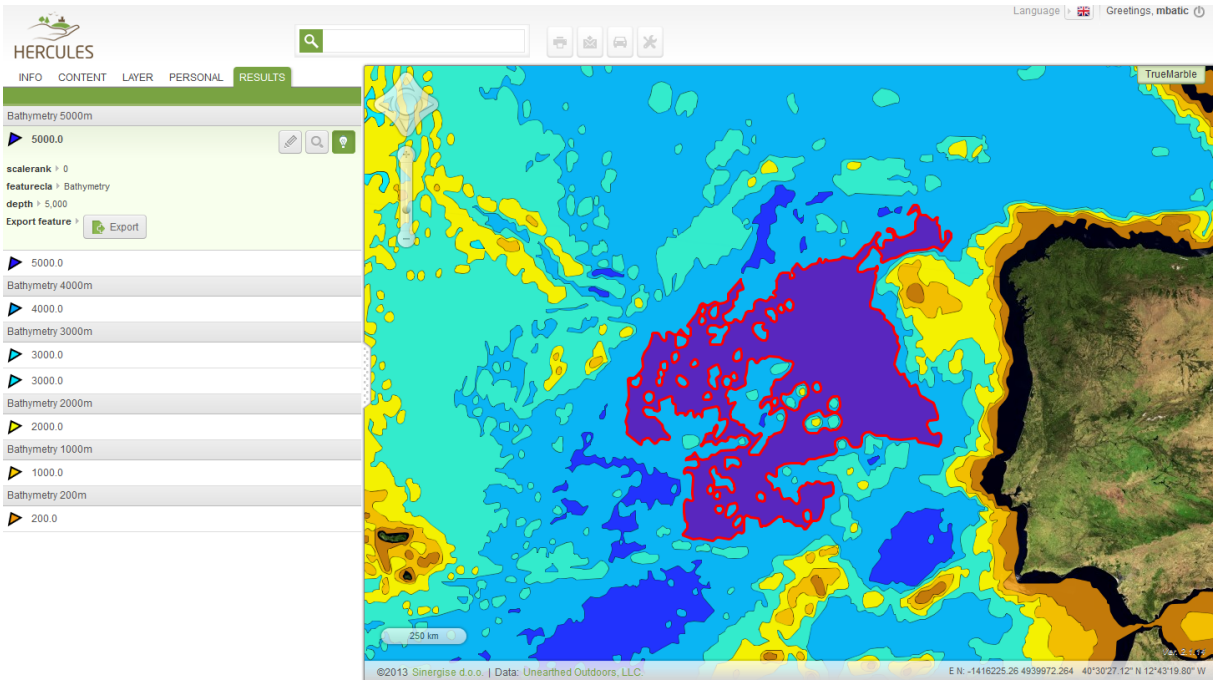


Figure 8: Highlighted (red border) selected feature.

4.4.5 Selecting objects

Apart from feature info, where only a simple query, based only on location and visible layers, is carried out, the Knowledge Hub supports more advanced selection mechanisms based on filters. Figure 9 shows the table with all features from the given layer.

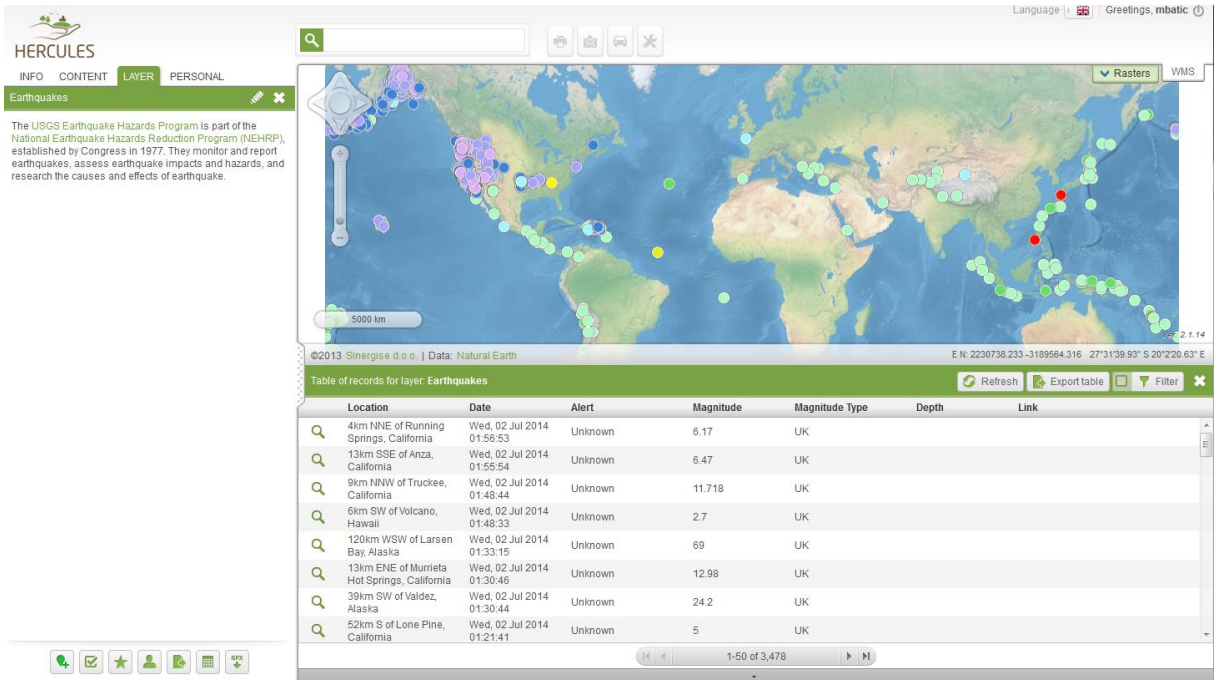


Figure 9: Earthquakes' locations; the table below the map shows records. Currently all records are shown.

Advanced filtering of data (see Figure 10) allows creating new layer based on query (filter) parameters, which includes both querying on geometries (standard geometrical queries, e.g. intersection, crossing, contains; see Figure 11) and querying additional data fields (e.g. text).

The filtered data can be saved as a 'view' layer, and is automatically updated when new entries are input to the original data. Filtered data can also be exported.

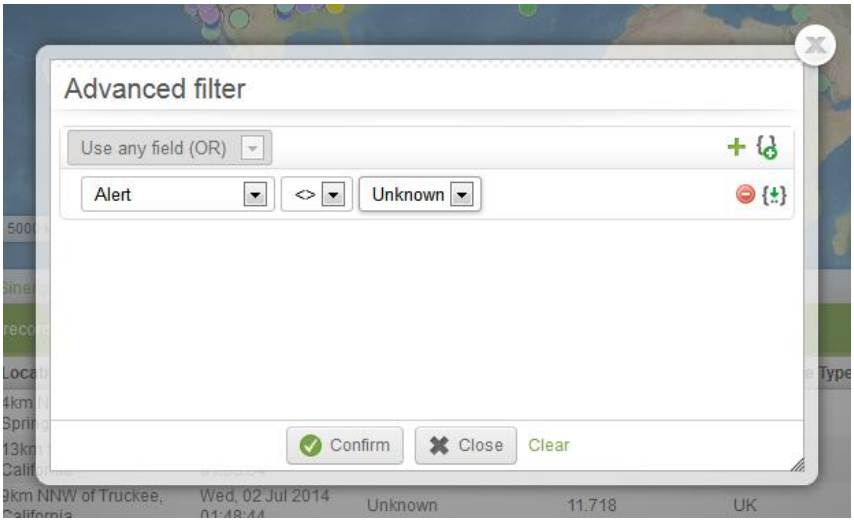


Figure 10: Advanced filter, filtering Earthquakes based on Alert type.

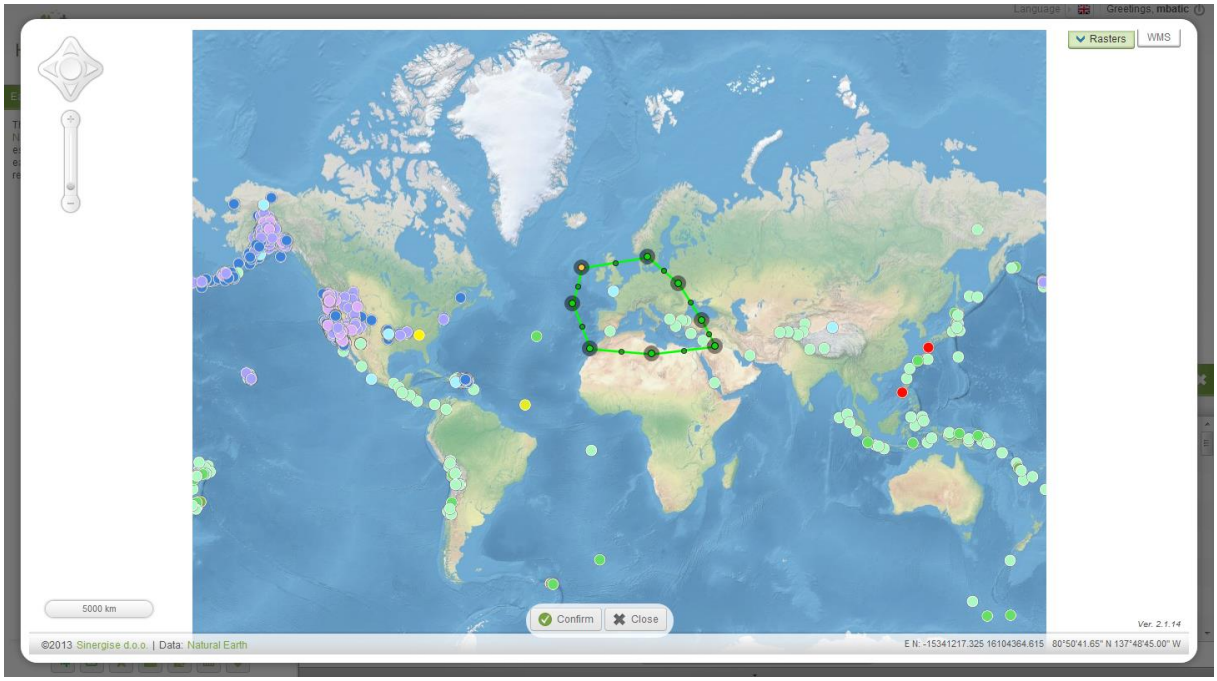


Figure 11: Advanced filter, geometry query.

4.4.6 Exporting data

The data from the Knowledge Hub can be exported according to permissions. Vector data can be exported to various formats (GPX, Esri shapefile, csv, Excel spreadsheet), although only Esri shapefile allows for geometry export. When exporting layer, user can select which fields will be exported (see Figure 12).

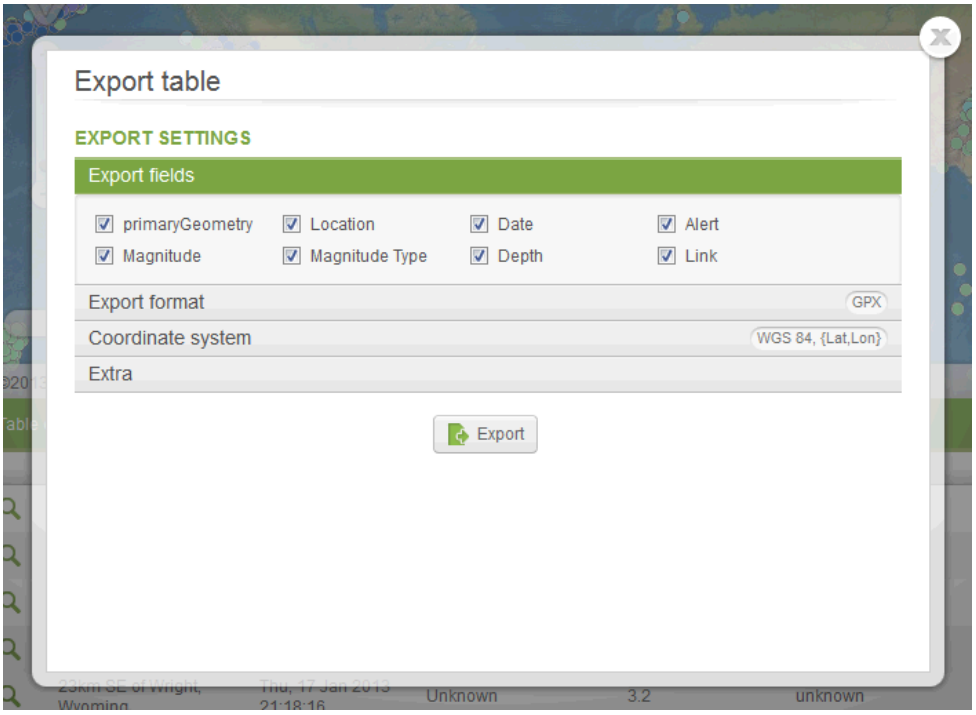


Figure 12: Table export dialog allows user to manipulate what will be exported.

Exporting raster data as GeoTiff is currently not supported, but will be implemented as a tool in the Knowledge Hub in the following months. In the meantime, raster data will be provided directly by Sinergise upon request.

4.4.7 3D capabilities

3D capabilities are made available using standard HTML5/WebGL technology without any additional browser add-ons or installations. 3D view is available where DEM is provided. Available raster and vector data are then mapped to the terrain model with other content drawn on top of the terrain. Figure 13 shows a 3D view of the Ljubljana castle.

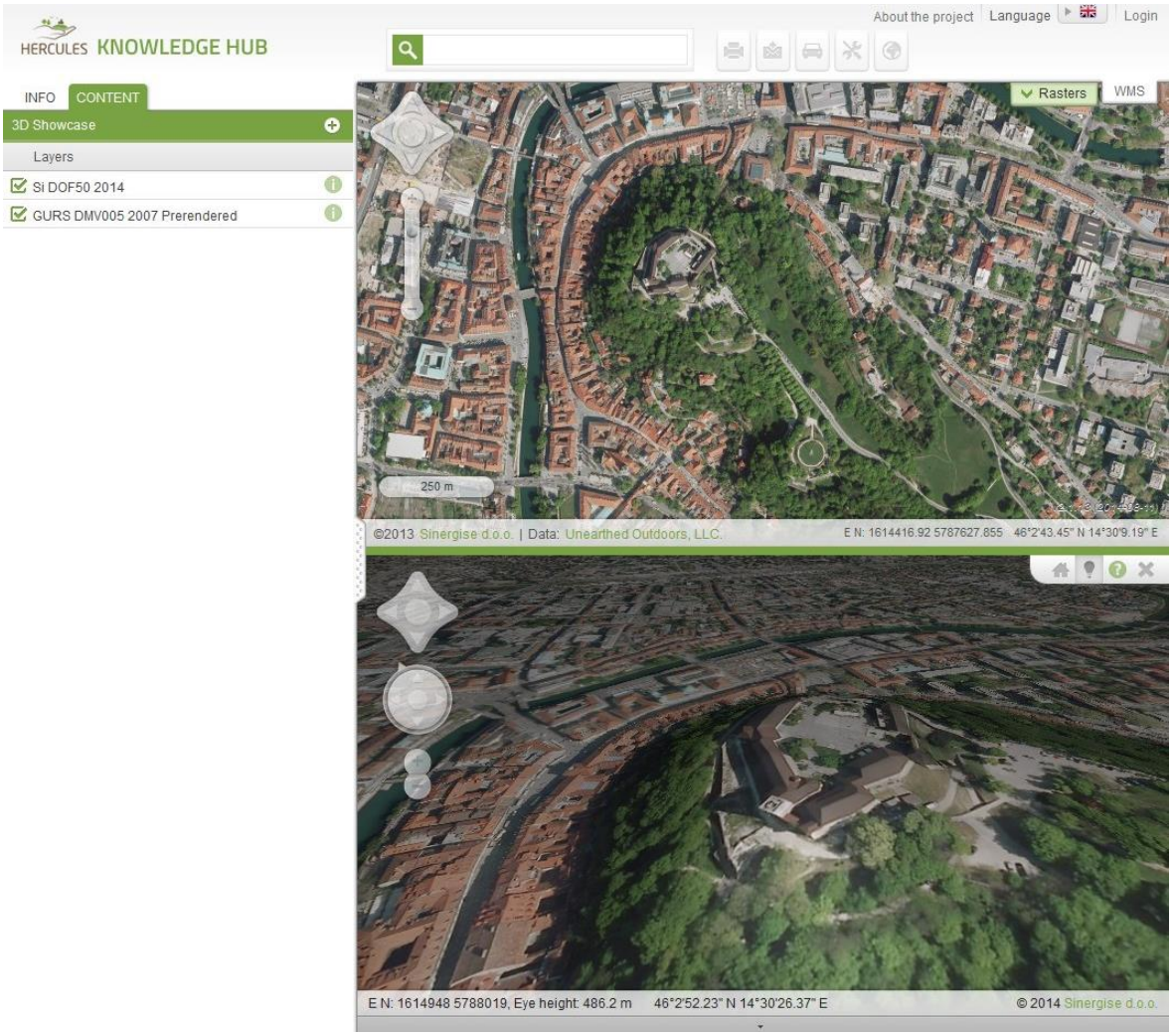


Figure 13: 3D view of Ljubljana castle.

4.4.8 Other tools

Additional tools are available through the buttons above the map. Currently supported features are:

- **Printing**
  Both printing to pdf and simple printing to jpg/png are supported. Additional templates for pdf printing can be added upon request. The Printing pop-up panel is shown in Figure 14.

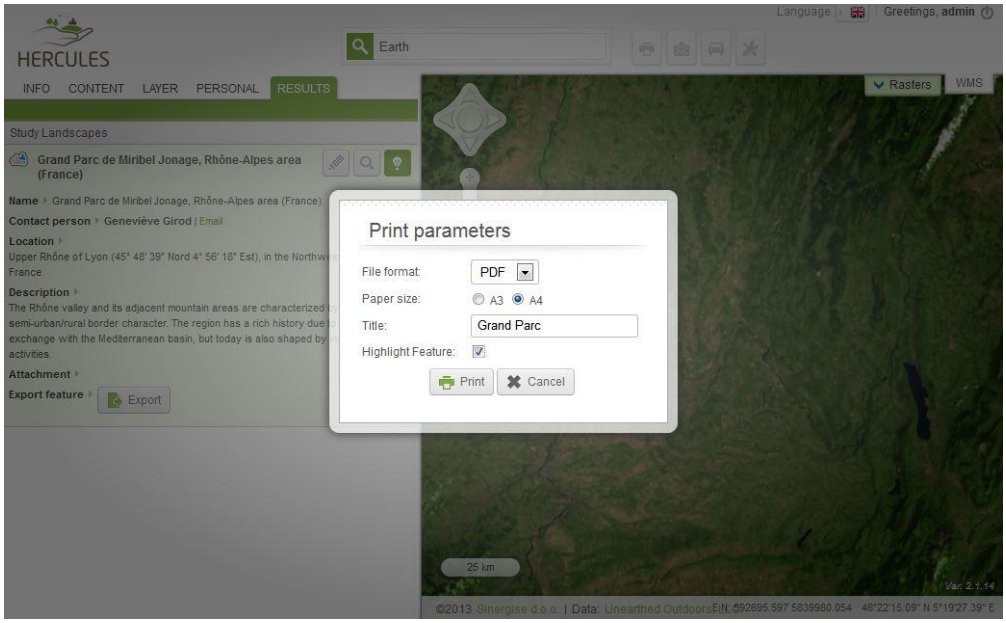


Figure 14: Print dialog box.

E-mail

When 'live' view of the map is preferable (by live we mean that the content is or might be changing), sharing a web link might be preferable to sending a 'hardcopy' (pdf, jpg, screenshot). The pop-up panel is shown in Figure 15.

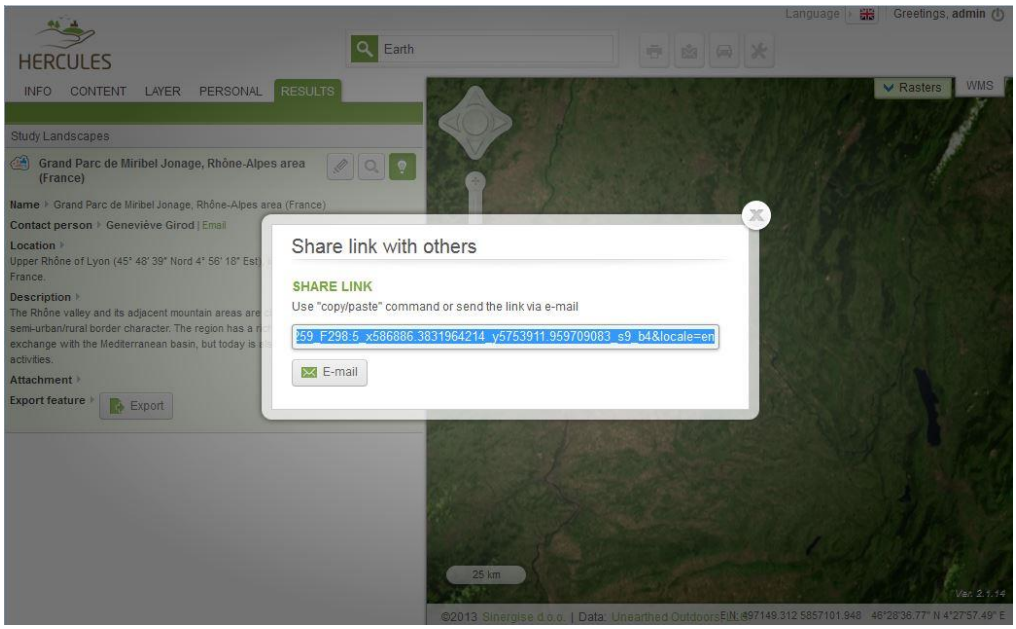


Figure 15: Pop-up panel to share a web link.

– **Directions**

  Figure 16 shows how Google Directions Api is used to find a car or pedestrian routing between two points).

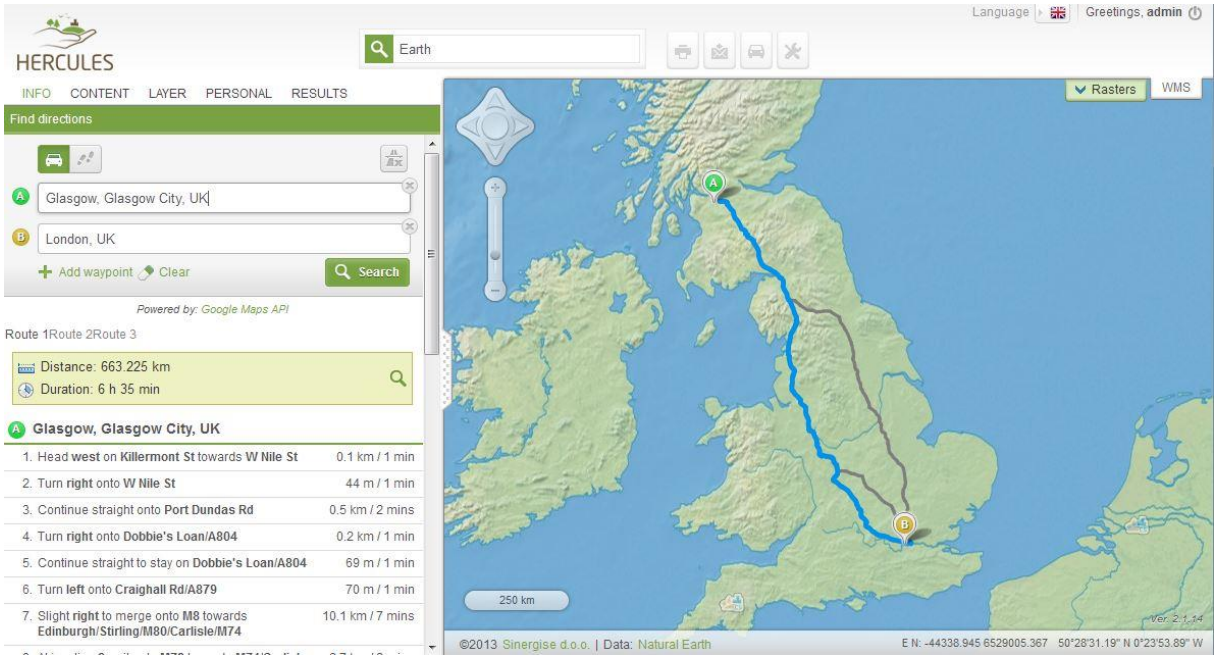


Figure 16: Get directions.

Tools

Figure 17 shows a number of additional tools.

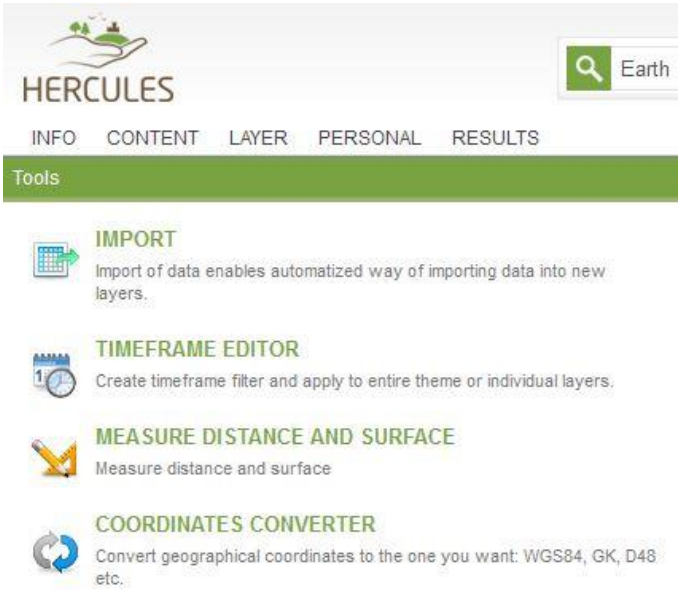


Figure 17: List of tools.

- **Import**
  Data importing currently supports importing Esri Shapefiles bundled into a .zip file (see Figure 18). Upon successful import, data is immediately available on the Knowledge Hub.

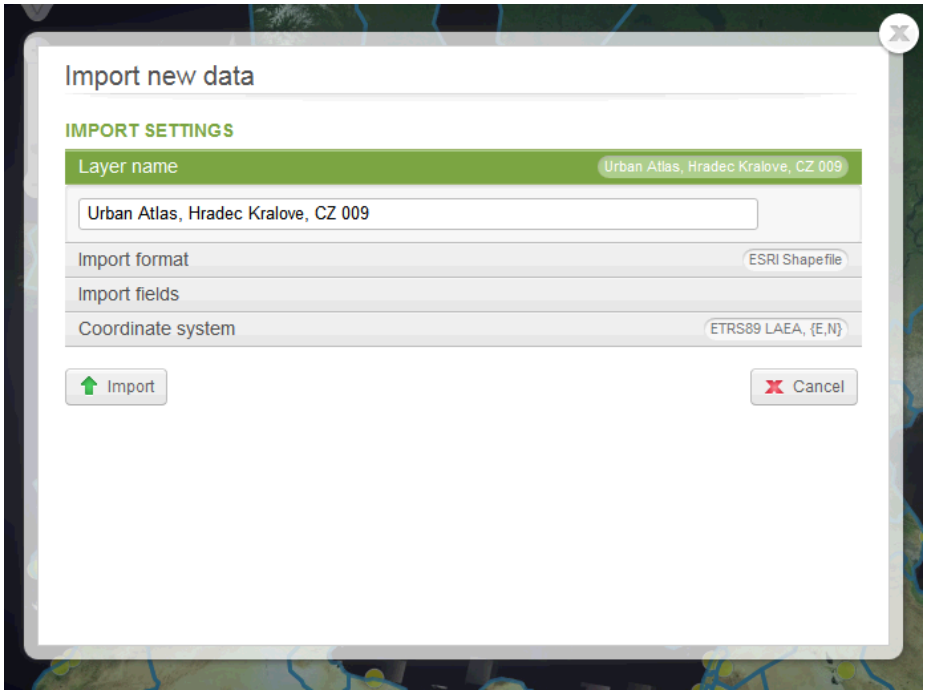


Figure 18: Import new data dialog.

– **Timeframe editor**

When dealing with data that has a temporal aspect to it, a timeframe editor can be used to specify the time interval, for which the data is displayed. . Figure 19 shows all data points available, while Figure 20 shows only data from a small time window.

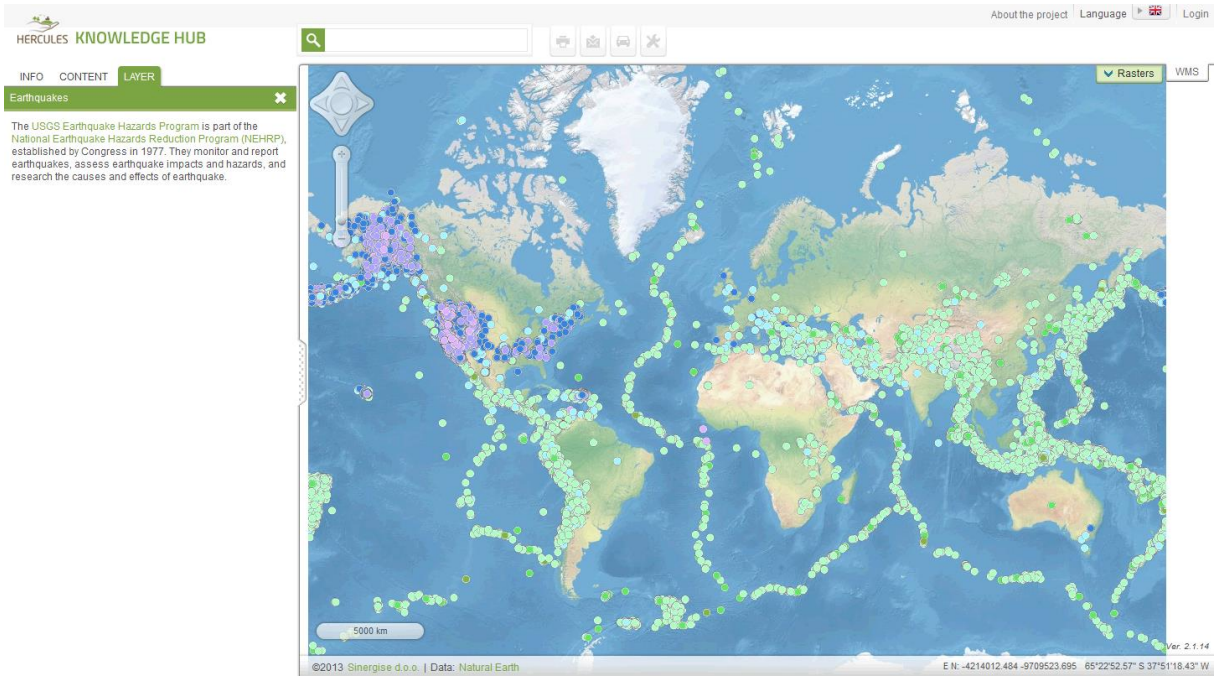


Figure 19: Showing all earthquakes' positions in the layer.

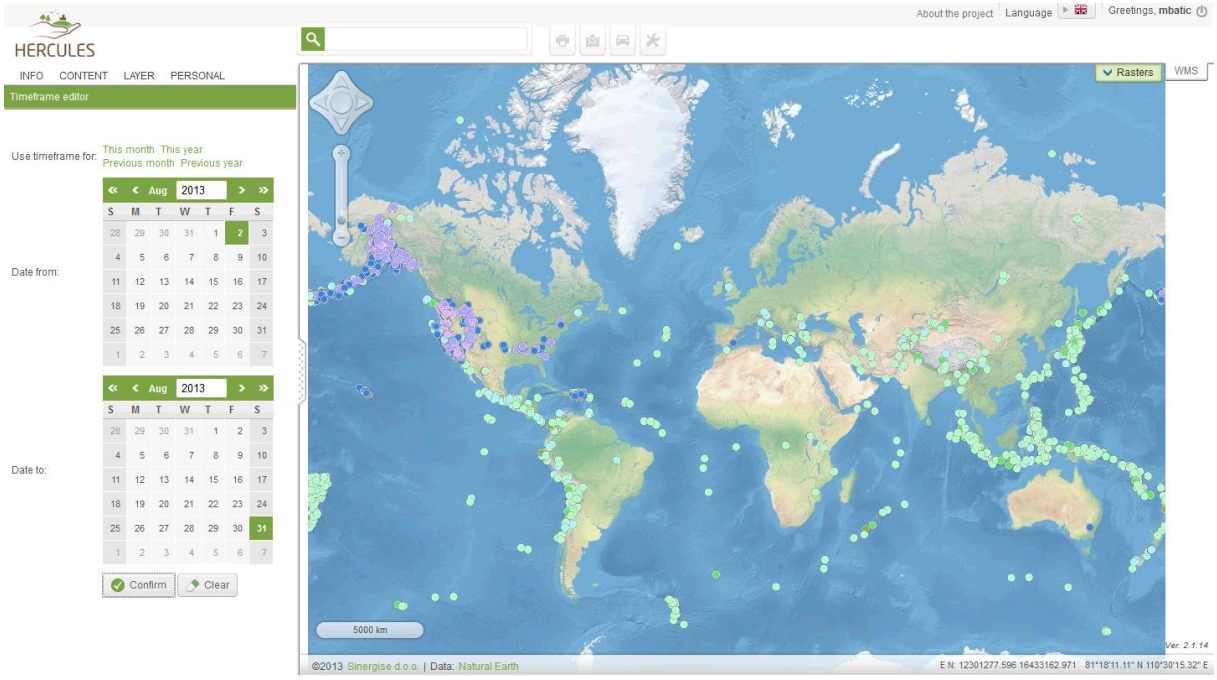


Figure 20: Using timeframe editor to only show earthquakes during August, 2013.

– **Measure distance and surface**

This tool allows a user to measure distances and surfaces of lines that he or she draws on the map (see Figure 21).

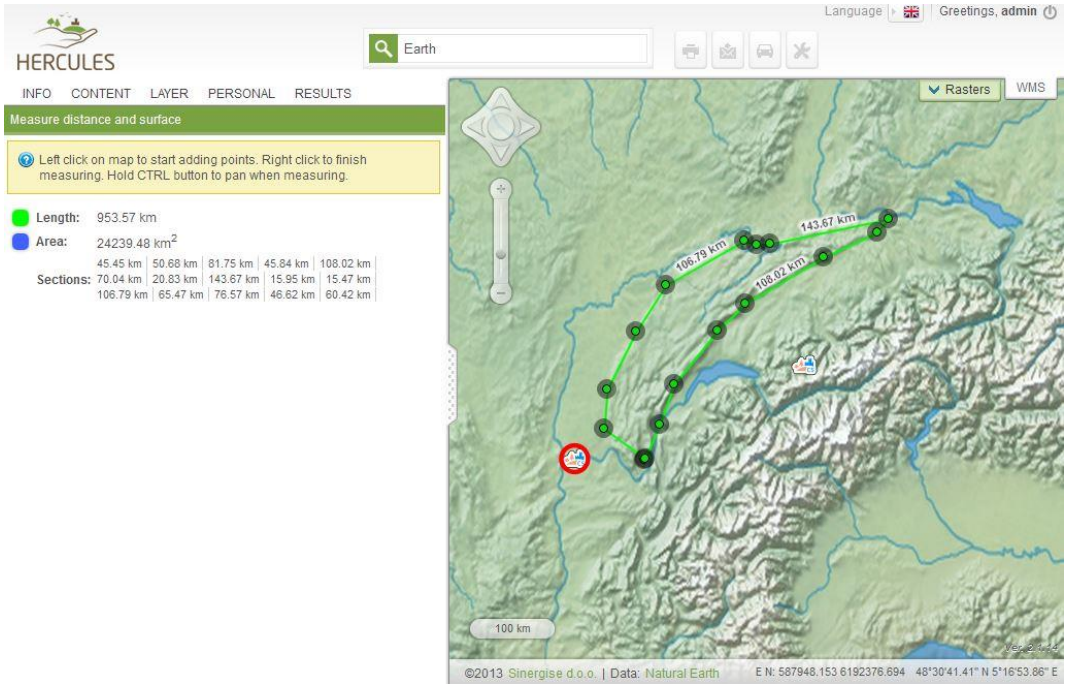


Figure 21: Tool for measuring distance and surface.

– **Coordinates converter**

  The tool converts coordinates of a user selected point (by mouse click on map or manual input) between available CRS (see Figure 22).

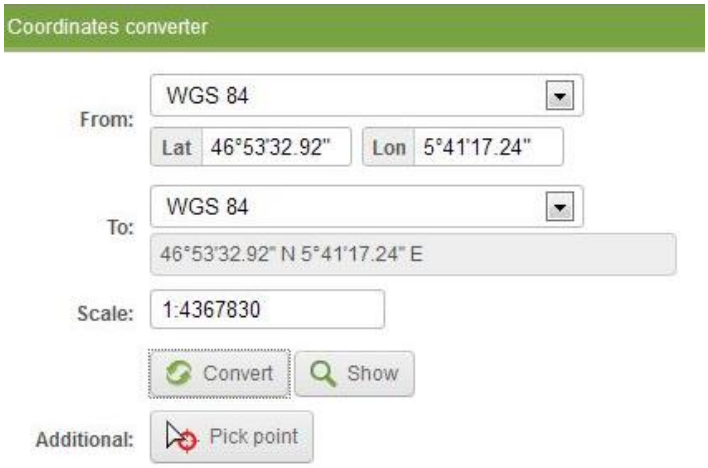


Figure 22: Coordinates converter.

4.5 Future Knowledge Hub improvements

The Knowledge Hub will become truly useful once it is used by other HERCULES WPs to support their use-cases and stories. What we have developed is technology, which can be configured in a way to ask for specific things (e.g. “landscape topology”). We believe this deliverable to be the start of an iterative process of customisations of the application based on the actual needs.

We have already provisioned two improvements of the current platform, namely language support and help functionality. Both will be made available on the Knowledge Hub shortly.

Language support

Currently, Knowledge Hub is available in English, Slovenian and Czech languages. Since additional languages are easy to include, we invite partners, who would like to have Knowledge Hub localised to their language, to contact Sinergise.

Help functionality

Main help on usage of the Knowledge Hub (web GIS platform) will be added shortly. It will be expanded as the Knowledge Hub grows, topics prioritised to cover most problematic or unintuitive tools. When functionality from other WPs will be added, also help will have to be updated.

5 Knowledge Hub and HERCULES

Authors

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Figure 1 clearly shows the benefit of the Knowledge Hub to an extremely wide range of audiences. This broad spectrum of the Knowledge Hub users will in our opinion only be reached if we (i.e. HERCULES partners) provide an initial "virtual landscape". Populating the Knowledge Hub with data, useful to various audiences, is a Herculean task, but only by synthesising the existing knowledge we will be able to provide additional insights to landscape changes, their drivers, patterns, and outcomes, and become a proper Hub of Knowledge.

Therefore, even before we can present the public with HERCULES results, we should gather the existing knowledge. Users of the Knowledge Hub web GIS platform can import data (Esri shapefiles), and edit it, style it, etc. once it has been imported. For larger or more complex datasets (e.g. datasets covering the whole world, datasets with large number of geometries), users should get in touch with Sinergise and we will import the data ourselves.

We propose that the data HERCULES partners would like to show on the Knowledge Hub is imported to the Knowledge Hub data repository. This will allow us to curate the data if needed, but most of all it will allow for faster viewing and analysing.

The Knowledge Hub deliverable is closely linked to other WPs inside the HERCULES project, as can be seen from the Figure 23. Already in the preparation phase the collaboration with other partners (VU University Amsterdam as part of WP2, University of Freiburg as part of WP6, Forest Communication Network as part of WP7, Conseil Innovation Management et Environment – CIME as part of WP8, European Landowners' Organization as part of WP9, to name just a few) was essential to find prerequisites for the Knowledge Hub and prepare the specifications. If we consider Figure 23 in terms of Knowledge Hub's future, we can distinguish major "data providers" as WPs:

- WP3 – Landscape-scale case studies (short-term history)
- WP4 – Cultural landscapes typology and recent dynamics
- WP5 – Fine- and broad-scale modelling of future landscapes

While:

- WP6 – Visioning for re-coupling social and ecological landscape components
- WP8 – Implementation of good landscape practices on the ground
- WP9 – Design of recommendations for landscape policy and practice, communication, and dissemination

can be identified as first Knowledge Hub public.

In the first phase we would like to get a clearer image about what data HERCULES partners would like to become a part of the Knowledge Hub. Only than we can identify possible shortcomings of the Knowledge Hub in terms of importing data and help with the importing

complex. For the rest of the data we would like the partners to start using the import tool (see section 4.4.8 – Other tools) by themselves. The Knowledge Hub will truly become a living virtual organism when no intervention from Sinergise will be needed.

When the main datasets will be incorporated into the Knowledge Hub, additional functionality will be implemented in collaboration with other WPs:

- WP2 – Studying long-term landscape change
- WP5 – Fine- and broad-scale modelling of future landscapes

The Knowledge Hub will then not be limited to data and feedback gathering, but will also allow making available research analyses (automatic or semi-automatic modelling, supported by change detection, pattern recognition, time series analysis and future dynamics forecasting).

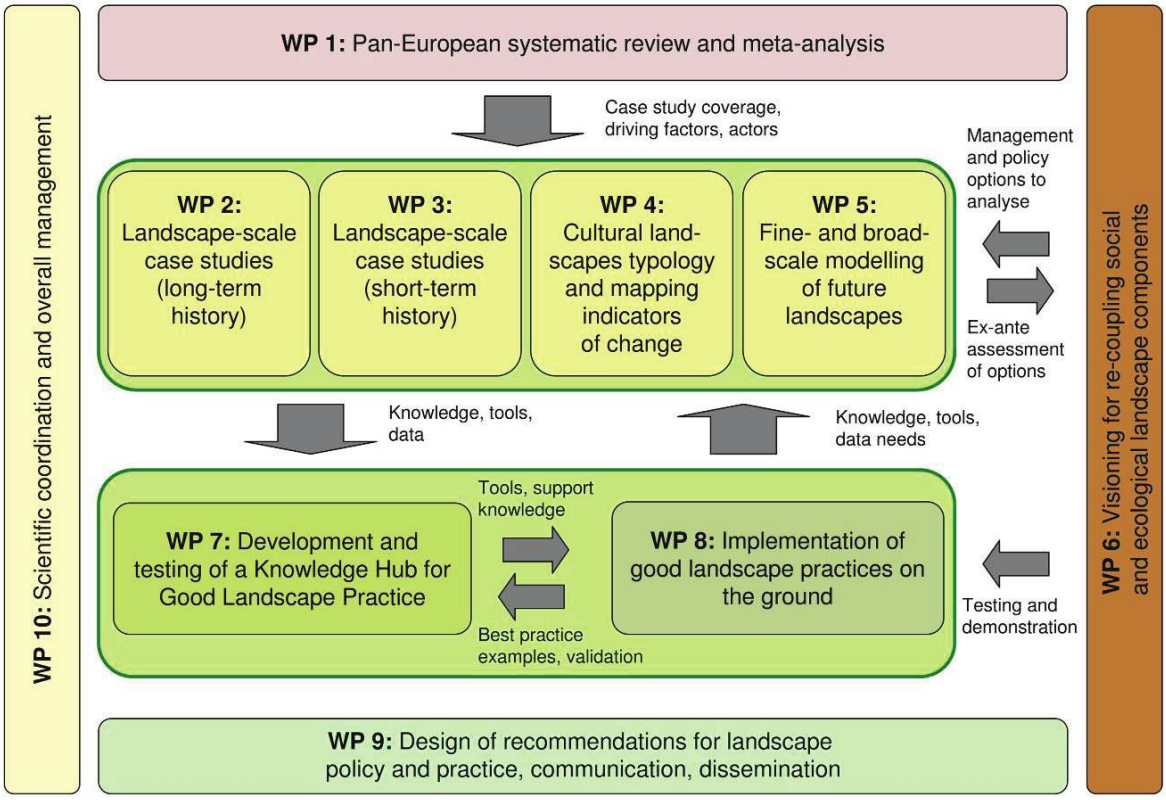

Figure 23: Interdependence of the Knowledge Hub (WP 7) with other WPs within HERCULES project. Image taken from Description of Work (HERCULES project).

For the first time, the HERCULES Knowledge Hub will make a set of sophisticated and highly useful functions accessible to the wider public.

6 Conclusion

We have presented main specifications and implementation details of the Knowledge Hub.

Since the nature of the software is somewhat fluid in sense that it tries to conform to users' expectations, we believe the Knowledge Hub will grow and expand within the timeframe of the HERCULES project as well as afterwards.

We believe that with this deliverable and the prototype smartphone application (deliverable 7.2) we have provided a suitable platform where everybody can participate. Extending the Knowledge Hub into a platform for research analyses (automatic or semi-automatic modelling, supported by change detection, pattern recognition, time series analysis and future dynamics forecasting) is foreseen during the continuation of the project.

Now, as the repository is available, it is of utmost importance to be used by partners – they should fill it with data and present their 'stories' through the platform. Only then will the repository become truly useful.