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ORIGINAL PAPER

Visualising administrative division dynamics: transformation of borders and names in the Bohemian-Saxonian borderland

Martin Bartůněk[1] ✉ — Jan D. Bláha[1]

[1] Department of Geography, Faculty of Science, J. E. Purkyně University, Ústí nad Labem, Czechia
✉ *martin.bartunek@ujep.cz*

Abstract

Regions are main building blocks of larger territorial units, but they also display high dynamics affecting how regional identities can be studied. The regional dynamics and multilayered nature ultimately require new approaches to their visual representation. The goal of this article is to present a novel approach to visual presentation of the administrative regions' dynamics by cartographic means of representation in a synthetic map that can assist in the research of regional identities. We adopt the theory of the institutionalisation of regions, the administrative division of the state is a process in which the borders and names of regions are constantly transformed causing changes in the perception of the population. Then we analyse the laws on administrative division reforms and old/historical map documents. This enabled us to identify the dynamics of individual borders and names of administrative regions (choronyms) that form spaces with a higher or lower degree of stability. We propose a visualisation approach to represent such dynamics, and we assert that through cartographic visualisation of the degree of transformation in these spaces it is possible to get an insight into population's awareness about the named regions and their delimitation.

Keywords

Administrative region,
Perceptual/vernacular region,
Regional dynamics,
Border,
Cartographic representation

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Highlights for public administration, management and planning:

- The people's regional identity (the relationship to the territory) supports regional development.
- The names of regions are one part of the formation of regional identity, which is important for the development of the territory.
- Perceptual/vernacular regions may or must not correspond to planning/administrative regions.

1 Introduction

One of the mottos of today's European Union (hereafter referred to as EU) is unity in diversity. Diversity then means an effort to support the cultural specifics of the population, which are reflected in a continuous space in terms of regions (e.g. EU 2000, 2007). Determining the people's regional identity of some place is then a very common topic of research by geographers and one of the research approaches is exploring perceptual/vernacular regions. In the spirit of the new regional geography, this article also focuses on this aspect, where an effort is to connect the dynamic nature of regions with cartographic representation. Cartographic representations of perceptual/vernacular regions on a map have been addressed by many authors, with an emphasis on the boundaries of one region (e. g. Brownell 1960; Siwek & Kaňok 2000; Semian 2012a; Konopski 2021) or on determining the boundary between two territorial units (e.g. Šerý & Šimáček 2013; Marek 2020). The nature of the data in this study is different, but instead focuses on space rather than individual regions, where many unknown regions can be considered.

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Attention in this study is devoted to one of the specific types of regions, to administrative regions, especially to their borders and names of regions, respectively their dynamics. It can be argued on the basis of the theory of the institutionalisation of regions (Paasi 1986) that even this type of region can be reproduced in perceptual/vernacular regions. There are many reasons for this statement. The first one is that administrative regions contain borders, which are visible in space or on the map. Administrative regions are named, so that even residents of more distant regions within the state can have awareness, for example through the media, literature. The last reason is related to the division of the state itself and the transfer of competencies to a lower level, so institutions are bound to this region.

In the former Eastern Bloc, administrative divisions have changed very often in each state (Jordan 2001) and this can lead to changes in the perception of regions in different generations (Marek 2022). Many scholars from this part of Europe have addressed this aspect and analysed this development in their studies (Jordan 2001; Yoder 2003; Chromý et al. 2009; Otiman et al. 2013; Šerý & Šimáček 2013; Burda 2016; Janicki 2020). However, a synthetic view focusing on the (in)stability of the borders and names of regions in space and their cartographic representation has not yet emerged.

Creating a synthetic map that addresses the dynamics of borders and names of regions can be an initial phase of research to gain insight into a research area where individual (perceptual/vernacular) regions are unknown. Indeed, visualisation using a synthetic map, i.e. using a cartographic representation of possible perceptual/vernacular regions, offers a more illustrative tool for provide clues for formulating hypothesis before the actual investigation (which is further discussed based on the research area) by other research methods (e.g. a questionnaire). In a follow-up phase of research dedicated to collection data on perceptual/vernacular regions, the synthetic map can be further used to focus on spaces with different characteristics e.g. where "schizophrenic regions" (Marek 2022) can be expected due to unstable development. This article thus fills a gap in the research of people's regional identity using a synthetic map.

This study concerns several aspects of administrative regions which are followed by these research questions: What spaces are created by changes in administrative division and where are they located in the research area? What graphic means and their variables can be used in a map to visualise (in)stability? What variables in territorial and symbolic shape can be observed through a synthetic map (on the Bohemian side and what on the Saxonian side if there will be a relationship of inhabitants to administrative regions)?

This will be achieved on the basis of research of documents and maps about the development of the administrative division over the last 70 years and a comparative analysis of the borders and names of the regions of part of Bohemia in Czechia and part of Saxony in Germany.

The structure of this article starts with the concept of the (administrative) region in relation to perceptual/vernacular region, people's regional identity and cartographic representation with focus on border and name of the region (Section 2), then the process of data collection and the process and methods used for cartographic representation of (in)stability based on the research site is presented (Section 3). The next part presents the results with regard to the differences and similarities in the development of the administrative division on the Bohemian and Saxonian side and at the same time three model areas discussing possible perceptual/vernacular regions through synthetic map (Section 4). The last part of the article (Section 5) focusses on a discussion of the results and the final evaluation.

2 Theoretical background

The region was always a key object for geographers since the foundation of their field (Kostbade 1968), but the understanding of the concept of region changed through time due to its philosophic-paradigmatic background, which is the main principle of scientific knowledge (Kuhn 1970). However, it is important to keep in mind that these shifts are interrelated, and it is not proper to distinguish the concept of region before and after the paradigm shift. The shift then means a change in the epistemology of the region's concept and methods of exploration, which are current and only dominant in regional studies, meaning that different concepts of the region can still be encountered not only in scientific articles (Matoušek & Osman 2014). Based on these shifts, regional geography underwent a development where it had a different position within the system of science, when it was considered to be the heart of geography (Holmén 1995), but also irrelevant and not exact (Schaeffer 1953). The detailed evolution of thoughts in regional geography and concepts of the region is dealt with in many studies (e.g. Guelke 1977; Claval 2007; Paasi 2009a; Kasala & Šifta 2017), which is related to the development of geography itself. In these

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studies, three fundamental shifts can be recognised (classical – modern – spatial science – postmodern) in the understanding of the region and the directions in regional studies within the field of geography. The focus of this article is on the regions and their visualisation with a very narrow focus, and therefore it is appropriate to outline at least a short timeline of the development of the concept of the region and the approach to its study relevant for this article.

The first shift from classical to modern geography can be dated to the end of the nineteenth century when several great regional geographers adopted different approaches on how to look at regions and how to study them (Paasi 2009a). Primarily, there were works on natural and cultural similarities and differences, where the focus was especially on the environment – Ratzel's determinism, or culture – Vidal's possibilism. The region is later studied in both perspectives and regions should contain an analysis of nature and an analysis of culture with the perspectives of time and change – Sauer's morphology (Sauer 1925), with a focus on their uniqueness – Hartshorne's chorology (Hartshorne 1939). This first phase of modern geography can be dated to the middle of the twentieth century, which was essentially a descriptive form of regional studies. This traditional approach to the study of the region is still current and very widely used as more usable, for example, in regional planning (Kasala & Šifta 2017) or in education (Daněk 2020), but criticised for its lack of scientific approaches (Sýkora 2008).

The radical shift in the paradigm and methodological nature of geographical research comes with the post-war development and the arrival of the quantitative revolution. In the spirit of spatial turn, geographers start to move away from regions to spatial structures and systematic geography is starting to be more relevant and regional geography remains lagging behind for spatial scientists (Daněk 2013). That was caused by the introduction of Schaefer's morphology (1953), in which he suggests that geographical research should move away from gathering information to a more scientific (nomothetic) approach. This means creating theories and laws in space (Sýkora 2008) based on quantitative data and statistical evaluation techniques that are objective and can present the future development of regions. In the 1950s and 1960s, methodological articles in the spirit of positivism continue to accumulate, but they lack deeper epistemology in research. David Harvey's book Explanation in Geography (1969), which gave geography as a spatial science a clearer theoretical boundary, was important in this regard. Recent regional studies with the development of GIS are still very relevant in regional research (Kitchin 2006). However, geographical space cannot be understood in depth without mechanisms and transformations just on the basis of statistical analysis alone, which is why in the 1970s this approach has begun to be criticised for moving away from society and overlooking its subjective factors (Matlovič & Matlovičová 2015). Regional geography is once again coming to the forefront of researchers' interest with the advent of the cultural turn in geography on social and symbolic aspects (Odehnal & Šerý 2012) and the adaptation of social theories on the bases of increasing globalisation (Semian 2016). Until then, the region was considered to be given and static (Chromý 2003) and primarily an object of study (Kasala & Šifta 2017). However, on the basis of Hagestrand's time and Giddens' theory of structuration (Claval 2007), the region also becomes a subject of study and is considered to be a dynamic process (Paasi 2009b). Gilbert (1988) identified three main directions in the study of new approaches to the region, and this whole package can be described as the so-called New Regional Geography, in which consciousness and identity are one of the main interests. Among the most cited theories in the conceptualisation of the region is A. Paasi's (1986) theory of institutionalisation, who defines the origin and process of a region and is analytically divided into four stages: (1) the emergence of a territorial shape (borders); (2) the emergence of a symbolic form (name); (3) the emergence of institutions and (4) part of a regional system and the emergence of regional identity.

The basis for this research is the theory of institutionalisation focusing on borders, the name of the region and regional identity. The last-mentioned concept should become part of regional development (Raagmaa 2001; Paasi 2013; Semian & Chromý 2014) and one of the possibilities of its study is a visualisation on the basis of an analysis of the spatial-historical development of the administrative division of the state.

2.1 Administrative and perceptual/ vernacular regions

Changes in the concept of the region also produce different types of regions, which are dominantly studied and regionalised. In his taxonomy, Hartshorne (1959) distinguished formal, functional, and general regions and this taxonomy is quite similar in the following studies to the present day. In traditional regional geography, the interest is mainly in formal regions which have some

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uniformity in one or more characteristics (Montello 2003). Geography as a spatial science introduces functional, or nodal regions based on horizontal flows and interactions in space (Klapka et al. 2013). In postmodern geography, the region is understood as a social construct and a third main type of region is defined as the perceptual/vernacular region, which are in a population's mind (Jordan 1978). In this main division of regions, the administrative region is not directly mentioned and since this article is about administrative regions, an important question is what the administrative region is and in what category it falls into.

Today, the administrative region is already a traditional part of individual states where economic and social development is implemented. The character of these regions is that they acquire hierarchies (municipality, district, province, state) where a certain decision-making competence is transferred by the state with precisely defined spatial units in the term of borders (Krishan 1988). Administrative division is related to the size of the state, but factors such as (geo)political issues – new European regionalism versus old regionalism in the Eastern Bloc – also enter into delimitation of borders (Jordan 2001; Semian & Chromý 2014). Their delimitation should take into account three main principles – spatial efficiency, spatial equity, and spatial stability (Klapka et al. 2016). However, regions (just as administrative ones) are a process with some dynamics (Paasi 2011) and administrative divisions cannot take into account changes in a population's spatial behaviour.

Administrative regions are included among formal regions, but as Montello (2003) suggests, they are specific in many ways and should be in their own category. They are defined and constructed on the basis of rules such as the spatial behaviour of individuals (functional regions) and other criteria (typical for formal regions) such as the distribution of natural phenomena, historical boundaries and cultural groups (Klapka et al. 2016). Administrative regions are delimited, named and institutionalised so they will also be perceived by the population – the perceptual/vernacular region (Jordan 2001). However, the administrative division is valid for some period of time and with a reform of the administrative division, in some cases (such as our research area) through the delimitation of borders and the name of the administrative unit, the population's perception and place identity can change (Konopski 2021).

The concept of people's regional/place identity as a shared belonging and identification to "my" region/place is described in many works (e.g. Relph 1976; Chromý 2003; Paasi 2003, 2009c; Zimmerbauer 2011; Semian & Chromý 2014; Peng et al. 2020) and one of the aspects is that people's regional identity is changing and evolving just like regions. In the process of creating and transforming people's regional identity, components in terms of borders and names of regions are involved (among others), even for administrative regions which are institutionalised units (Paasi 1986).

Formation of people's regional identity may occur through the name of the region (Chromý 2003; Semian 2012b) as a symbolic shape of the region (Paasi 1986), which in the case of an administrative region is often reflected by the centre of a nodal region (functional region) or the name of a natural/cultural region (formal region). The concept of borders is reflected in the new regional geography as a social construct, and interest is focused on the creation, transformation and extinction of borders (Chromý 2003) and reflection in regional consciousness (Paasi 2009a). Although the administrative borders are clearly visible lines, either in maps or in space in the form of signs, borders in new regional geography are no longer seen as static lines, but rather as a part of a process in the social, political and economic space (Agnew 2008). In addition, the term "border" is more frequently replaced by terms like boundary, frontier (Paasi 2009d), liquid borders (Lange & Pires 2015), porous border, hard and soft places (Zimmerbauer & Paasi 2020) or fuzzy borders (Semian 2015) and fuzzy zones (Leung 1987) in the idea of people's regional identity. It is valid for administrative regions as well, because it is related to administrative division reforms in individual states in recent history. Indeed, by changing the administrative division and institutionalisation of the regions, some regions may disappear, arise or transform due to changes in the management of borders and names of the region, which is related to many tendencies, such as social, economic, cultural and (geo)political ones. These changes in administrative regions (objective regions) are subsequently reflected in the cognitive map of inhabitants of different generations and their perceptual/vernacular regions (subjective regions) (Bláha & Nováček 2016; Marek 2022). Thus, the study of the evolution of administrative regions should also be associated with research on perceptual/vernacular regions across different generations also taking into account that administrative regions are primarily created from above by government and may not coincide with the perception of the population (Antonsich 2010).

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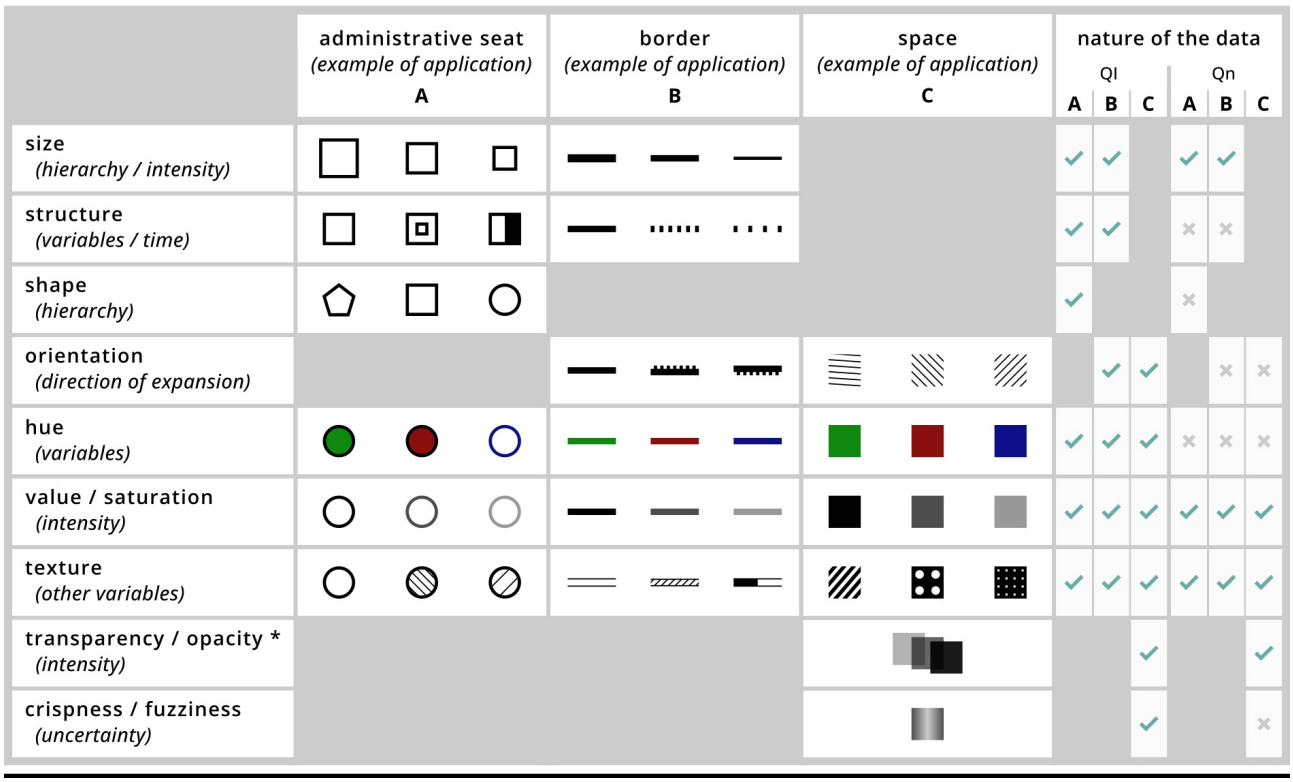


Fig. 1 Graphic parameters of map symbols in visualisation of dynamics of spatial phenomena and their applicability based on the nature of data (authors based on Bertin 1967; MacEachren 1992, 1995; Slocum et al. 2009; Field 2018)

2.2 Visualisation of (in)stability

Interest in the administrative division and historical borders is significant, especially in the Eastern part of Europe (Jordan 2001; Yoder 2003; Chromý et al. 2009; Otiman et al. 2013; Šerý & Šimáček 2013; Burda 2016; Janicki 2020) where several reforms have taken place, however, their cartographic representation i.e. the representation of dynamics (stability, instability, transformation, fuzzy space) lacks importance about the character of the borders and spaces which emerged after the reforms.

In the framework of cartographic visualisations, or how to express the concepts of border and the name of the region dynamics using cartographic methods, it is necessary to use correctly chosen means of map representation. Even nowadays, the theory of cartographic semiology (Bertin 1967) and the theory of cartographic information (Koláčný 1969) are useful in the design of the map key.

The parameters of cartographic signs are based on cartographic semiology. This is a reasonable connection of the properties and specifics of the depicted phenomenon, in this case the borders and their stability, with its cartographic representation. The transfer of cartographic information is ensured on the one hand by the easy compressibility of cartographic signs (the ability of signs to accumulate more information), on the other hand by their usability in relation to the key properties of cartographic representation in the context of its users (illustrativeness, readability, etc.) (Miklošík 2005).

Bertin (1967), respectively MacEachren (1992; 1995) and other subsequent authors (Slocum et al. 2009; Field 2018, etc.) offer many graphic means and their variables that can be used in research on the stability of various phenomena (Fig. 1). The first graphic variable is usually the colour. The cartographic visualisation of stability is often performed in geomorphological studies, mainly in the analysis of landslides or erosion (e.g. Reis et al. 2012; Djerbal et al. 2017; Akbari et al. 2019). In these studies, instability, which is the most important aspect of the visualisation, is shown in red, because this colour psychologically attracts attention the most. The red colour not only attracts attention, it also associates some form of fierceness and activity. If we relate this aspect to the research on perceptual/vernacular regions, active or unstable regional identities may be observed in spaces with frequent changes in administrative divisions.

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In research on regional identities, the second aspect is stability. In this case, blue or green is an appropriate colour tone, as it is associated with calm and peace and is also suitably distant from red or orange within the colour circle (Voženílek & Kaňok 2011; Bláha & Štěrba 2014; Miklín et al. 2018). The use of colour allows us to exploit its other parameters and by using proportional value/saturation we can achieve various forms of stability or instability in the context of the administrative division dynamics. The use of colour in this respect is thus appropriate for data of a qualitative nature where the aim is to express the character of a border or space based on the change of the name of the region. The next option is to work with quantitative data where the aim is to express time using graphic means and their variables (especially the size or colour value/saturation) and thus achieve a representation of the phenomenon of (in)stability (e.g. in Gurňák 2003, 2005). There are other options that can be used to visualise qualitative data to represent (in)stability. Multiple variables can be expressed by texture or structure, orientation can be used to express the direction of extension, especially in digital products transparency/opacity, also crispness/fuzziness to represent locational indeterminacy (see MacEachren 1992) or other variables which are not visual (sound, haptics) or require animation of the map. In addition to the expression of the concepts of border (by line feature) and the name of the region dynamics (by area feature), points can also be used to express various variables (e.g. the seat of an administrative unit in semantic relation to the name of an administrative region).

The following part of the article deals with the visual representation of the development of administrative regions through recent history on the example of the Bohemian-Saxonian borderland, which could be used to create hypotheses about perceptual/vernacular regions or to subsequently clarify the causes of the identified perceptual/vernacular regions by other research methods.

3 Data and cartographic processing

Cartographic visualisation requires specific spatial and attribute data and a variety of methods, which are introduced in this section of the study. In order to be able to analyse, visualise and subsequently evaluate the dynamic aspects of the administrative division organisation over time and categorise borders and spaces based on naming, a comparative study using GIS tools and cartographic methods were used. This comparative study is observed in the research area (Fig. 2a) on the borderland between Bohemia (Czechia) and Saxony (Germany). An important aspect for the selection of these cases to determine the trend of the two states of the EU was the comparable size of the territory (5,500 km^2), population (850,000 inhabitants), landscape (high diversity), economic development (urban-rural) and development after the WWII (part of the Eastern Bloc and then the EU).

3.1 Data for cartographic visualisation

Secondary spatial vector data for the data analysis were used, which visualised the administrative division of these countries since the first reform after WWII (district and counties). On the Bohemian side, the shapefile layer created within the NAKI project Zpřístupnění historických prostorových a statistických dat v prostředí GIS (Disclosure of historical spatial and statistical data of districts in Czechia in a GIS environment) during 2012–2015 was used (Historický GIS 2014). On the Saxonian side, the datasets (DL-DE-BY-2.0) created by Bundesamt für Kartographie und Geodäsie–BKG (Federal Agency for Cartography and Geodesy) with spatial information on the administrative boundaries of the German Democratic Republic (hereafter referred to as GDR). Additionally, on the basis of map document (2006) of the Statistische Landesamt des Freistaates Sachsen–StLA Sachsen (Statistical Office of the Free State of Saxony), vectorised changing borders on the basis of the free municipal boundaries dataset was used.

The next step was to analyse the administrative division reforms through laws. On the Bohemian side, the reforms after WWII took place in:

- 1949 - Act No. 280/1948
- 1960 (first reform) - Act No. 36/1960
- 2000 (second reform, first part) - Act No 129/2000
- 2003 (second reform, second part) - Act No 314/2002

On the Saxonian side in:

- 1952 - Law Gazette of the GDR 1952 p. 613
- 1990 (reinstitutionalisation of Saxony) - Federal Law Gazette 1990 II, p. 889
- 1996 (first reform) - Saxon Law Gazette p. 549
- 2008 (second reform) - Saxon Law Gazette p. 102

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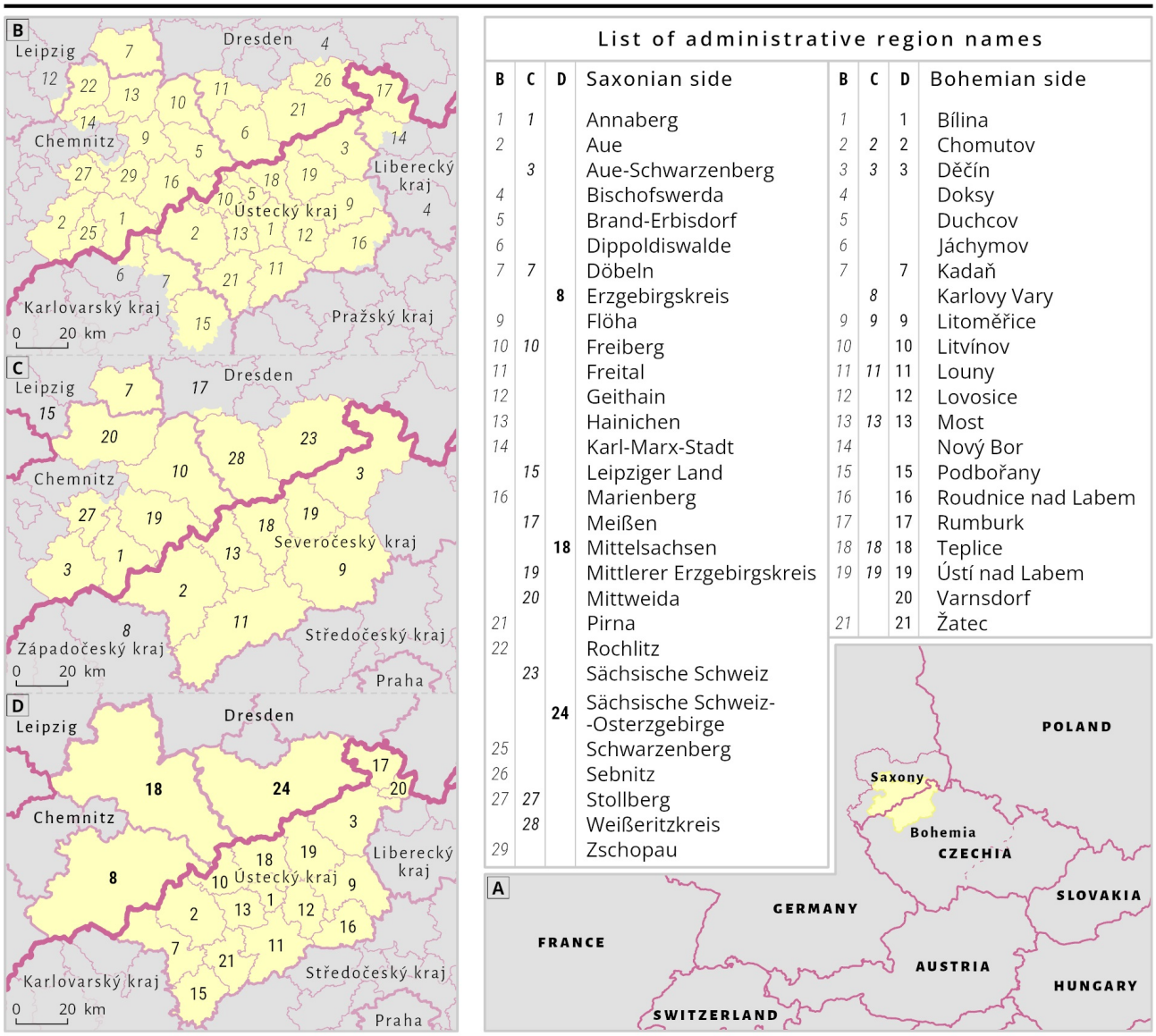


Fig. 2 (a) Location of study area within Central Europe and administrative division on borderland between Saxony and Bohemia in (b) 1954, (c) 1998, (d) 2022 (Historický GIS 2014; BKG; StLA Sachsen 2006; EU 2021)

Based on the analysis of maps, GIS data, documents and laws, in the research area can be identified (Fig. 2b,c,d):

- three administrative divisions (two reforms),
- two scales of administrative regions between the municipality and Saxony and Bohemia, respectively,
- spatial data containing numerous amounts of borders for the administration of the territory and names of the regions.

In order to be able to analyse the characters of borders and find out to what extent they are stable or unstable and how the creation or extinction of the administrative regions' border and region names creates specific types of spaces, the second phase, their categorisation and visualisation using GIS, is necessary. The subsequent analysis in the following section is based on a single scale. Higher hierarchies, i.e. counties (kraj in Bohemia and bezirk, regierungsbezirk, landesdirektion in Saxony), do not enter the analysis, while lower hierarchies, i.e. districts (okres, ORP in Bohemia and kreis, landkreis in Saxony), are the administrative regions from which the following synthetic map is formed.

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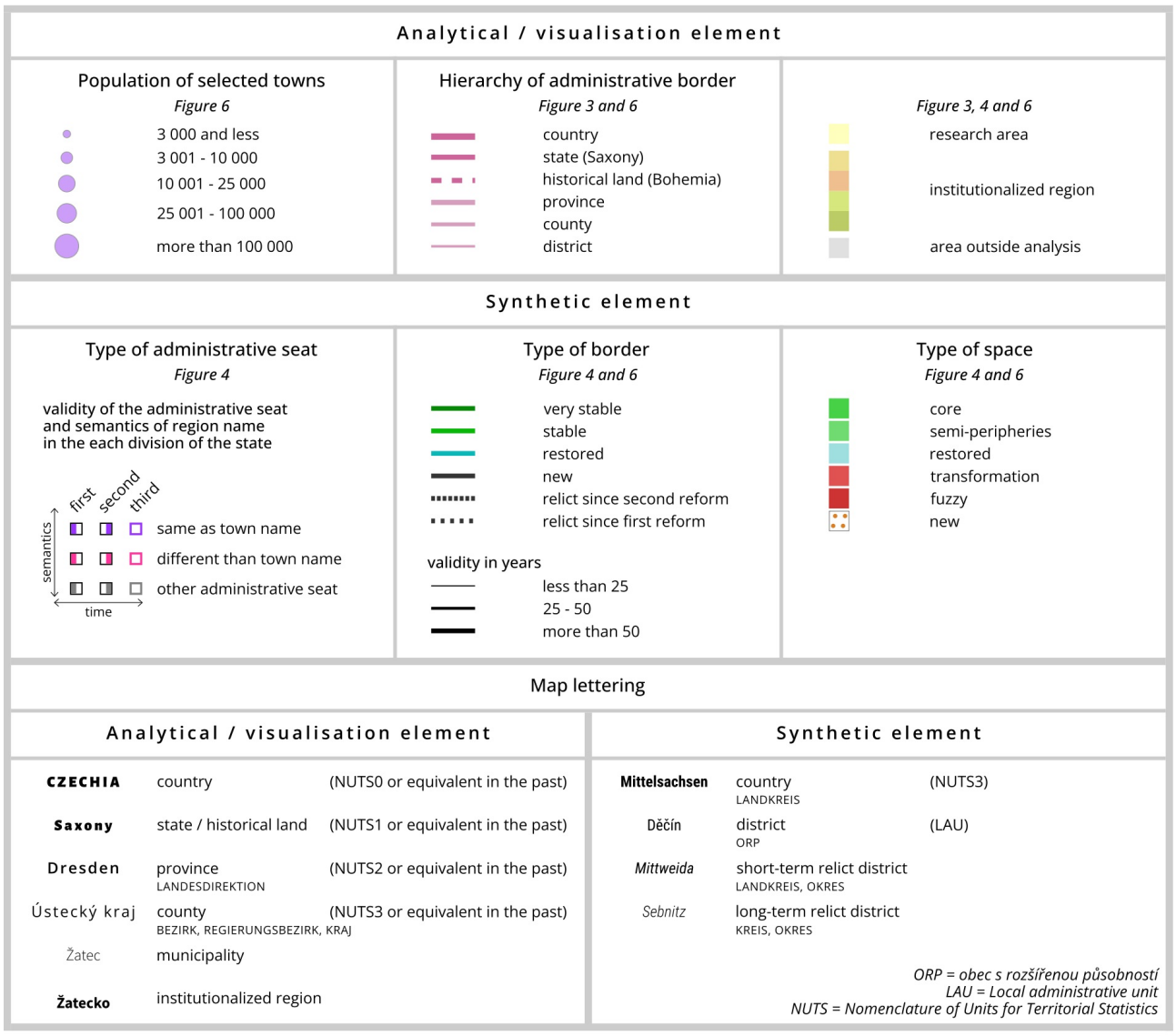


Fig. 3 Complete map key of the research area

3.2 Designing the map representation

Before focusing on the dynamics of the administrative regions themselves, it is appropriate to display the complete map key of the analytical section, the synthetic map and map lettering (Fig. 3), which was used in figures in Section 3 and 4. For better clarity, the same parameters were used except for the size due to different scales.

3.2.1 Border dynamics

The first key factor in the concept of administrative regions dynamics is the stability of the borders and this can be represented cartographically by colour of line and by its size and structure. In Bohemia and also in Saxony, two reforms were implemented during the studied period, in which the borders of the regions changed.

In some cases, the border remained unchanged for 70 years. These borders can be assessed and characterised as very stable borders. Subsequent reforms were realised at different times on the Bohemian and Saxonian sides. In Bohemia, it took place earlier (1960) than in Saxony (1996). However, the borders existing since 1960, respectively 1996 can be considered to be stable borders because their subsequent reform did not affect them. The last reform was conducted in 2003 in Bohemia and in 2008 in Saxony. The borders that arose during these reforms and did not copy the previous set of administrative borders can be charac-

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terised as new borders. Another type is relict borders, which have disappeared by any reform. In addition to this categorisation, it is possible to cartographically show the specific time period when they disappeared by broken line (the more disappeared the border is, the bigger the gap in the line is). The last type is the restored borders, which were previously defined, disappeared after the first reform, but after the second reform they are valid again and can be found in space nowadays.
The use of map representation, specifically the width of the line, can also show the time of validity of each type of border, and since the reforms in Saxony and Bohemia were carried out in different years, it is essential to visualise the temporal dimension of the borders.

3.2.2 Name of the region dynamics

The next phase focused on how the dynamics of the borders form different types of spaces based on the spatial changes and transformation of the semantics of the names of defined administrative regions. The character of the spaces is qualitative in nature again, and therefore the main graphic variable is the colour of the areal features (fill), but also its texture.
The core can be considered for those spaces whose names appear in all the monitored periods and no reform has affected them. The semi-periphery was not affected by the second reform, however before the first reform there were other regions. The restored spaces are those that were identified in the past and are visible in reality nowadays, but after the first reform the names of the regions have disappeared for some time. Another example that could be observed are transformation spaces, i.e., those where there was a region for a long period of time, but after the last reform this space moved to a neighbouring administrative region. Spaces where the change of borders and the names of regions are constantly changing during any reform can be considered to be fuzzy spaces. The new spaces arise after the second reform, which means the new naming of the region. Within this characteristic of space, two possibilities can occur and therefore an additional graphic variable (texture) was used. The first possibility is that a new naming of the region is created in a developmentally relatively stable space, since the first reform did not affect the semantics of the naming and is therefore a complementary attribute to the transformed space. The second possibility then arises in spaces where the region's name is constantly changing (fuzzy), but at the same time a new region naming has emerged that may affect perceptual/vernacular regions.

3.2.3 Seat of the administrative unit

Due to the size of the research area, or the possible use of scale within this paper, the seat of the administrative unit point layer was used. Using the structure of point and colour, additional information can then be offered about the evolution of the region names, or how their semantics have changed.
Based on the border dynamics and transformation of the semantics of region names with additional information through administrative seats, the (in)stability can therefore be visualised in a synthetic map (Fig. 4) against the background of our research area.

4 Applications in research of regional identities

This chapter first presents the results of the analysis of the development of administrative divisions (tendencies on the Bohemian and Saxonian side) and on this basis the attributes of possible perceptual/vernacular regions are generated (4.1). The second part (4.2) compares three model areas, i.e. possible perceptual/vernacular regions through synthetic map with other institutionalised regions.

4.1 Administrative region dynamics and its consequences for perceptual/vernacular regions

In Bohemia, after WWII and as a basis for the analysis, the administrative division was established in 1949, in Saxony in 1953. Within this administrative division, the tendencies were very similar. The hierarchy was arranged in four levels (state, county, district and municipality) because the states/historical lands (Saxony and Bohemia) were abolished. At the level of districts, a similar size of administrative units can be observed and the names of the regions referred to nodal towns. However, on the basis of centralised policy, the size of administrative regions in Bohemia was more than doubled by the first reform in 1960 (Fig. 5a). In Saxony, on the other hand, this division was valid throughout the communist period (until 1996). After 1990, trends in hierarchy, spatial size and names of administrative units were quite different. Although Saxony was already in the EU structures and, in accordance with the principle of subsidiarity, one would expect administrative regions

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to shrink, the size of administrative regions almost doubled. This principle was, on the other hand, applied on the Bohemian side (as one of the processes of the Czech Republic's efforts to join the EU) during the second and last reform (in 2003). Administrative regions were restored (with a few exceptions) from the 1949–1960 division. However, this is also related to the size of the municipalities, which are very small in Bohemia compared to Saxony. In Saxony, there was a tendency to merge municipalities after 1990, whereas in Bohemia there was a tendency to divide them. The most recent reform in the research area was conducted in Saxony in 2008, which increased the size of the administrative regions even further. It is important to mention that although the same hierarchical levels are compared on both sides (in terms of historical development), de facto the Local Administrative Units (LAU) on the Bohemian side and the Nomenclature of Units for Territorial Statistics (NUTS3) on the Saxonian side are compared according to today's EU statistical regions.

The size of administrative units is related to the delimitation of borders. If we compare the representation of individual types of borders on the Bohemian and Saxonian side with regard to the time aspect (Fig. 5b), far fewer borders were set on the Saxonian side during the entire study period (on the Bohemian side almost 300 m of borders per km^2, in Saxony almost 225 m/km^2). As the size of the administrative regions increased, the borders on the Saxonian side had to be reduced.

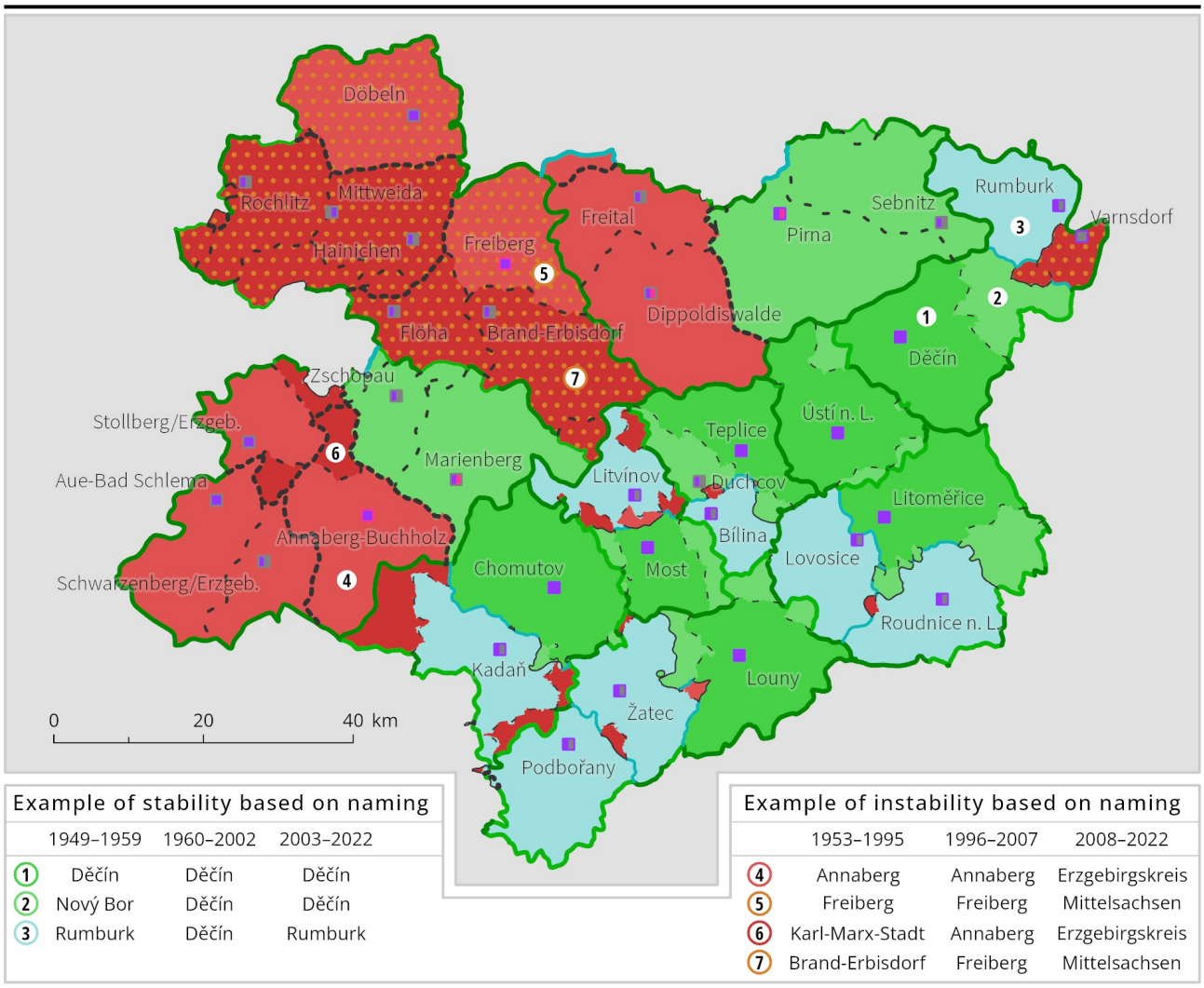


Fig. 4 Synthetic map of the research area (authors based on BKG; StLA Sachsen 2006; Historický GIS 2014; ARCDATA Praha 2016)

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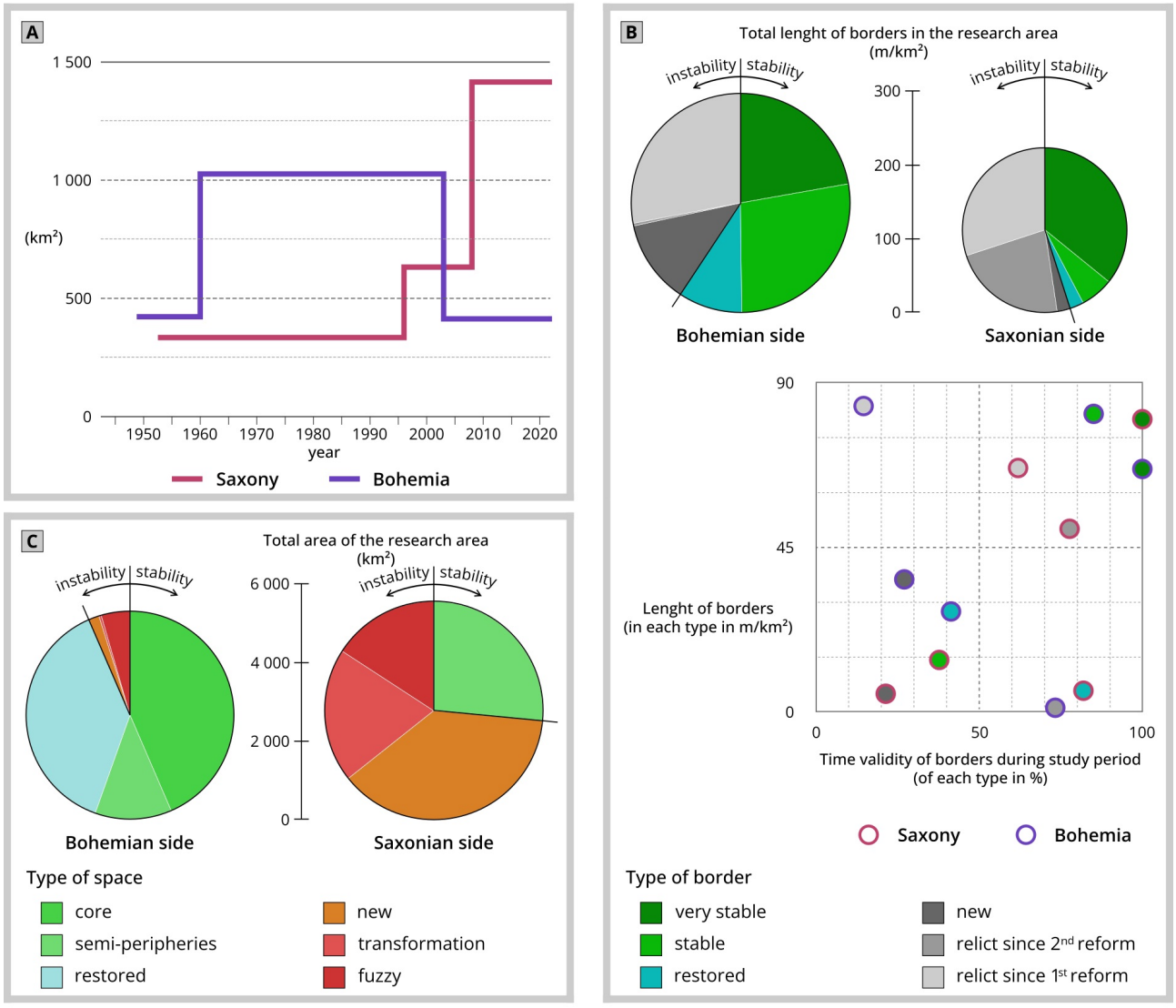


Fig. 5 Spatio-temporal comparison of administrative regions in the research area focusing on the aspects of (a) size of districts, (b) delimitation of borders, (c) spaces given by the semantics of names

Today, more than 50 % are considered relict, however, those that have been retained are relatively very stable. The Bohemian side is much more diverse and today there are twice as many borders as on the Saxonian side. Moreover, since the reforms took place in different time periods in Saxony and Bohemia, the temporal dimension of the different types of borders is important and this is most obvious when examining relict borders. In Bohemia, although there are very many relict borders from the first reform, they lasted only 15 % of the studied time (1949–2022), which may suggest that these borders will not be reflected in the perceptual/vernacular regions. In Saxony, on the other hand, this type of border existed for much more of the studied time (61 %) and their delineation in perceptual/vernacular regions may be much more persistent. Similarly, the relict borders after the second reform may still be present in the perception of the population because the reforms happened recently and at almost the same time on both sides. However, their strength may be more evident on the Saxonian side because the length of these borders is fifty times greater than on the Bohemian side (that is 1 m/km^2 in Bohemia compared to 50 m/km^2 in Saxony).

Another aspect is the representation of spaces based on the names of regions (Fig. 5c). The Saxonian side is much more unstable according to the categorisation because there was a gradual shift in the semantics of the region names after 1990, whereas on the Bohemian side there was

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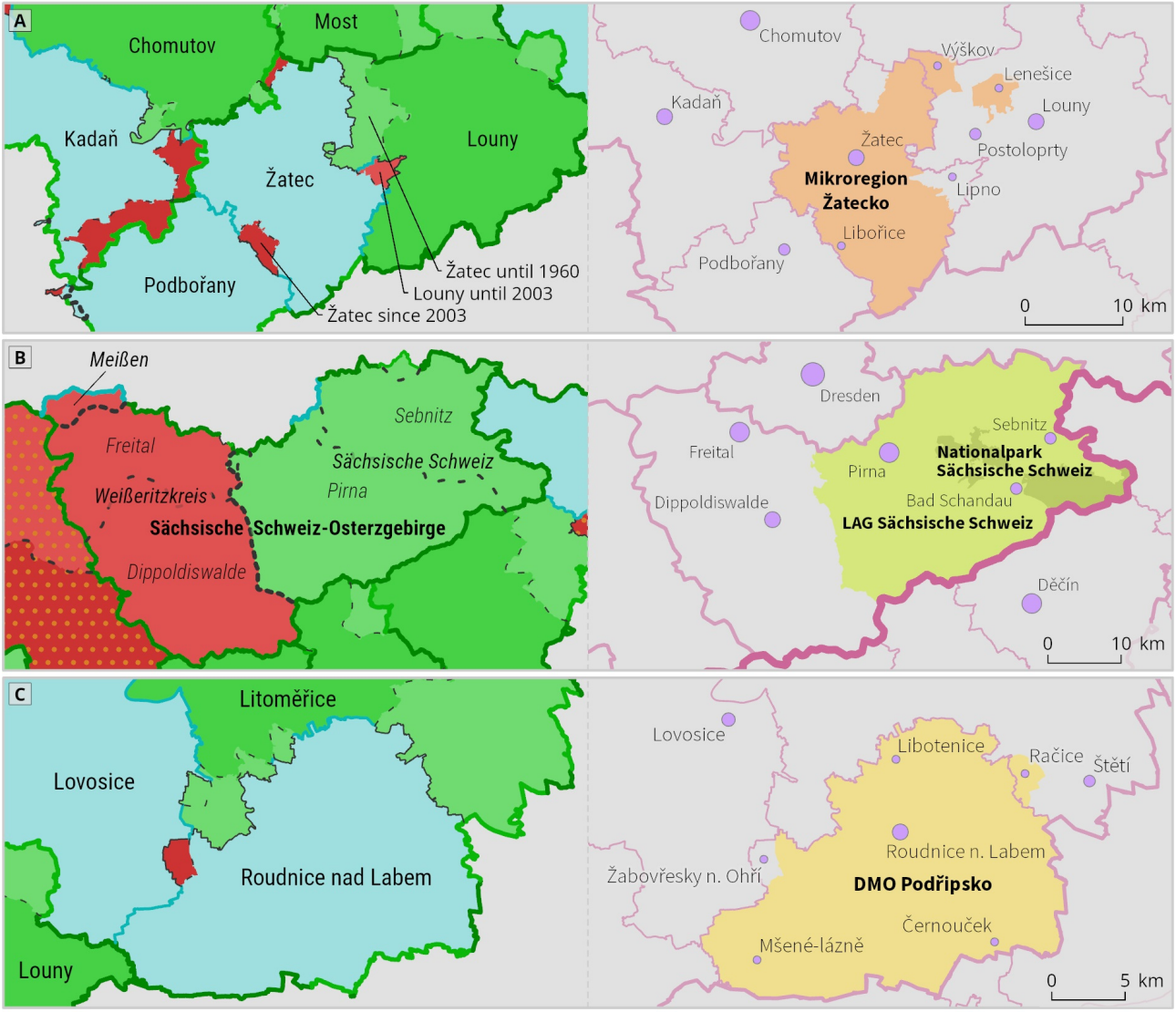


Fig. 6 Cartographic representation of administrative region dynamics on the example of (a) Žatecko, (b) Sächsische Schweiz, (c) Roudnicko (authors based on Historický GIS 2014; ARCDATA Praha 2016; BKG; StLA Sachsen 2006; EU 2021).

(with a few exceptions) a return to the former names. On the Bohemian side, the names of regions have always referred to the names of nodal towns, on the Saxonian side this approach was also used to name administrative units during the communist period, but nowadays names referring to (cultural) landscape (e.g. the Ore Mountains) or geographical location (e.g. Central Saxony).

4.2 Perceptual/vernacular regions through synthetic maps

It is clear from the theory of the institutionalisation of the region that administrative regions are not the only part for the formation of a regional identity. Beyond the borders and names of the region, the institutions also play a significant role in the reproduction of the region and its perception by the population. Based on the study of the development of the administrative division and subsequent visualisation, three model spaces are compared with other regions. Other regions that are made up of initiatives from the bottom and may refer more to perceptual/vernacular regions and not from the top by the government, which is typical for administrative regions.

One of the cases (Fig. 6a) could be ORP Žatec as an administrative region ("Žatecko"). It is a representative of a region that was reinstitutionalised, because between 1960 and 2003 it was mainly ab-

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sorbed by the Louny Region. It is not possible to talk about the core space, because for 43 years Žatecko did not exist "de iure", however, in the past, Žatecko was part of the regional system. The area that refers to the definition of Žatecko in the past is then expressed in the area shown in light blue fill area. In the light green fill area, a certain loss of relationship with this region can be expected, as since 1960 these municipalities have been part of another region (the Louny or Chomutov districts). In the dark green fill areas, Žatecko cannot logically be expected. Based on the analysis, it is possible to trace spaces where the delineation of perceptual/vernacular regions may be fuzzy, i.e. in spaces called transformation and fuzzy in the red fill areas. Comparing the historical development of this administrative region with the Žatecko microregion (a voluntary association of municipalities), we can examine the perceptual/vernacular regions in some specific municipalities. For example in Libořice and its surroundings, the administrative regions have been constantly changing, but the mentioned microregion is located here. Lipno and its surroundings was part of the district of Louny from 1949 to 2003 and possibly for this reason is not part of the microregion (yet). The last municipalities of Výškov and Lenešice have not been part of Žatecko (for a long time) and yet the microregion is located here. The next case on the Saxonian side is Saxon Switzerland, which is the old name of the area with sandstone rocks. In 1990, a national park was created in this area, but six years later also an administrative region with this name. Moreover, after the territorial reform in 2008, the territory of "Sächsische Schweiz" could be expanded due to the change of borders and creation of the region "Sächsische Schweiz-Osterzgebirge". Referring to the map (Fig. 6b), it is clear in which space the perceptual/vernacular region of Saxon Switzerland can be expected (those municipalities that have been part of the administrative region since 1996, but there is also a national park in the territory of the municipality). The naming does not have to directly reflect the management of the national park border, but it can also overlap with the surrounding municipalities, precisely on the basis of the name of the administrative region. It means that the old naming of the area with sandstone rocks could have taken on other meanings which also demonstrates the association of municipalities for the development of the rural economy (LAG Sächsische Schweiz). Research of people's regional identity could thus be carried out in the municipalities beyond the national park border with an interest in the space at the border of the two extinct administrative regions (Sächsische Schweiz and Weißeritzkreis), Saxon Switzerland could also exist here, regardless of the character of the landscape.

The last example is on the Bohemian side. The visualisation (Fig. 6c) shows a space that can be named after the administrative region of ORP Roudnice nad Labem ("Roudnicko"), but at the same time almost identical municipalities are part of the public benefit corporation Říp, which wants to develop "Podřipsko", one of the old ethnographic regions of Czechia, from below. However, based on the tendency in naming of administrative regions in Bohemia, renaming cannot be expected, although it could be beneficial. In fact, earlier research (Bartůněk 2021) portrays this space as "schizophrenic regions".

5 Discussion and conclusions

Administrative regions are a specific type of region whose nature is based on homogeneous aspects, whether in terms of natural, historical, social, cultural and/or spatial behaviour of the inhabitants for political administrative purposes. The administrative division of the state is then the result of a combination of these factors (Klapka et al. 2016). Regions then take on different characteristics, such as hierarchy or size, as well as delimitation, name and institutions and thus they can be reproduced in the minds of the inhabitants, in the perceptual/vernacular regions that each inhabitant keeps in a cognitive map of the space (Jordan 2001). On the other hand, they may not be projected in the mind at all because they are created by a top-down process by the government and may not respect the people's regional identity in the area (Antonsich 2010). Or, as the administrative divisions of a state (often) change, the perceptions of inhabitants across generations may also be transformed (Marek 2022). These are the primary reasons why this study seeks to link these aspects of the theory of the institutionalisation of regions (Paasi 1986) with the synthetic map by analysing the historical development of administrative regions and their spatial analysis in GIS. On the basis of the cartographic representation of stability, transformation and fuzzy sets (Bertin 1967; MacEachren 1992 and others) it can be a useful tool to reveal the people's regional identity (their perceptual/vernacular regions) because the visualisation illustrates named regions (linguistic landscape) and their spatio-temporal character.

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The cartographic representation of (in)stability was based on several sub-processes. One of the very first tasks is to find the data on the historical development of administrative regions. Laws are almost useless in this respect, as they lack a spatial component on the delimitation of regions, but it is necessary to address this step, because the time dimension is crucial to the analysis. The vertical and horizontal structure of the administrative region usable for GIS analysis must be obtained from the old/historical maps or vector data of a secondary nature can be used, which may be more accurate if they have been produced by other projects. If the vectorization has to be done on the basis of georeferenced old/historical maps, it is advisable to use spatial layer of today's municipalities for better accuracy. Even so, a certain amount of generalisation can be expected if there have been past mergers or separations of municipalities close to the administrative region border. However, this is not as much of a concern as if the aim were to visualise data, for example, in the development of population or in the case of large-scale map visualisations, but for the purpose of research on historical regions, generalisation in hundreds of metres could be expected. Moreover, with regard to the fluidity of borders, the exact line of the historic borders changes in the population's minds (Šerý & Šimáček 2013; Marek 2022) and the further we go into the past, the more one can expect a greater degree of cartographic generalisation.

The spatial analysis in GIS was devoted to the dynamics of historical development with a focus on the management of borders in space and the semantics of the names of regions, and on this basis a synthetic map was created to characterise borders and spaces. By using qualitative data dealing with the character of borders and spaces, the main graphic variables were mainly colour based on the psychological and other subjective perception (Dent et al. 2009; Voženílek & Kaňok 2011). By using a cross-border research area as an example, the comparative method revealed more variables in the cartographic representation of the data. In these countries, two territorial reforms took place in different time periods, and therefore it was appropriate to show the time in a synthetic map, specifically by the width of the individual border lines. The changes in the naming of regions were also different on both sides, and therefore graphic variables showing the semantics of the region names could also be used as additional information (by point feature and their variables). The synthetic map can therefore be visualised through graphic means and their variables as follows against the background of our research area:

- colour and its parameters, different strength and structure of line features,
- colour and its parameters and texture of areal features,
- colour and its parameters and structure of point features.

However, similar research will be feasible especially in the former Eastern Bloc, because the administrative structure in Western Europe after 1945 remains almost unchanged. Although it can be assumed that the tendencies in the development of the administrative structure in the area of the former Eastern Bloc were similar, it is nevertheless necessary to look at other territorial units and compare them. Especially in the case of a state where a different number of reforms took place, as the visualisation is likely to show different attributes. This is evidenced by the example between Bohemia and Saxony, which was different and it is a question of the extent to which the Saxonian administrative divisions were affected by the accession to West Germany.

Many works deal with the development of the administrative division of individual states, but a certain comparison between two or more states remains behind. Based on the selection of the research area in this work, it was possible to look at trends in Bohemia and Saxony. Although the research area is only a small part of these territorial units, it is still possible to trace tendencies for the whole territory, because the hierarchy of administrative division, territorial size of the administrative region and to some extent the names of regions are then implemented in other parts of the state. The cross-border study thus helped to identify various trends in the development of administrative regions, such as the size of administrative units, the amount of borders, and the number and semantics of region names, which are attributes that can influence the perception of regions by the population. Based on the analysis and comparison of the size of the administrative regions and the representation of borders and names of the regions in the space various hypotheses can be formed. Based on the analysis of this cross-border study it can be assumed (if there is a relation to these regions by inhabitants), that:

- On the Bohemian side, there will be more perceptual/vernacular regions. Size of the administrative units (districts) on the Bohemian side is smaller than on the Saxonian side

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- where the hierarchy of administrative regions has changed.
- On the Bohemian side, the boundary line of perceptual regions will be less fuzzy. The borders between the administrative regions are more stable than on the Saxonian side, as almost 50 % of them are valid since 1960.
- On the Saxonian side, the perceptual regions will not contain the name by nodal towns to the same extent as they will on the Bohemian side.

Administrative regions are one part of the acquisition of spatial awareness, and if names by landscape or geographic location are more likely to be used in administrative division, a lower incidence of naming to nodal towns can be expected, even though the size of these nodal towns is comparable on the Bohemian and Saxonian sides.

- On both sides, it is necessary to deal with generational differences.

It is appropriate to explore the differences in perceptual/vernacular regions between generations, because during the communist period there was no reform on the Saxonian side (on the Bohemian side there was a reform soon after the WWII) which could have influenced the population's perception of the regions. Regions as they have been valid for almost 50 years may still persist in the minds of the older generation (somewhere around the age of 40 and more).

It is necessary to mention that people's regional identity is influenced by many factors, not just the definition of the administrative region. However, based on the dynamics and transformation of administrative regions visualised by the synthetic map in the initial phase of research, it is possible to define a hypothesis which can provide clues for delineation of perceptual/vernacular regions. Perceptual/vernacular regions which will be explored in the follow-up phase of the research by other research methods with a focus on the boundaries and names of the region. Later, after analysis and comparison of the synthetic map with the identified perceptual/vernacular regions, it will be possible to confirm the hypotheses formulated by analysing the historical development of administrative regions or to reject the hypotheses and investigate other causes for the definition of the perceptual/vernacular regions. It will then be possible to find out to what extent the administrative and perceptual/vernacular regions coincide or whether other types of regions can be traced that influence the population's perception of the regional organisation of (not only) the area of interest.

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