Designing Maps for a New Thematic Atlas of the Czech History

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Abstract. Academic atlas of the Czech history summarizes findings of historical research in the Czech lands in an innovative manner and covers the whole range of history from prehistoric era to the present. The work could be processed thank to synthesis of geographic information systems technologies and cartographic visualization with close collaboration of historians and cartographers. The challenge of interpreting various maps with data components representing time, space and theme issues represented the demanding task and in many cases the map layers structure and visualization had to be approached individually. The maps of historical events of the twentieth century are for the first time presented without the impact of communist ideology. The paper presents the complete work including preparation of the sources, their digitizing and vectorization, creation of map key and database model, meetings with historians together with correcting their conceptions about map closer to the cartographic principles as well as other issues of presenting multiple border lines, arrows, exonyms, etc.

Keywords: thematic map, historic atlas, GIS, cartographic visualization, historic map

1. Introduction

The Academic Atlas of the Czech History represents, after a long period of time, a comprehensive cartographic–encyclopedic work that summarizes the current knowledge of historical research in the Czech lands. Partly, this work builds on the highly successful Atlas of the Czechoslovak History published in 1965 (Purš et al. 1965) and some later publications; however, it includes a number of brand new or newly treated chapters. The new atlas work is primarily dedicated to the history related to the Czech lands (the area of the present Czech Republic) and timewise covers the whole history from prehistoric times to the beginning of the XXI century. The content of

the atlas is divided into five main sections describing the important historical periods of development in the Czech Republic: prehistory, medieval age, early modern, top modern times and modern history. The texts of individual sections of chapters are supplemented with maps, which alternate with pictures, illustrations and other elements (tables, graphs, etc.).

The work on the concept of the atlas already begun in 2005 as a part of a research project that arose at the Historical Institute of the Academy of Sciences. After the conceptual phase of work, refinement of the structure and content of the atlas, forming a team of historians and authors of the first test maps with texts (2005–2006), the first version of a manuscript of an atlas of maps including designs and illustrations was subsequently analyzed (2007–2009), in 2010–2011 the manuscript was reviewed by external opponents and negotiations on the issue of financial support for the work took place. With some exceptions, the designed maps were processed in analog form, often in the form of copyright sketches, sometimes only of verbal description of the map content. For processing the resulting maps, which would correspond to the cartographic principles and would be made in print quality, in 2011, a team of cartographers from the Department of Mapping and Cartography (Czech Technical University in Prague – Faculty of Civil Engineering) was approached. The cartographic works started in 2012 and were carried out in collaboration with historians until the beginning of 2013. During the processing, map materials and sources were often updated by the authors. After following editorial work and necessary corrections, publication of the atlas at the Prague Publishing house Academia is expected at the end of 2013.

2. Preparatory Steps for Cartographic Visualization of the Content of Maps

Preparing for the cartographic work included setting basic rules and procedures, in particular choice of cartographic representation, design of basic symbols of the map legend including color scheme, setting principles for geographic nomenclature, and finally design of structures used to store data and software. Basic deliberation related to the map frame and size of individual maps of the atlas with respect to the size of the page of the atlas and its layout was performed by a graphic studio.

The maps were manufactured mainly in ESRI ArcGIS Desktop 10, which has a number of tools for cartographic map creation of a high quality. Also the ability to store map layers in a database is advantageous there. Design of the data structure entailed a File geodatabase for each of the thematic sections of the atlas, processed by the author–cartographer, with the found-

ing of one dataset with relevant feature classes for each map. In a relatively small number of special cases, Adobe Illustrator or OCAD cartographic software have been used.

For visualization of the map layers the Albers equal conic equivalent projection was chosen. The choice of base meridian and undistorted parallels depended on the geographical scope of the displayed area. For frequently occurring cutout of the Czech Republic at a scale of 1 : 2 million were chosen parallels 45° and 55° N along the central meridian of 16° E; for some maps (especially large-scale), other views or their modifications (e.g. rotation) were selected. The atlas creators do not anticipate any cartometric or other geometric analyses over the content of maps of the atlas; the viewpoint of minimizing distortion in the maps may not therefore be decisive for the choice of cartographic projection.

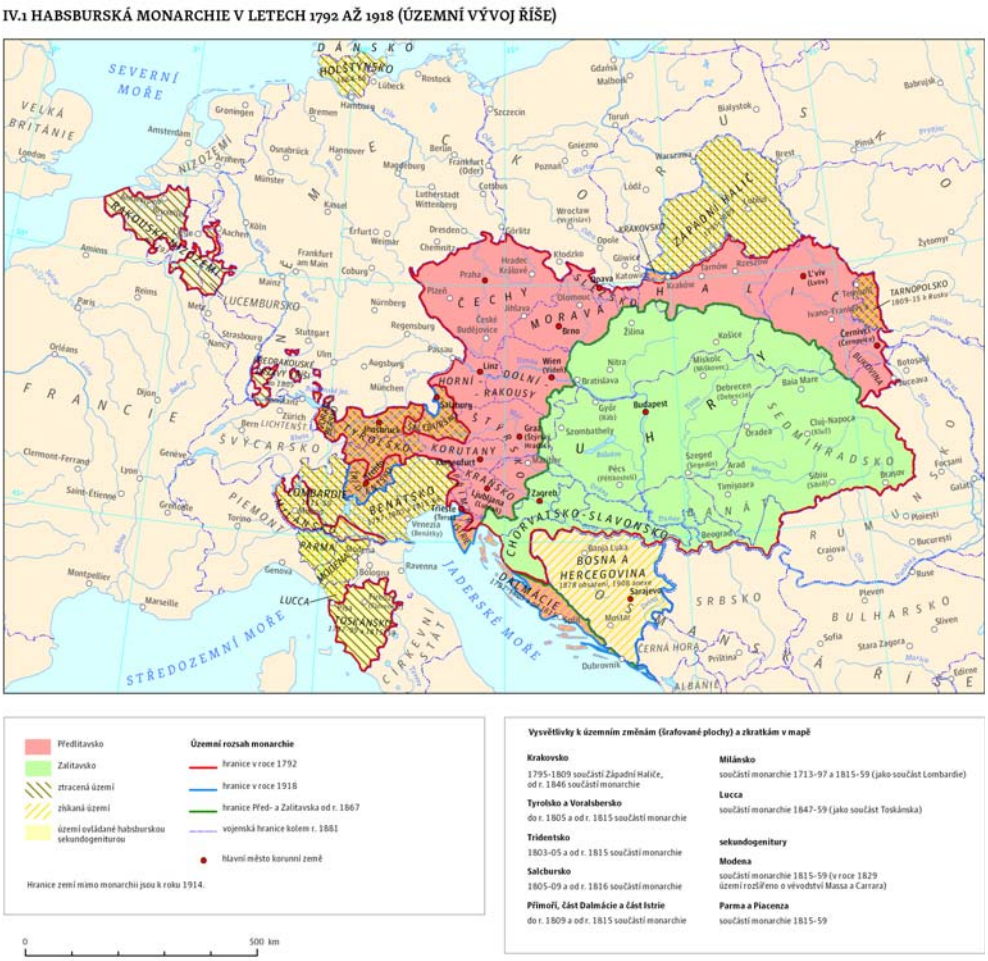

Figure 1. Example of a small-scale map.

An interesting but difficult task was to design the list of symbols. The atlas contains more than 350 maps of diverse content; in many cases the historical map layers were updated during the map creation by initiative of authors–historians or supplemented by other elements. Due to that the creation of a complete list of symbols was not real at the beginning of the cartographic work, and to strive for it would not be even effective. Therefore a basic style for creating maps was designed, which defined commonly used cartographic features: symbols for area elements (color hypsometry, water bodies, color thematic elements – such as areas of countries), linear elements (various kinds of borders, hydrography, geographical grid, communications, thematic line elements – such as military campaigns) and point features (settlements, themed spot features – e.g. significant castles). The colors were chosen on the basis of general cartographic rules (Brewer 2005, Voženílek 2005). A separate color sequence was designed for hypsometry when individual level of elevation is represented by little saturated hues. Several color scales were created for use in maps such as choropleth or diagram maps. The CMYK color solution was consulted with a graphic studio providing the overall graphic design of the atlas, composition of pages, and resulting print. Designed map key (Fig. 2) was the basis for the visualization of maps, other map signs have been completed by thematic authors–cartographers during the progress of the work according to the nature of the processed content of the individual maps.

Figure 2. Part of the designed map key.

General rules for labelling of the map elements based on a choice of two basic fonts designed by the graphic studio: sans-serif Guardian Agate Sans was used for the labelling of displayed anthropogenic objects (e.g. towns, administrative areas), serif Skolar for natural objects (e.g. hydrology, mountains). The Czech names are used for description of territories; the labels for settlements are always assigned to the current official name in the language of the country, supplemented, where appropriate, by a period name belonging to the display of historical events, such as Zlín (Gottwaldov), Chemnitz (Karl-Marx-Stadt), Karviná (Fryštát). Methodically, a serious point which had to be addressed at the global level, even taking into account the specifics of individual maps, is represented by exonyms. Given the cultural–historical importance of exonyms, the names of settlements related to the topic of the maps may be supplemented by Czech doublets in brackets, such as Dresden (Drážďany), Graz (Štýrský Hradec), Venezia (Benátky); exceptionally by doublets in a foreign language. As the source of valid data, there was the United Nations' database of geographic names and the Czech exonym index (Beránek et al. 2006).

Due to the differences in the range of displayed area (Europe, Central Europe, the Czech Republic, regions or otherwise selected minor historical sites) and requirements for the level of detail, it was not possible to determine in advance the resulting dimension of the maps or keep a single dimensional variety of the maps. The scope of work processed and diverse character and quality of the material supplied did not allow pre-creating a template for the final layout of the pages of the atlas, according to the principles recommended in atlas cartography (Voženílek 2005). From the A3 format, however, the final determination of the maximum possible width of maps of 265 mm proceeded as well as recommendation as far as possible to use several sizes for map fields as much as possible in order to maintain a uniform graphic design throughout the atlas.

3. Cartographic Work on Historical Maps

3.1. Data

The basis for the work of cartographers were the reconstruction maps processed for the purposes of the atlas by historians, as well as various maps, sketches and illustrations created earlier. Only in rare cases electronic data were available, of which the mapping could partly be based on. All the analog resources were converted by scanning into digital form and in the form of georeferenced raster files were used in the cartographic processing of historical maps. Generally used elements recurring in a large number of

maps (altimetry, geographical grid, water streams and bodies) were stored in a separate reference dataset.

The creation of a data model in ArcGIS consisted in the creation of feature classes in the dataset of each map. The data of all maps were created either by direct vectorization primarily of thematic layers of historical content from raster background, or by importing vector data from the reference dataset (e.g. hydrography, current border lines). Reference data layers were created primarily from publicly available sources of geographic data, but with careful check-up and possible modification of data – such as Natural Earth (hydrography) or EuroStat (current borders, towns etc.). An important aspect of the work was connection of appropriate attributes to facilitate correct production of maps depicting different periods of time (e.g. year of founding of water dams). For a digital terrain model which later served to visualize shading and color hypsometry, data from available sources (SRTM30, CleanTOPO) were used. Generally usable reference data have been stored in two variants with different level of generalization, usable in smaller details for Europe or in larger scales for Central Europe, or

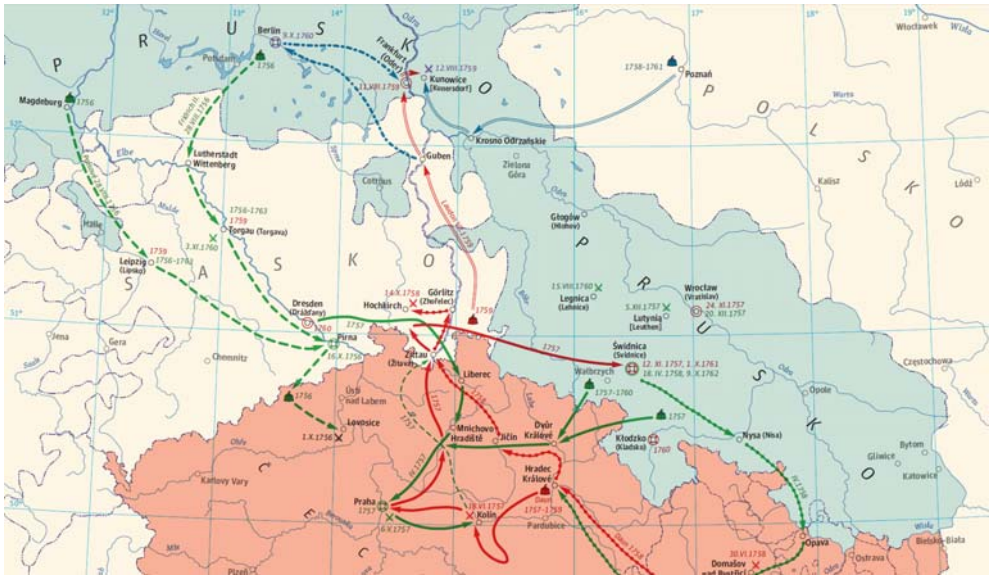

Figure 3. Section of a map with more complex content.

the Czech Republic. The data model allows easy tracking of data of individual maps, to share layers between maps and, after its completion, it represents a valuable data base usable both for adding additional content to the maps and for creation of any other similarly oriented cartographic outputs.

3.2. Visualization

The visualization of data layers consisted primarily in application of the general map key. In some thematic layers (especially point ones) it was necessary to create a new cartographic symbolization during the work. The color solution of thematic elements was in case of need tailored to the specific content of the map or set of thematically related maps.

For the representation of thematic elements using point features mostly basic geometric shapes were used, but a number of intuitive pictograms was also created (e.g. castles, battlefields, machine– and woodworking industry, declaration of independence, seat of ecclesiastical administration, etc.). Pictogram symbols were created in the form of a special cartographic font and could then be shared and used in different sections of the atlas (Fig. 4).

Solution to symbology of linear elements was very complicated in some cases. In a large number of maps it was necessary to show different types of boundary, identification and movement related lines in addition to the different time phases of the historical events displayed. Among the most elaborate in this respect belong the maps showing battles of WW2, where it was necessary to distinguish the lines/arrows symbolizing the movement of combat units with regard to various attributes such as affiliation of units with the fighting parties of the conflict, the type of movement of combat units (attack, advance, transfer, retreat, withdrawal), its intensity (attack major, minor, undifferentiated), a type hierarchy of units (army, brigade, division, group), military units by type of weapons (air forces, tanks etc.), a time period of the war. The resulting solution combines morphological changes in the properties of line characters – size (width) of structure, hue (color) – with variants of line end symbol (arrowhead single or double), placing symbols within lines, and additional text or abbreviation (Fig. 5).

Figure 4. Designed font used for point symbols.

Defining the range of area elements in the maps were solved by colors according to the list of symbols; hatch areas were used for overlapping areas. For states, hypsometry with shading or color fill with shading was used; in maps of larger scales (approx. 1 : 500,000 and more), the relief does not appear at all, and if it does, then by more significant elevation dimensions only.

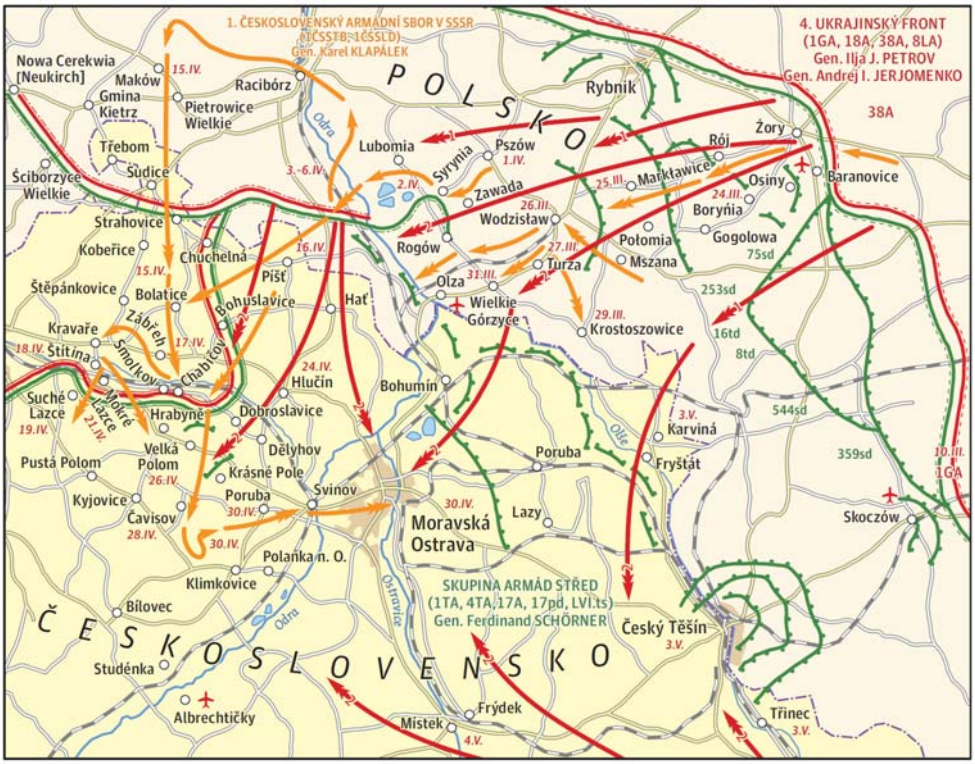

Figure 5. Section of fights of the World War II.

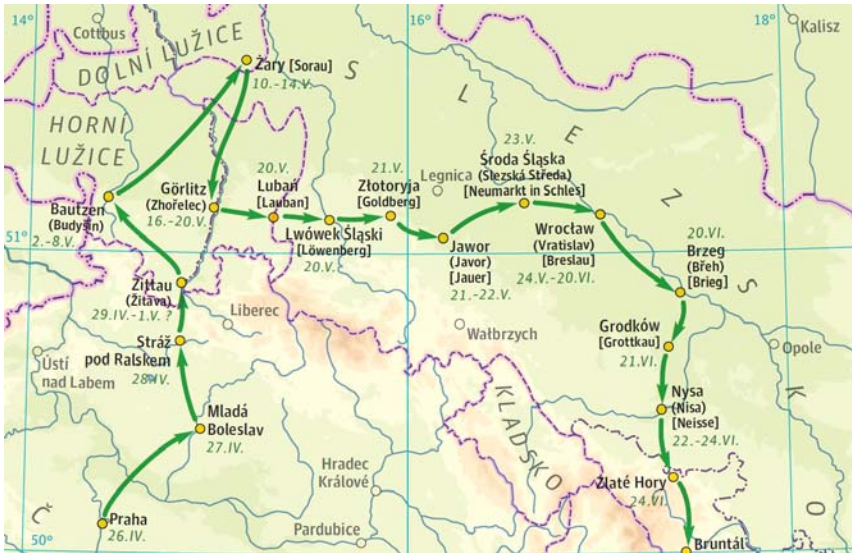

Figure 6. Illustration of the solution to multiple sorts of exonyms.

The largest share of the work on visualization was creation of labels that were generated directly from the attribute tables of particular feature classes, with the addition of potential exonyms or contemporary names (Fig. 6). Most of the labels (in particular settlements) in ArcGIS were generated parallel to the geographical grid; a lot of manual work, however, required modification of thematic texts.

Due to the large number of heterogeneous maps, a wide group of historians (several dozens of authors) and their individual notions about the presentation of maps it was not possible to fully comply with consistent symbology throughout the atlas. Any deviations are always explained in the particular map legend. From a technical perspective, the visualization was performed by standard symbolizing methods of ArcGIS, without cartographic representations, whose use would require more time to prepare, which, unfortunately, was not available.

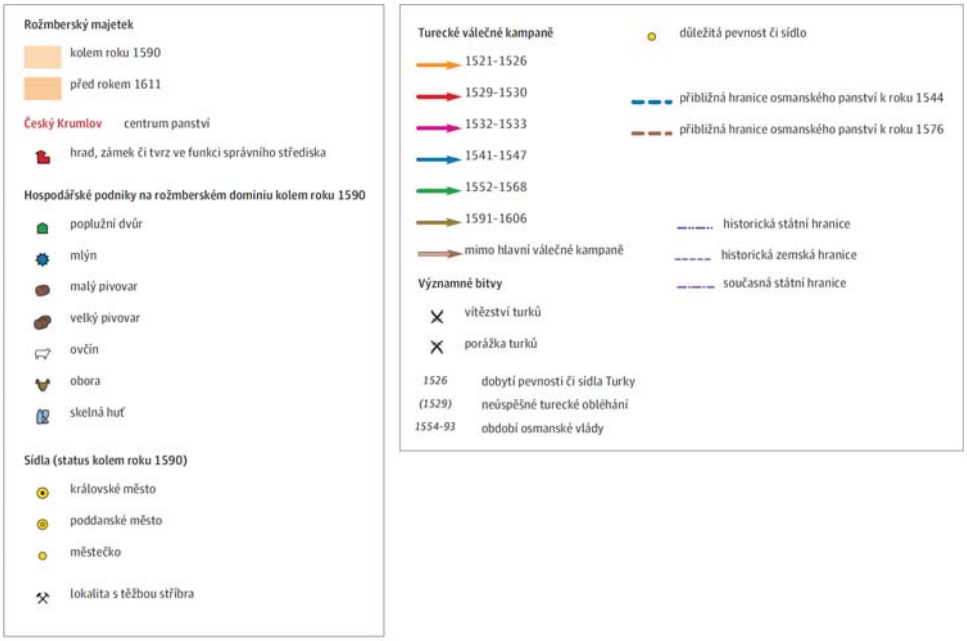

Figure 7. Examples of map legends.

3.3. Map Composition and Exports

The Academic Atlas of Czech history will contain one main legend explaining the general symbols used across all the maps of the atlas, especially general geographical and topographical elements. There will also be local legends attached to individual maps and clarifying specific thematic elements used in the map. In most cases, the legend is placed outside the map frame, with the addition of simple graphic scale and potential other infor-

mation relating to the contents of the map (Fig. 7). Small-scale maps are plotted with geographical grid, in medium and large scale maps the grid is absent but the north arrow is added.

For DTP preparation, the maps have to be processed in a suitable data format for export. Several types of exports – to PDF with a resolution of 1200 dpi or EPS of 300 dpi were made depending on predominant content of the map. Maps with shaded relief could not be directly exported from ArcGIS as the entire contents at once, because it would prevent proper multiple layers blending and the desired color of elements under the shadow layer would not be properly maintained. Therefore the export took place using separate layers. The bottom layer represents area elements or border edgings, the second layer was shaded relief, and the top layer contained point and line elements along with descriptions. The graphical studio then merged the export layers and layers of shadow with appropriate transparency.

4. Conclusion

Cartographic work on the large Academic Atlas of the Czech History included a series of time-consuming and technically demanding activities. Due to the fact that the point is a historical atlas, the map making is very specific and substantially different from thematic atlas works, containing mainly cartographic presentations of statistical data, as well as from conventional atlases or world regions. The maps have to show not only the physico-geographical or general topographic content layers relative to the specific historical period, but, as a matter of course historical events or situation, often with links to the present state of the region. Thematic elements may then vary in multiple attributes reflecting the quality, quantity and time classification of the displayed phenomena, which should be appropriately cartographically visualized.

Close cooperation with historians in the case of the creation of historical maps is essential. Experts in history as the authors of the content side of the map pages are responsible for their factual accuracy. Their efforts include the proper, detailed and comprehensive historical content to the map can sometimes be in conflict with what is real to display in the map of a defined size and scale while respecting the principles of cartography. The use of GIS technology with appropriate tools for cartographic visualization may certainly be recommended; also very important is coordination of appropriate procedures with graphic studio providing professional print of the publication. For the team of cartographers, the creation of historical maps for the historical atlas posed a valuable experience, which would be possible to further develop in the future.

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