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SELECTED ASPECTS OF CREATING HISTORIOGRAPHICAL MAPS USING GIS

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ABSTRACT

The paper deals with the creation of historical maps in the environment of geographic information systems on example of prepared historical atlas with an interim title Czech Historical Atlas.

At the information age, efforts are being made to move cartographic products into the electronic Internet environment, large atlas works not excluding. The Czech Historical Atlas is a new piece of historical atlas cartography devoted to selected themes of the history of Czech Lands in the twentieth century and was, in accordance with trends of computerization, from the very beginning conceived as partially printed and digital.

In preparatory phases of the atlas, it was necessary to solve the division of topics between the printed and electronic version of the atlas as well as to cope with the preparation of maps for digital distribution and the atlas environment as a whole. As carrying, the Esri platform was chosen – partly using the concept of the Story Maps, partly common map applications. Parts of the content will be supplemented by open-source technologies.

Important points that needed to be solved included the transfer of selected maps existing within ArcGIS and taken from the Academic Atlas of Czech History, which came out only as a printed publication, to the proposed platform, as well as the workflow of creating new maps in order to take advantage of all the electronic environment possibilities. It was necessary to solve difficulties in designing the map key, especially figural elements, together with issues of frequent alterations of frontiers in the environment of Central Europe in the 19th and 20th centuries.

Keywords: atlas cartography, digital map, historiographical map, frontiers, Czech Lands, Czech Historical Atlas

INTRODUCTION

The rich history of the Czech Lands and the wider Central European region has been and continues to be the subject of scientific research by historians, art historians, individual independent researchers and the general public. Significant historical events have been regularly (and with varying degree of accuracy and rightness) captured on maps and in periodical publications where maps were often included.

In the second half of the second millennium, atlases, whose domain was foremost the twentieth century, were increasingly used as a mean of giving evidence of historical events. At the end of the twentieth century, with the development of IT and digital information recording methods, partially electronic atlases, first published on digital

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media (CD-ROMs, etc.), began to grow as stand-alone applications. These were later becoming (due to the onset of the Internet, development of graphical formats and network tools rounded off with cloud solutions) atlases making use of the Internet, web services, JavaScript, HTML5 and other options, either supplemented by printed publications of the same content (or more often with only a sample content) or being released as completely digital. This trend is still in progress even at the time of release of this paper.

The benefits of electronic publications are obvious – they are capable to capture virtually unlimited amount of information, regardless of the number and format of the pages of standard printed publications. They can utilize hypertext space and easily put readers into the necessary contexts by using hyperlinks and a number of additional content. They can be easily used in the field via mobile devices without having to carry bulky publications. Finally yet importantly, they can be easily updated, even free of charge – thus the users have an ever-accurate information available.

On the other hand, electronic publications also have several disadvantages. Above all, it is more difficult to enforce observing the copyright law – texts and images in electronic form are easier to misuse. This is also linked to a more difficult pricing policy for digital products, the preparation of which naturally consumes a comparable amount of finance as for printed products. Another disadvantage may be a platform incompatibility and a number of mutually different formats, protocols and standards that may make it difficult to use the electronic content on different devices.

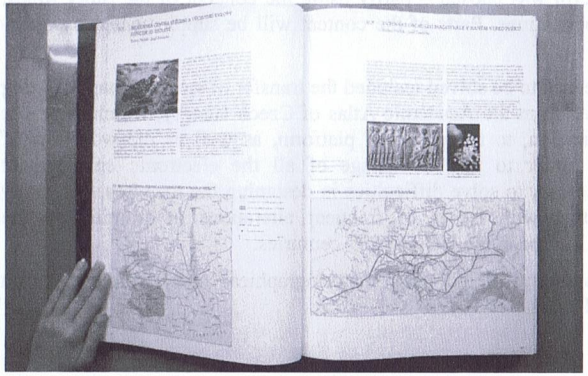

Figure 1. The Academic Atlas of the Czech History

THE ACADEMIC ATLAS OF THE CZECH HISTORY AND ITS SUCCESSOR

The publishing of electronic atlases began at the end of the 1980s [1] and their number was rapidly expanding. The cradle of digital atlases was represented by the USA, but in the 1990s and early 21st century a number of digital atlases were also created in most Western European countries, in Canada, Australia, Japan, Brazil and other countries.

In the Czech environment, the onset of digital technologies in the preparation of atlas works was noticeably slower and the first works originated with more than a decade of delay compared to the world cartography. Probably the last major printed historical atlas

published in the Czech lands was the Academic Atlas of the Czech History (Fig.1) [2], released in 2014. It was most likely also one of the last extensive professional atlas publications that were published as purely printed, without an accompanying digital content. This atlas was also dealt with in [3], and an extensive critical review of it brought the article [4].

A partly successor project, which is, in printed form, mainly focusing on the Czech Lands and the Central European area in the 20th century, is an atlas being created with draft name the Czech Historical Atlas, which was already introduced in [5]. A great innovation of this work is an electronic map portal, which brings a large number of maps originally intended for the Academic Atlas of the Czech History, converted into electronic form, along with dozens of maps newly created based on research of the Institute of History of the Academy of Sciences of the Czech Republic.

Havlíček [5] also presents an electronic database of 20th-century atlas works (Fig. 2), which was used as a research material, from which it is possible to draw rich during the design of both printed and electronic works of the Czech Historical Atlas.

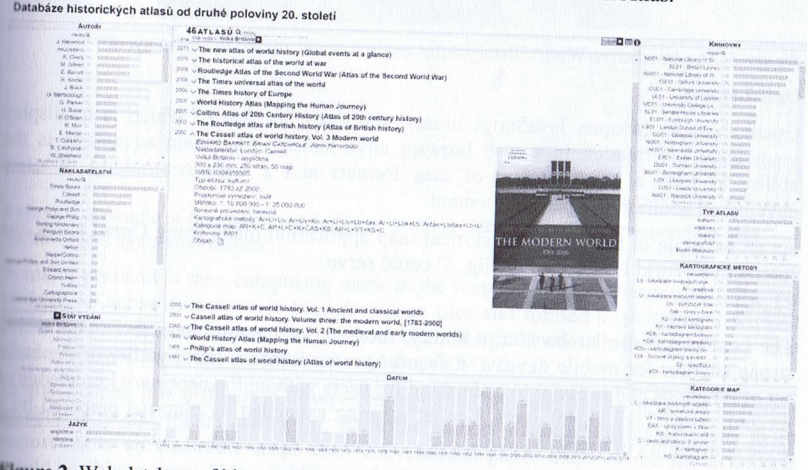

Figure 2. Web database of historical atlases of the second half of 20th century

For example, Bejvančická [6] conducted a search within electronic atlases, revealing that most of the web atlas projects use relatively old and imperfect technologies, and that atlases are generally less interactive than they could be using other methods of their preparation.

AVAILABLE TECHNOLOGIES

Mainly due to the rapid development of Web technology and expanding broadband Internet coverage there was a natural choice to create an electronic historiographical atlas via web map portal, not using quite obsolete and outdated form of electronic stand-alone application. Especially relatively rapidly changing, emerging and fading out technologies have resulted in the fact that it is possible to relatively easy keep going applications created in the web environment thanks to substitution and updating the

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technology used, but this is difficult for once already designed and to the users distributed programme mapping applications.

The following technologies, which represent only a fraction of all those available for the preparation of web cartographic works, were considered in the preparation of the web map portal [7].

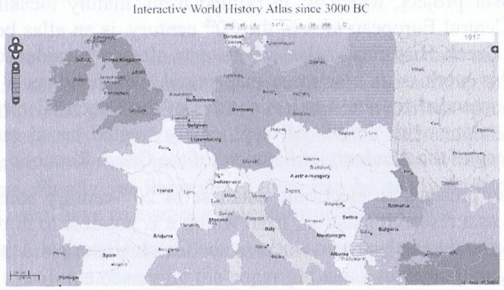

Figure 3. The Interactive World History Atlas environment (written in OpenLayers)

OpenLayers

OpenLayers is an open JavaScript library, the main purpose of which is to display geographic information in a web browser environment. The main advantage is the ability to load a large amount of data formats and a wide community of users developing additional expanding content.

As an example of a well-done historical map application made using OpenLayers, the Interactive World History Atlas (Fig. 3) could serve.

Leaflet

The Leaflet is a similar JavaScript library, focused on creating interactive maps with a strong support for mobile devices. It focuses on the flawless functionality of the basic set of functions and is easier to understand for users without the necessary knowledge of programming. Like OpenLayers, Leaflet is being expanded by plug-ins prepared by a wide community of users.

MapBox

Unlike the previous two, MapBox is a commercial project that focuses apart from the creation of web maps also on the development of its own standards (which also find their use within OpenLayers or the Leaflet). The most important use of MapBox is in the field of vector and raster map tiles.

SVG

The SVG data format generally combines the graphical part with the content of the map or the entire web page. There are a number of web atlases that use the combination of SVG and XSLT transformation as a central technology, where both the maps and the entire servicing application, including graphic elements, form windows etc., are generated from the data files by appropriate transformations.

ESRI PLATFORM AS A PARTIAL SOLUTION

A rather limiting factor in the selection was the fact that major part of the maps intended for the electronic portal had previously been created and cartographically tuned in ArcMap software. For this reason, the possibilities of transferring the current state into the web environment [7] were explored in particular.

As a promising technology, OpenLayers were shown as the basic frame of the application, when the map content is exported from the Esri environment in the form of KML (Fig. 4), rasters are being converted to the tile matrix. MapTiler application was experimentally used to perform this; it is also possible to work with tiles created directly in ArcGIS using web-publishing tools, or else they can be generated using, for example, scripts in Python or VBA by moving the map window and step-by-step saving the current composition to a raster file.

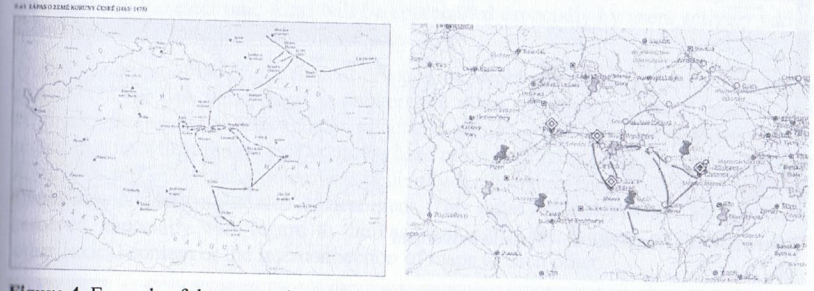

Figure 4. Example of the conversion between ArcMap (left image) and corresponding data within OpenLayers environment

A major problem is then composing maps in the map application environment. Rasters without an active feature were loaded as map tiles and formed a background without interactive elements. Interactive polygon elements, and above all figural and line elements including texts, are then retrieved from KML files.

In many cases, it is difficult to observe cartographic conventions, such as the principle of simplicity and spatial clarity [8], since the authors–historians generally have more requirements on electronic maps than conventional paper maps in the same manner would be able to carry. Very problematic in this respect is the issue of frontiers (more in this case e.g. in [9]), when, on top of that, in the Central European area the frontiers have undergone many changes within a short period of time and it is necessary to represent the selected time levels of the state frontiers in a clear and non-conflicting form.

Apart from platform independence requirements, due to the interconnection of Esri products, it is naturally an easy way to use the ArcGIS Online cloud, or a publication using the ArcGIS Enterprise server. The published data can then be compiled by application builders into ready-made map applications. Unfortunately, the options for setting up these applications are limited, thus they will be used to portray isolated topics within the portal, especially in the form of Esri Story Maps, which are focused on presenting map data with a central linking element of action (a „story"; Fig. 5, 6).

The Story Maps and Esri web mapping applications in general are an intermediary for making easy-to-use applications, where many things can be created automatically and

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for a few clicks with wizards, but many features are not even available in application builders, even though they often represent essential functions, for example, to limit the map window pan. These deficiencies can be resolved by editing source JavaScript files using a compiler, which means an action not for everyone and requires advanced programming skills.

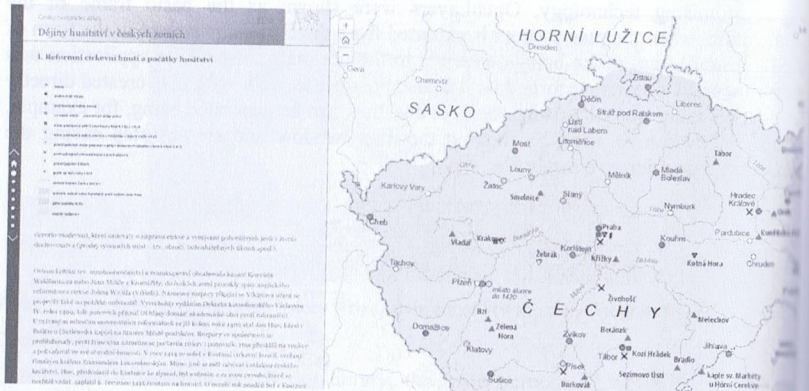

Figure 5. Story Maps layout – Hussite movement

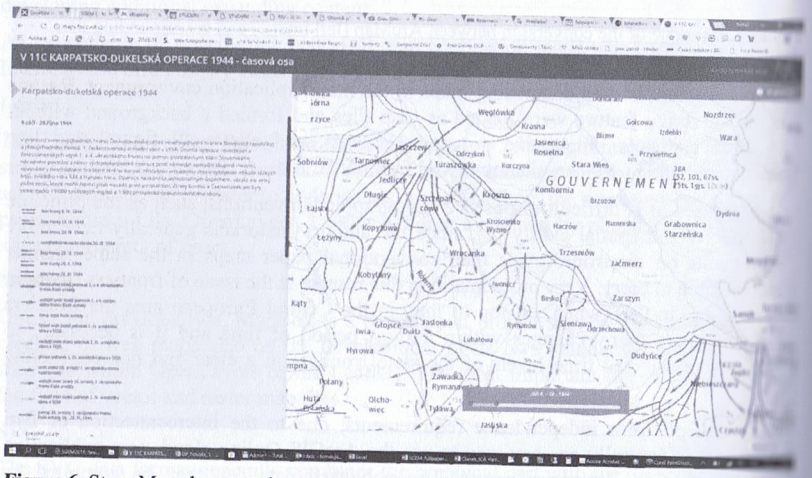

Figure 6. Story Maps layout – the Carpatho-Dukla offensive during the WW2

The final appearance and functionality is not yet fully resolved and finalized, but the use of Story Maps for individual maps or a series of maps with a distinctly dynamic and lexical aspect appears to be nearly certain. In addition, the broad functionality of OpenLayers (furthermore extensively expanded by the community in the form of plug-ins) will find its use as a principal technology not being based on any commercial solution, which was one of the primary intents of the authors.

CONCLUSION

The platform named Czech Historical Atlas introduces the history of the Czech Lands, including the relation to the Central European space, and brings a comprehensive portal summarizing the historical research of the Academy of Sciences of the Czech Republic. Its user-friendly form was lacking within the professional public, but may also be appreciated by ordinary users, to which may help better understand themes previously brought in an isolated manner. In particular, its digital part brings a missing element to the Czech and Central European historiography. It will offer relevant content both to professionals and historians as well as to lay users interested in the history of Czech Lands, while the electronic form will be appreciated especially by users actively taking advantage of the Internet or mobile devices.

At the beginning of the portal content preparation, problems of a dual nature were being solved. On the one hand, how to convert the maps already practically finished and originally intended for print-only publications, which was solved by the use of Esri technology in which these maps could be used more easily, but not with a small amount of difficulty. The second problem was generally the design of maps and, above all, their symbology for use in the web environment. This issue has not yet been satisfactorily resolved, especially with regard to the easy linking of the contents of the maps with other lexical content or the interconnection of maps to each other.

ACKNOWLEDGEMENTS

The research has been financially supported by the grant of the Ministry of Culture of the Czech Republic, NAKI II programme, project No. DG16P02H010.

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SEMI-AUTOMATIC FLOOD DETECTION USING HISTORIC SATELLITE IMAGERY

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ABSTRACT

Worldwide, flooding causes more damage than any other natural hazard. The growing extensive flood risk has a large impact on the present and future economy, especially in developing countries, which have limited funds for prevention and mitigation measures. Moreover, the allocation of these funds is often done without sufficient and adequate information on high-risk and flood-prone areas, since the acquisition of flood data is very expensive as well. Therefore, this research focuses on a low-cost methodology to create the necessary, accurate flood maps in data-sparse regions. In this methodology, historic Sentinel-2A satellite imagery was used to detect water bodies, which in later research will be the basis for detecting flooded areas and creating flood maps. Multiple indexes that combine several bands of the satellite image to enhance the difference between water bodies and land use, were tested to determine which combination gives the best results. Two study areas, one in an urban and one in a rural environment, were chosen and compared since these environments have completely different characteristics, which result in different spectral properties and reflectance values in the satellite images. The indexes that were tested in both study areas are the NDWI (Normalized Difference Water Index), the MNDWI (Modified Normalized Difference Water Index) and the AWEI (Automated Water Extraction Index) for images with shade and without shade. The last index gives the most promising results, for urban areas as well as rural areas. Not only different indexes were tested, but also the threshold value of water per index was determined. The complete methodology was automated in a Python script, so the end user can easily create 2D flood maps without the need of extensive background knowledge. The first results of this tool are very promising in determining water bodies and flood areas. Future research will focus on combining multiple flood maps, generated with open source satellite images, into a flood prediction map that can help developing countries in understanding future flood risk.

Keywords: natural hazard, flooding, NDWI, MNDWI, AWEI

INTRODUCTION

Worldwide, flooding causes more damage and affects more people than any other natural hazard [1], [2]. Between 1980 and 2012, the global damage from flood events was estimated at 2.36 trillion USD [3]. These numbers will further increase due to climate change and the associated growing flood risk, together with socio-economic development in high risk areas.

https://doi.org/10.5593/sgem2018/2.3