

CentropeMAP and CentropeSTATISTICS – Cross-Border Geodata Infrastructure with User-Defined Thematic Maps

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1 ABSTRACT

Growing together – together we grow. This is the head note of Centrope, the dynamic cross-border region between the Czech Republic, Slovakia, Hungary and Austria. Cross-border access to standardised spatial data sets is essential for a common development of this region in the near future. CentropeMAP provides an interface for geodata stored in four different countries since 2003 when the project was initiated on behalf of the Eastern Austrian Planning Association PGO, a co-operation of the three Austrian federal provinces Lower Austria, Burgenland and Vienna with a base map of the region created with GIS software. For the first two years data exchange happened only offline, exchanging GIS layers on CD-ROM.



Figure 1: The Centrope Region. Source: <http://centrope.com/>, April 2010.

The CentropeMAP server was set up in the year 2005 and hosts a map server as well as geodata and a map viewing client. Since this time there has been free web access to all CentropeMAP-related datasets. The user receives maps showing data from servers all over the region together in the same view. Recently the extension CentropeSTATISTICS was added, featuring statistic data for the whole region for download and map view. Also the statistical data comes from local authorities and is merged to a single table for the whole region. These tables can be queried, exported, aggregated, and even visualised at the CentropeMAP portal. Twice a year representatives from all partner regions meet to discuss the further development of CentropeMAP and CentropeSTATISTICS. The CentropeMAP applications and files are hosted on a Linux server. All geodata and viewing applications for CentropeMAP and CentropeSTATISTICS use open source software.

2 THE CENTROPEMAP PROJECT

2.1 The Centrope Region

Centrope is a cross-border region consisting of several regions in four countries:

- Austria: federal provinces Burgenland, Lower Austria, and Vienna;
- Czech Republic: South Moravia (Jihomoravsky), South Bohemia (Jihocesky) regions;

- Slovakia: Bratislava (Bratislavsky) and Trnava (Trnavsky) regions;
- Hungary: Győr-Moson-Sopron county.

It was founded officially in 2003 by the Kittsee treaty (Kittsee is a town in Burgenland, Austria) within an Interreg-IIIa project. Since the enlargement of the EU in the year 2004 there are great potentials for integration, collaboration and developing synergies in the border quadrangle. The Central European Region is rapidly growing together and represents an attractive and strong region in economy, labour market, science, research and development, cultural activities, politics and administration, regional development, transportation, and other fields of action.

2.2 Background of CentropeMAP

CentropeMAP was started by PGO, the East Austrian Planning Association (a co-operation of the three Austrian federal provinces Lower Austria, Burgenland and Vienna), in 2003 with a base map of the region. During the first and second years, datasets were exchanged only by snail mail distribution of CD-ROMs among the project partners, but of course there was no way to guarantee that the same datasets were used within the whole region because nobody could make sure the the content of the CD-ROMs was spread to all people being in touch with data of the region.

Print-ready maps were generated and made available for download from the CentropeMAP website which was also launched in 2003. Furthermore, some basic statistic datasets were put together in a download area on the website. While CentropeMAP was in its early development phase, it had already turned out that direct online access to different servers becomes more and more important dealing with cross-border data exchange, providing geodata as web map services and statistical data via online databases. Therefore the CentropeMAP web map server was set up in 2005. It gives access to the current project data store using web map services which are hosted directly on the server, or by the local authorities of the provinces and regions. Most of the local authorities configured separate web map services especially for the use within the CentropeMAP project, some also have existing services on their official administrations' servers which can be used in CentropeMAP.

2.3 Project Status 2010

The CentropeMAP web mapping application (see figure 2) features some hundred different map layers from all parts of the Centrope region. Many fields of interest for spatial planning experts are covered (topic categories according to ISO 19115¹): biota, boundaries, economy, earth cover, elevation, environment, farming, geoscientific information, imagery and base maps, inland waters, planning and cadastre, society, structure, transportation, utilities and communication.

All layers could be turned on and off separately until 2010. However, this structure had a significant disadvantage: To receive information for the whole region from different servers, one separate layer for each server had to be activated. Therefore, in April 2010 a new layer structure was introduced using cascading WMS, which means that data from different servers are buffered at the CentropeMAP server and converted into one single map image which is then delivered to the client. So for each layer now only one single click is needed to retrieve information from all distributed servers. Most of the layers have legend items included; some remotely hosted web map services, however, do not support legend generation. Besides, there is a printing function where PDF documents can easily be created. Two so-called gazetteers help to search for points of interest or municipalities by offering a keyword search joined to the geodatabase. The search results are highlighted in the map when the mouse pointer is placed over a search result. An online dictionary allows the user to add translations of single expressions into one or more of the five languages English, German, Czech, Slovak, and Hungarian.

¹ ISO 19115 "Geographic Information - Metadata" is a standard of the International Organization for Standardization (ISO). It is a component of the series of ISO 191xx standards for Geospatial metadata. ISO 19115 defines how to describe geographical information and associated services, including contents, spatial-temporal purchases, data quality, access and rights to use. The standard defines more than 400 meta data elements, 20 core elements. (Source: http://en.wikipedia.org/wiki/ISO_19115)

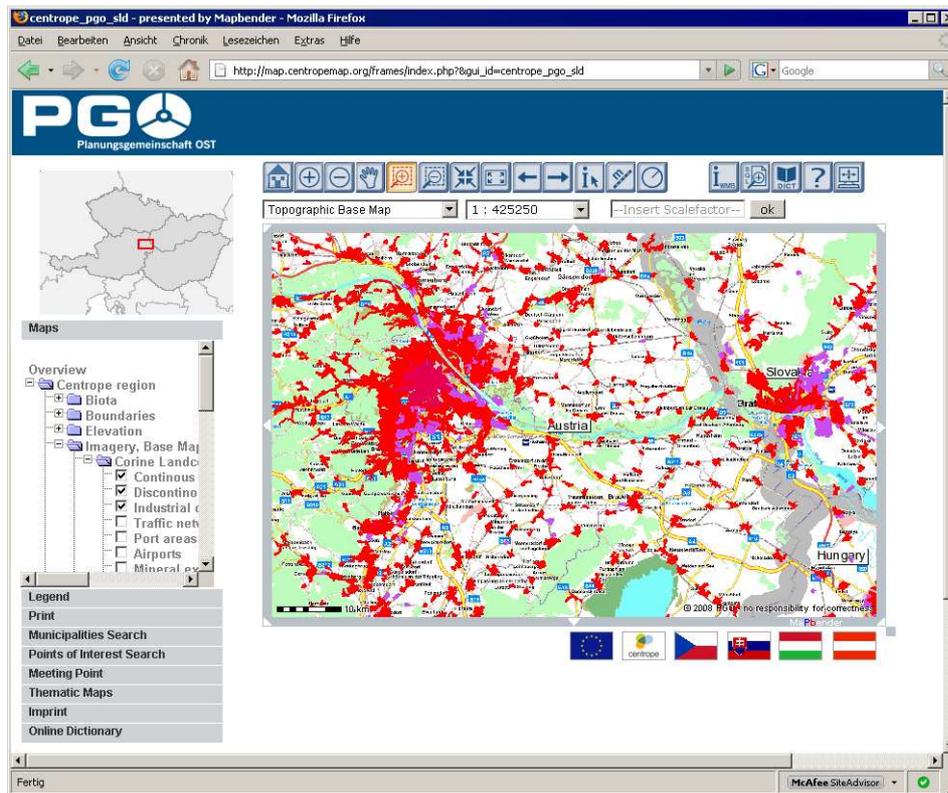


Figure 2: The CentropeMAP web map service client.

The CentropeMAP website (see figure 3) is available in five languages (German, English, Czech, Slovak, Hungarian). It offers information about the region, the project, and also a lot of downloadable material from maps and tables to workshop protocols. Also the CentropeMAP help (“How to Use” guides for CentropeMAP and CentropeSTATISTICS) are offered multilingually. The upgrade of CentropeMAP including CentropeSTATISTICS was on air for testing purposes since the beginning of the year 2009, and it has finally been made available to the public in April 2010. At this time, also the graphic stylesheet of the CentropeMAP website has been improved. Throughout all parts of CentropeMAP grey and blue colours are dominating, which are the code colours of PGO.

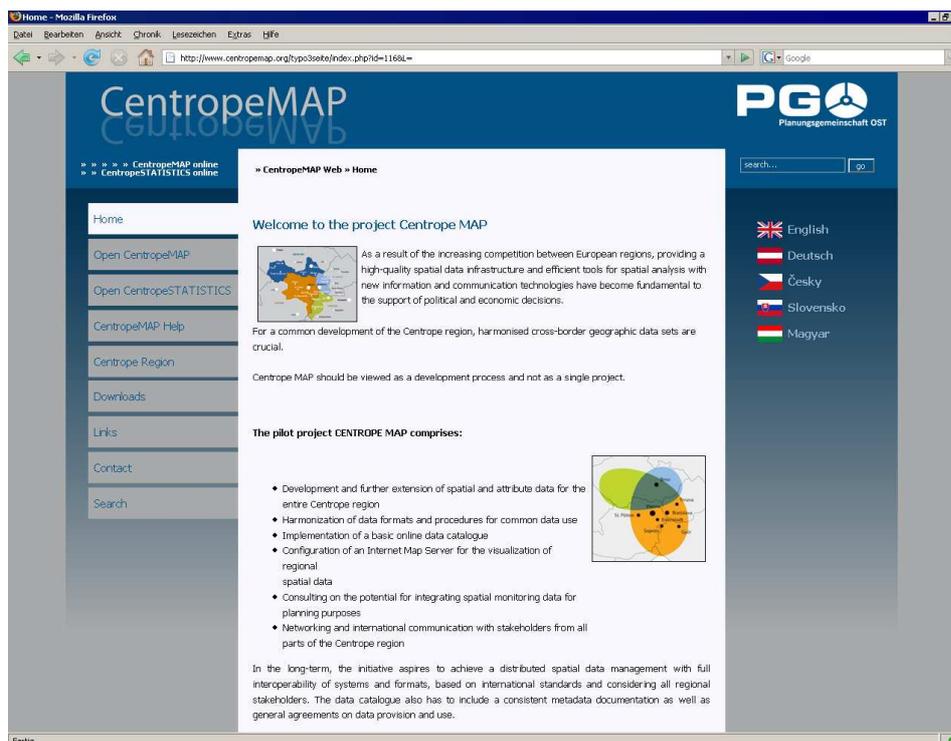


Figure 3: The CentropeMAP website.

3 TECHNICAL IMPLEMENTATION

3.1 Server Hardware, Operating System, Software

The CentropeMAP applications and files are hosted on a Linux server. All geodata and viewing applications for CentropeMAP and CentropeSTATISTICS use open source software, for example UMN Mapserver, Geoserver, PostgreSQL (with PostGIS), Mapbender, Typo3, and some in-house developed PHP and Javascript code.

3.2 System Architecture

The Mapbender map viewing client is the heart of the CentropeMAP system. It gives access to all embedded web map services, manages user access rights and hosts the web interface for map viewing. CentropeMAP uses WMS standards up to 1.1.1 and WFS 1.0.0, WCS are currently not in operation.

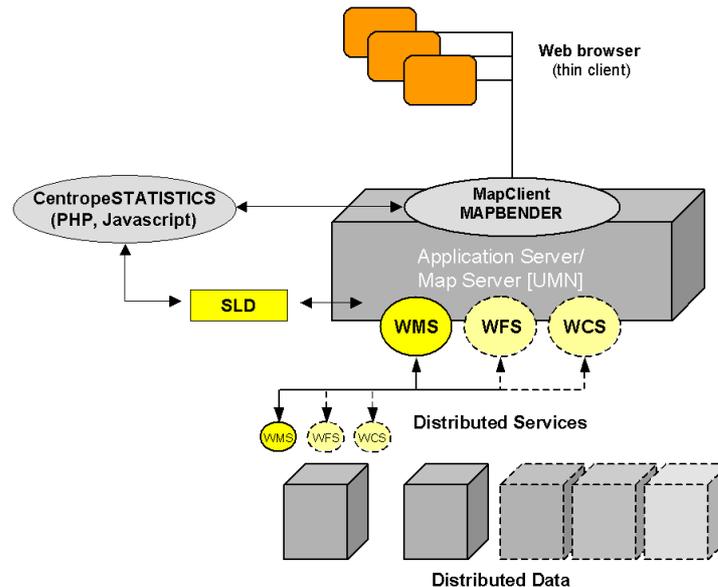


Figure 4: CentropeMAP system architecture.

Mapbender composes the GetMap requests and sends them either to the own map servers (UMN and Geoserver) or to the distributed servers in other parts of the Centrope region. CentropeMAP's own map servers now also use cascading WMS to interact with the other map servers within the region to return only a single image per thematic map layer.

The CentropeSTATISTICS extension is a PHP, SQL and Javascript application interacting with Mapbender. It is developed and kept up to date by CEIT Alanova. Thematic maps are created with Styled Layer Descriptor (SLD²). The statistic data are linked with an XML generator which allows the user to create choroplethic thematic maps on the fly. There are two ways to work with CentropeSTATISTICS:

Basic mode: In the basic mode certain maps are predefined. The user selects a theme (e. g. "Age Group Percentage 2008, 80 years and older") and immediately gets a preview. With just one more click the map is created in the CentropeMAP main window. The basic mode is meant for quick access to frequently queried data and for users who do not often work with statistical data.

Expert mode: In the expert mode the user selects a theme (e. g. "Population Indicators: Age Group Percentage (by year)"). Then the query parameters have to be defined (in our example, you would have to select a year). In the next step the table is shown that contains all data from which thematic maps can be created, and, in addition, also other useful data (in our example, you would find both the absolute and the percentage values of age groups 0 to 14, 15 to 60, 60plus, and 80plus). At this stage the statistic data can also be exported for use outside CentropeMAP in CSV³ format. The user selects the desired column and can then

² SLD is an XML standard defined by the OGC to define the appearance of map layers.

³ CSV is a common file format for moving tabular data between two different computers. Each line in the CSV file corresponds to a row in the table. Within a line the table cells are separated by commas (or, in German speaking countries, by semicolons).

choose the grouping method, the number of classes, and a colour ramp. Again, a preview is shown like in the basic mode, and with one more click the map is transferred to the CentropeMAP main window (see fig. 5).

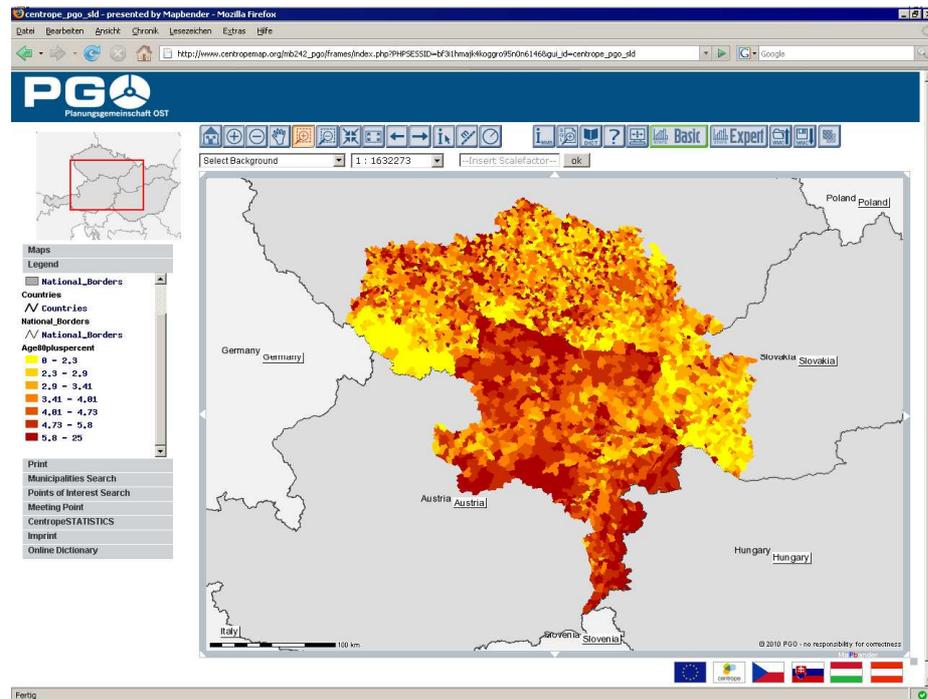


Figure 5: Statistic map created with CentropeSTATISTICS (showing percentage of population aged more than 80).

3.3 Styled Layer Descriptor and Web Map Services

SLD describes the appearance of layers in a web map service when the data are delivered to a client. A map layer has a default style which is defined for standard display. However, this style can be overruled by attaching a SLD document to this layer (as far as the map server supports SLD). In the GetMap request, the SLD code can either be directly added to the URL of the request or it can be saved in a separate file of which the URL is referred to in the GetMap request. This may bring along the advantage that a GetMap request always refers to the same URL, but the SLD file at this URL may be altered by user interaction. Of course, the SLD URL can be anywhere, it need not be stored at the same server as the geodata. It is therefore a great advantage of SLD to customise layers of web map services without influencing the way other users see this layer.

However, only a few map servers which are referred to in CentropeMAP accept GetMap requests containing SLD information. If all servers of the CentropeMAP project partners interpreted SLD documents, there would not be any problems matching the styles of layers from different servers containing the same information. If this can be changed, the cross-border geodata integration in CentropeMAP will make a big step forward.

SLD is also the main technique behind CentropeSTATISTICS: The user-defined maps are created through SLD only. The layer containing the geodata for the statistical map has a pre-defined transparent layout so that it is invisible without any attached SLD document. As soon as the user creates their own map layer from statistic data, their selections are converted into a SLD document on the CentropeMAP server. The map view is refreshed then, containing the SLD URL as part of the GetMap request of the statistics layer. Also a timestamp is added to this request. These timestamp characters are ignored by the mapserver, but Mapbender only reloads a layer when the request string has changed, so the timestamp ensures that every GetMap request is different from the one before, causing the client to load the new map on refresh.

4 OUTLOOK

Nowadays spatial datasets are usually fragmented throughout Europe. Each country has its own geodatabase, not necessarily paying attention to the data situation in neighbouring countries or regions. INSPIRE, the European initiative for a common spatial data infrastructure, is working on standards for cross-border geodata infrastructure in addition to various other policy initiatives. CentropeMAP is not part of the

INSPIRE network, but we try to follow these standards as closely as possible because INSPIRE compliancy is an important basis for future compatibility with similar projects, databases, or networks. CEIT Alanova is also involved in Plan4all , the European Network of Best Practises for Interoperability of Spatial Planning Information, which helps the Centropemap project proponents to act as “mental partners” of INSPIRE and therefore obey the given guidelines.

The goal is to use web map services which are already online for multiple other purposes so that there is no additional effort necessary to feed Centropemap with geodata. The layer styles could be adapted using SLD, if the countries’ servers supported this technique. Twice a year there are meetings with representatives from all partner regions to discuss the further development of Centropemap and Centropestatistics and help to ensure that all efforts are put on a solid, official ground.

Still, an important prospect is the option to emphasise interactivity. From the technical point of view, there is the possibility to let the user draw directly into the map. User-generated content can be stored in the Centropemap geodatabase. There have already been a few Centropemap project spin-offs in the past few years where digitising tools were in use. Of course, if one thinks about extending user rights, user management becomes more important than before. If the digitising tool were open to everyone, everyone would have the possibility to change or delete content generated by others, and the doors would be widely open for spam content or other kinds of abuse. So, from today’s point of view, enhanced interactivity might be restricted to special user groups.