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Special issue – Franciscean cadaster as a source of studying landscape changes

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Front cover photography: Exploration of the collapse dolines, such as the one at the Small Natural Bridge in Rakov Škocjan, has enabled a deeper understanding of karst processes in recent years (photograph: Matej Lipar).
Fotografija na naslovnici: Raziskave udornice, kot je ta pri Malem Naravnem mostu v Rakovem Škocjanu, so v zadnjih letih omogočile globlje razumevanje kraških procesov (fotografija: Matej Lipar).

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LONG-TERM LAND-USE CHANGES: A COMPARISON BETWEEN CZECHIA AND SLOVENIA

Ivan Bičík, Matej Gabrovec, Lucie Kupková

MATEJ GABROVEC

Many elements of the 19th century land use patterns are preserved at Sorško polje Plain in Slovenia.

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Long-term land-use changes: A comparison between Czechia and Slovenia

ABSTRACT: Detailed information about land use is available from the mid-nineteenth century onward for the countries of the former Habsburg Monarchy. For Slovenia and Czechia, databases have been created that make it possible to analyze the period from the first half of the nineteenth century to the beginning of the twenty-first century. The processes of changing land use were comparable during the period examined. Nonetheless, the cultural landscape in Czechia was significantly more transformed. Because of the nationalization of land after the Second World War and the establishment of state-owned collective farms and cooperatives, today large complexes of farmland predominate, whereas in Slovenia fragmented properties still predominate, and the cultural landscape therefore preserves many more elements from the nineteenth century.

KEY WORDS: geography, agrarian geography, historical geography, land-use changes, Franciscean cadaster, Slovenia, Czechia

Dolgoročne spremembe rabe zemljišč: Primerjava med Češko in Slovenijo

POVZETEK: Za države nekdanje Habsburške monarhije so podrobni podatki o rabi zemljišč na voljo od sredine 19. stoletja. V Sloveniji in na Češkem je urejena podatkovna baza, ki omogoča analize za obdobje od prve polovice 19. do začetka 21. stoletja. Procesi sprememb rabe zemljišč so bili v obravnavanem obdobju primerljivi. Kljub temu pa se je kulturna pokrajina na Češkem bistveno bolj preobrazila. Zaradi podržavljenja zemljišč po 2. svetovni vojni in ustanavljanja državnih kmetijskih posestev in zadrug danes prevladujejo veliki kompleksi kmetijskih zemljišč, medtem ko v Sloveniji še vedno prevladuje razdrobljena posest, v kulturni pokrajini je zato ohranjenih mnogo več elementov iz 19. stoletja.

KLJUČNE BESEDE: geografija, agrarna geografija, historična geografija, spremembe rabe zemljišč, franciscejski kataster, Slovenija, Češka

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1 Introduction

Analyses to date of changes in long-term land use, which cover a period of at least two hundred years, are limited to the territories of individual countries (Himiyama et al. 2001; Gillmor 2001; Bičík et al. 2015; Gabrovec and Kumer 2019). There is a lack of studies comparing changes in land use across multiple countries for such a timespan. This article addresses this research gap by comparing long-term land-use changes in Slovenia and Czechia. These two countries were selected because databases on land use are available for their territories; these databases were created based on archival cadastral material and they cover the period from the first half of the nineteenth century to the beginning of the twenty-first century. The data are available at the level of cadastral units, and analyses of land-use changes during this period have also been published (Bičík, Jeleček and Štěpánek 2001; Bičík et al. 2015; Gabrovec and Kumer 2019). These publications have shown the processes of land-use change using various statistical methods, supplemented by extensive cartographic material. These findings are only conditionally comparable because of the use of different methods. In this article, the databases for both countries are arranged in the same manner, which means that various land-use categories have been combined into the same groups. For the period from the first half of the nineteenth century to the beginning of the twenty-first century, a typology developed by Czech geographers (Bičík and Jeleček 2009) was used to show land-use changes, and an index of change was calculated that has also already been used multiple times in Czechia (Bičík et al. 2015). This makes direct comparisons possible, and the differences are explained below through various driving forces behind the changes resulting from differences in both countries' economic and political development, as well as their natural features.

Outside of Slovenia and Czechia, studies of land-use changes based on detailed cadastral data for the time period studied are available only at the level of individual case studies (Cousins 2001; Kanianska et al. 2014; Harvey, Kaim and Gajda 2014; Prokop 2018), which make it possible to identify individual processes, but do not allow analyses or determination of patterns at the country level. Many case studies have also been carried out in Slovenia and Czechia (Ažman Momirski and Gabrovec 2014; Bičík, Kupková and Štych 2012; Gabrovec 1995; Gabrovec, Komac and Zorn 2012; Mares, Rasin and Pipan 2013; Paušič and Čarni 2012; Petek and Urbanc 2004; Rašín and Chromý 2010; Šmid Hribar 2016; Štych et al. 2012; Geršič, Gabrovec and Zwitter; Žiberna 2018), and these allow a more detailed explanation of the driving forces behind land-use changes.

2 Methods

The index of change (Bičík and Kupková 2002; Bičík et al. 2015) was used in our study. It is an aggregate index and indicates the intensity of land-use changes (in %) over a certain period of time; it does not, however, assess the »quality« (structure) of such changes.

$$IC_{A-B} = 100 \cdot \frac{\sum_{i=1}^{n} \left| P_{iB} - P_{iA} \right|}{2}$$

IC_{A-B} is the index of change between year A and year B; n indicates the number of land-use classes; P_{iA} is the proportion of relevant land-use class at the beginning of the period examined, and P_{iB} is the same proportion at the end. The higher the index of change, the more intensive the land-use change in the area examined. This index ranges from 0 to 100 and – put in a simple way – indicates the proportion of area where any land-use change occurred, based on a comparison of the beginning and end (changes that may occur during the period examined are not reflected). Territorial »shifts« without a change in size are also ignored, although these are relatively frequent, especially in the case of agricultural land.

In this article, five land-use classes are taken into consideration: arable land, permanent cultures, permanent grassland, forested areas, and other areas. The unit of analysis is cadastral municipalities or, in the Czech case, basic territorial units, which are comprised of one or more cadastral municipalities. The Slovenian and Czech land-use categories differ somewhat in their details. Nonetheless, there are no major difficulties in combining them into five identical land-use classes. The greatest difference between the Slovenian

and Czech categorization (Bičík et al. 2015; LUCC Czechia 2018) is in protected areas. This was a special category in the Czech case in 2010 that was included among other areas, and in Slovenia this category does not exist; with regard to land cover, protected areas are included among the other areas only in the case of land above the tree line, otherwise they are primarily classified as permanent grassland or forest areas.

Aggregate changes in land-use structure can be presented in a number of typologies. The one used in this article is based on areal increases (or decreases) in selected land-use classes (Bičík and Kupková 2002; Bičík et al. 2015). The classes that show an increase or decrease over the period of time examined are marked + or –; by using combinations of increases and decreases (related to different classes), various types are created. Changes in the three aggregate classes (agricultural land, forest areas, and other areas) over time are compared in this manner. To sum up, this typology is a simple one and indicates directions only, but not any significance of the changes observed.

3 Driving forces of land-use changes

»*Change in land use and land cover can be conceptualized as the result of the operation of pressures or driving forces: an impulse is applied, and a change of state results*« (Mather 2006, 179). Five factors commonly appear: population, economic development, technology, institutions, and culture (Mather 2006). In the case of Slovenia and Czechia, the driving forces were similar in certain historical periods and different in others. Similar processes were characteristic until the First World War, when both countries were part of the Austrian Monarchy, and after 2004, when both countries joined the European Union. The driving forces differred the most in the second half of the twentieth century. Even though both countries had a communist government, their economic policies and especially their agricultural policies differed significantly. The most important trend during the period examined was the growing importance of economic and social factors in the context of rapidly spreading technological and social innovations. Regarding the value of land as a natural resource, in fertile regions the economic aspects prevailed, and in less fertile areas the environmental aspect was the most important one (Bičík and Jeleček 2005; Bičík et al. 2015).

3.1 From the nineteenth century to the First World War

The land-use data from the first half of the nineteenth century show land-use structure as a result of centuries-long gradual agricultural use before industrialization. The economic and technological limits of the preindustrial production mode were behind the relatively low regional differences. Transport remained slow and costly, and long-distance trade and competition were limited. Most products were consumed locally, and the spatial division of labor and specialization remained weak. Most material goods, energy, and so on circulated within a limited space only (i.e., farms and villages). Consequently, different land-use types had to be spatially interconnected. Everywhere, including in mountainous regions, it was essential to possess enough arable land (to provide food), grassland (for livestock), and forests (to provide fuel and construction material) (Hampl 2000; Jepsen et al. 2015; Krausmann et al. 2003; Bičík et al. 2015). The revolutionary movements of 1848–1849 resulted in the end of feudalism: serfdom was abolished, the industrial revolution was accomplished, and the path toward a new social and economic organization, free-market capitalism, was opened. Much of the land that had previously been owned (and rented out) by landlords became the property of small farmers (Bičík et al. 2015). The long-term increase in arable land came to an end in both countries at the end of the nineteenth century. Industrialization took place more slowly in Slovenian territory than in Czech territory, and so with the growing population there was an increase in agrarian overpopulation in Slovenia, which reached its apex at the end of the nineteenth century (Petek 2005). In Slovenia, at the end of nineteenth century most of the population still earned a living through agriculture, standing at 76% in 1890. Despite labor-intensive agricultural production, it was impossible to feed the entire population and there were not many jobs outside of farming, and so there was significant emigration, especially to North America (Kladnik and Andrič 2013). Industrialization and agricultural intensification in Czech territory on the contrary caused development of urbanization, movement of rural population to the cities and increase of working class in the cities.

3.2 The interwar period

Following the war, Czechoslovakia was among the newly emerged nation states. Slovenia became part of the new Kingdom of Serbs, Croats, and Slovenes, which was renamed the Kingdom of Yugoslavia in 1929. One quarter of the territory of present-day Slovenia belonged to Italy until the end of the Second World War.

The structure of Czech (or Czechoslovak) agriculture changed significantly after the country's independence. The Land Reform Act was passed in 1919, and transfers of land started in 1920. The new laws stipulated that landowners could possess a maximum of 150 hectares of agricultural land, or 250 hectares of land altogether. The excess land was purchased by the state. The land reform of the 1920s fundamentally changed the land ownership patterns and tenure in rural areas. In the past, the large estates in general had been focused on cash crops. In contrast, most new landowners were forced to become subsistence farmers and had to labor intensively in the fields. This is why the amount of arable land slightly increased and permanent grassland decreased in terms of size in the mid-1920s. The driving forces that influenced the economy and society also underwent substantial changes. Agriculture was less important; industry and to some extent also services became the leading sectors. These trends are reflected in the changing structure of the workforce by sectors. Residential and industrial developments were booming, especially in urban areas. Consequently, built-up and remaining areas increased. However, this was a regionally unbalanced process (Bičík et al. 2015).

In Slovenia, agriculture was characterized by land fragmentation, as seen in the smaller average size of farms and the growing number of plots of land on farms. In 1931 the average farm measured 8.3 hectares. Market production was modest. The most market-oriented sectors were viticulture and fruit growing, and hop production continued to remain profitable, whereas silk production died out during this period. The entire period was also characterized by considerable industrialization in Slovenia (Kladnik and Andrič 2013).

3.3 From the Second World War to 1990

From 1948 to 1990, Czechoslovakia was ruled by a communist government. It is important to understand that all crucial decisions were de facto made by the Central Committee of the Czechoslovak Communist Party, which influenced the social and economic conditions, including land-use patterns. The most important land-use changes during the last 170 years took place between 1948 and 1960. This was a time of major economic and social changes, which included the effects of the expulsion of ethnic Germans, a new political and geopolitical orientation and economic system, large-scale industrialization, introduction of collective farming, emergence of military training areas, and the depopulation of rural areas (Bičík and Jeleček 2005). The communist government relied on outdated, inefficient energy and raw materials, and a very demanding industrial structure that could not compete with advanced western European countries. Shortly after the communist coup d'état (in February 1948), the Iron Curtain fell across the western border, large tracts of land became inaccessible, and in many cases new settlers had to move back. In this case, the effects on land-use patterns were great and almost immediate. Farming was severely restricted in areas along the border (only state-owned farms were allowed) and was often completely forbidden. Much of the western border is located at rather high elevations (25% of border regions are over 700 m), despite the fact that the German-speaking population had formerly intensively cultivated these regions. After the expulsion of the German population from 1945 to 1947, hundreds of villages and towns (up to 1,200) ceased to exist, and much of the arable land was completely abandoned. Communist reforms of Czechoslovak agriculture were carried out in three stages. First, the land previously owned by ethnic Germans and Nazi sympathizers was confiscated. In 1947 and 1948, mostly forests were nationalized. Finally, the new land reform that started in March 1948 confiscated all properties over fifty hectares. Even after these dramatic shifts, some 60% of farmland was still owned by private farmers – until the rise of cooperatives. Private farmers were encouraged, often violently, to join cooperatives and state farms; this process happened virtually in every single village. Later, cooperatives were gradually amalgamated into large units. Collectivization was rapid in the early 1950s, slowed down after 1955/1956, and came to an end in 1960. By the end of the 1980s, cooperatives and state farms managed 98.5% of all agricultural land. Cooperatives and state farms gradually introduced large-scale agricultural production on amalgamated fields. Settlement patterns changed fundamentally after the Second World War, and the state reacted by introducing a new official settlement network.

Starting in the early 1970s, it attempted to concentrate the dispersed population into so-called central settlements. Large-scale industrialization and intensive exploitation of raw materials were among the most important driving forces in the landscape during this period. Large residential projects, usually prefabricated blocks of flats, were built in mining and industrial regions to provide accommodation for the workforce, mostly migrating from rural areas. These new massive urban developments appeared almost exclusively on greenfields (Bičík et al. 2015).

In Slovenia, agricultural and rural development following the Second World War resulted from the impact of diffuse industrialization, which fostered urbanization. This urbanization remained hidden to some degree, however, due to extensive daily commuting. The split with the Soviet Union and its satellites in 1948 had a significant impact on Yugoslavia's development of an independent approach to communism. Despite agrarian reform pressures and other ongoing pressures for nationalization, in Yugoslavia nationalization was only carried out on a small scale, and in Slovenia the proportion of private land never fell below 85%. The agrarian reform act of December 1945 enacted the seizure without compensation of all land owned by »capitalist« landowners (i.e., banks, companies, joint-stock companies, monasteries, and churches) that encompassed more than twenty-five hectares of cultivated land. Other farm owners with more than twenty-five hectares of land received monetary compensation for their surplus land that was seized, as did nonfarming households, which were allowed to keep only three hectares of cultivated land. It was envisaged that compensation for the seized land would be paid out in the amount of one year's yield per hectare. Half of the land acquired in this way was allotted to people without land and other poor farmers with less than 2.5 hectares of land. The size of private farms was limited to ten hectares of cultivated land after 1953 (Kladnik and Andrič 2013; Čepič 1995). In the 1973, the maximum permitted landholding in Slovenia was increased to twenty hectares in mountain and karst areas (Avsec 1988). Because of the small and fragmented properties, income from farming was not sufficient to make a living, and so farmers started to take jobs in industry, working their land in the afternoon and on weekends. An increasingly large stratum of part-time farmers took shape. Their income from nonagricultural activity was largely invested in modernizing the farms. Job opportunities in industry and other activities for the rural population prevented the abandonment of farmland and made it possible to preserve farming activity and the rural cultural landscape (Klemenčič 1968; Klemenčič 1974; Logar 2013; Razpotnik Visković 2013; 2015). In an effort to offset the negative impact of permanent land loss due to urbanization, an extensive program of land reclamation was begun in the 1970s, the centerpiece of which was irrigation and drainage, which was ecologically highly controversial (Kladnik and Andrič 2013). Due to these processes, in 1990 the Slovenian rural landscape was completely different from the Czech one. Whereas large state-owned properties predominated in what is now the Czech Republic, in Slovenia a fragmented property composition was preserved that did not differ significantly from that of the nineteenth century.

3.4 After 1990

After 1990, full-scale political and economic liberalization was achieved, the central European countries became EU and NATO members, and standard capitalist and democratic regimes were established based on a market economy. In Czechia, the former state-owned farms have been transformed into limited companies through privatization. The communist-style collective farms have been transformed into cooperatives managed by landowners that nowadays constitute relatively functional units. People do not have an affiliation with the land. In most cases, the new owners that regained their land through restitution did not start farming but instead rented the land out. The greatest share of agricultural land is managed either by limited companies (46%) or by transformed cooperatives (23%). In the European context, these companies are rather large, which allows cost-effective farming and competitiveness. As Havlíček (2018) points out also a large part of land seized by communist regime from churches between 1948 and 1989 was returned to the churches mainly in 2014 and 2015. Overall, the period after 1990 was characterized by a decline in total agricultural production. Czech agriculture as a whole continues to profit from EU membership and from the subsidies in the framework of the Common Agricultural Policy. The continuing decrease in arable land is the most important land-use change after 1990. In most cases, arable land was converted into permanent grassland, also (sub)urbanization was important process of landscape change in this period (Bičík et al. 2015).

Slovenia has been caught up in a storm of rapid tertiarization and, in the past two decades, also globalization, which has exposed the great vulnerability of Slovenian agriculture that does not meet the agricultural production standards in developed countries around the world. With accession to the European Union, state protectionism was also dropped, and Slovenian farmers found themselves in a tough battle to survive on the global market. This started with independence of Slovenia (in 1990). By far the most important incentive that still motivates farmers to continue their rural way of life is preserving their farm tradition, something that has usually provided work for several generations. Other reasons include enjoyment of farm work, the desire to have one's own produce, and attachment to the land. Regardless of these motives to preserve agricultural land use, financial instruments as part of European Union rural development measures have a significant impact. One of the mega-drivers preventing more efficient use of farmland remains land fragmentation, but nonetheless there is a slow decrease in the number of farms and an increase in the concentration of land. There is also growing interest in land consolidation and agglomeration (Kladnik and Andrič 2013; Lampič et al. 2017).

4 Results

4.1 Overview of land use changes

A comparison of land-use changes in Slovenia and Czechia (Figures 1 and 2) shows that the processes in both countries were similar. During individual periods, the shares of individual types of use changed in the same direction and in comparable dimensions. However, the initial composition of land use already significantly differed in the nineteenth century, which was a result of natural geographical conditions. Thus, in Czechia the share of arable land is approximately twice as large as in Slovenia, and the share of forested land and permanent grasslands is correspondingly smaller (Gabrovec and Kladnik 1997; Gabrovec, Petek and Kladnik 2001; Bičík et al. 2015).

4.2 Index of change

In both countries, the index of change (Figures 3 and 4) shows a similar picture, with the highest values in two types of areas. It seems reasonable that the highest values are recorded in the core areas with intensive social and economic development. However, the majority of peripheral, mountainous border regions have also witnessed rather intensive changes. In both countries, the greatest changes took place in areas from which the ethnic German population moved or was expelled during or immediately after the Second World War. In Slovenia this is the Kočevje area in the southeast part of the country (Mares, Rasin and Pipan 2013), and in Czechia the hilly Sudetenland along the border with Germany. In addition, in Slovenia the Kras Plateau in the southwest part of the country should be highlighted. The Franciscean cadaster shows that among all Slovenian regions natural forest vegetation was cleared the most on the Kras Plateau, which was at that time synonymous with the barren and desolate karst landscape. Today forest covers more than half of the Kras Plateau, which is the result of planned reforestation at the end of the nineteenth century (Kladnik, Petek and Urbanc 2008; Kladnik 2011; Zorn, Kumer and Ferk 2015) followed by natural succession of meadows and pastures.

4.3 Typology of land-use changes

The maps of the typology of land-use changes in Slovenia (Figure 5) and Czechia (Figure 6) show a roughly similar picture, in which Class C predominates in both, showing a simultaneous increase in forested areas and other areas; that is, a combination of urbanization and afforestation. The next, with a much smaller share of cadastral municipalities, is Class A, corresponding to an increase in other areas – that is, primarily built-up land, and at the same time a decrease in farmland and forested areas. In Slovenia, in contrast to Czechia, Class B – which indicates the expansion of forested areas and a simultaneous decrease in farmland and built-up land – corresponds to just under a tenth of cadastral municipalities. In Slovenia, in addition to the Kočevje region, which the ethnic German population was expelled from, this class includes some

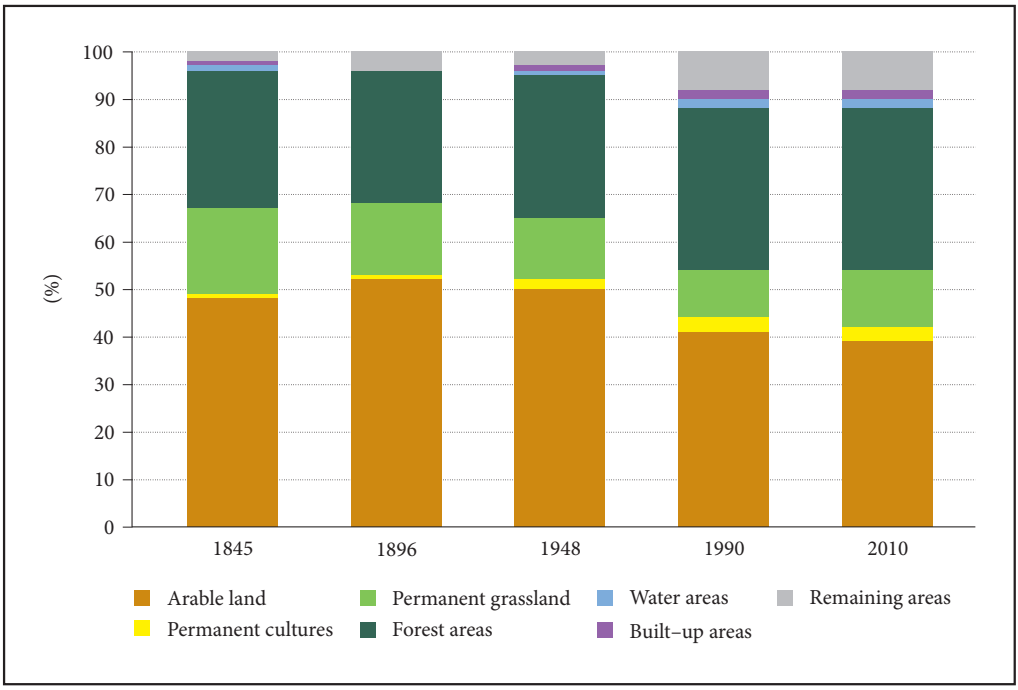

Figure 1: Czech land use between 1845 and 2010.

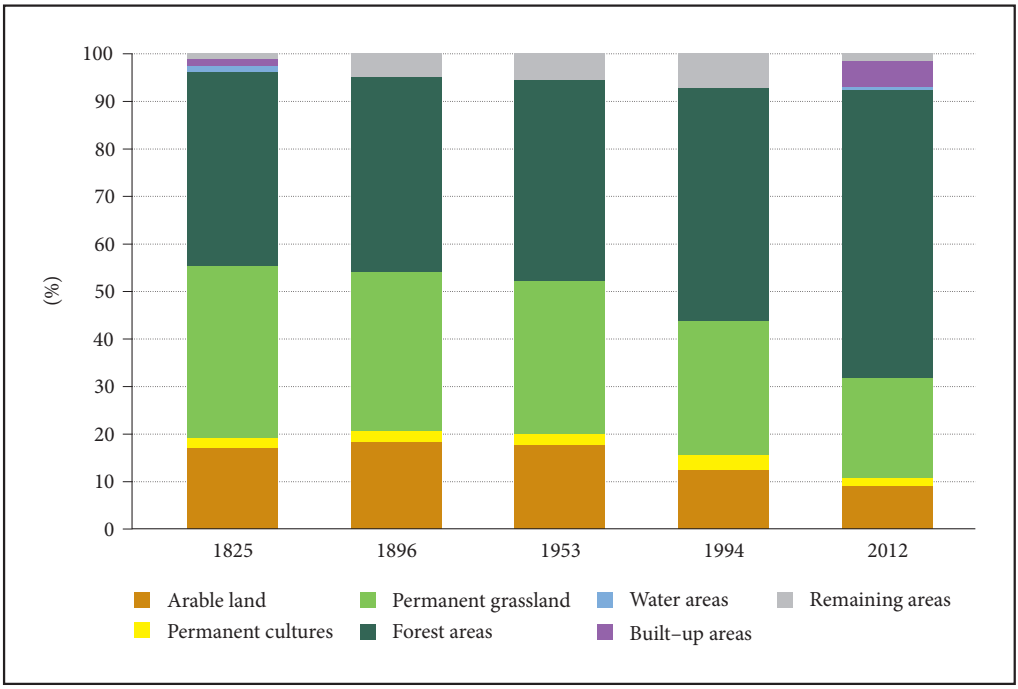

Figure 2: Slovenian land use between 1825 and 2012.

sparsely settled depopulation areas, especially in western Slovenia. This class would also include hilly border areas in Czechia, but in terms of land use much of the forested land there has been classified as protected areas (as mentioned in Section 2), which was included among other areas. In the typology of land-use change these areas are therefore mostly included in Class C.

5 Discussion and conclusion

This article is the first comparative study of land-use changes in two central European countries over a period of two centuries using uniform quantitative methods. It uses the index of change and typology of changes based on the calculated increase or decrease in farmland, forested land, and other land. The processes of land-use change were based on the driving forces behind the changes from the first half of the nineteenth century to the present, and these differed the most between the two countries during the twentieth century. The consequence of different agricultural policies in the period after the Second World War is not reflected so much in different land use, but in the different sizes of parcels and the diversity of land use.

Although the driving forces behind the changes are presented in the framework of short time periods, land-use changes are cartographically presented and analyzed only between the beginning of their study in the nineteenth century and 2010 or 2012. In the future it would therefore make sense to examine the second half of the twentieth century in greater detail because the processes of change were most intense during this period and at the same time there were also the greatest differences between the two countries. As a result, one would expect greater differences in the processes of land-use changes, but the analysis showed that these were comparable during the period analyzed. Nonetheless, the cultural landscape in the Czech Republic has been visually transformed to a significantly greater extent. Because of the nationalization of land after the Second World War and the establishment of state-owned collective farms and cooperatives, today large complexes of farmland predominate, whereas Slovenia is still characterized by fragmented properties and the cultural landscape therefore preserves many more elements from the nineteenth century.

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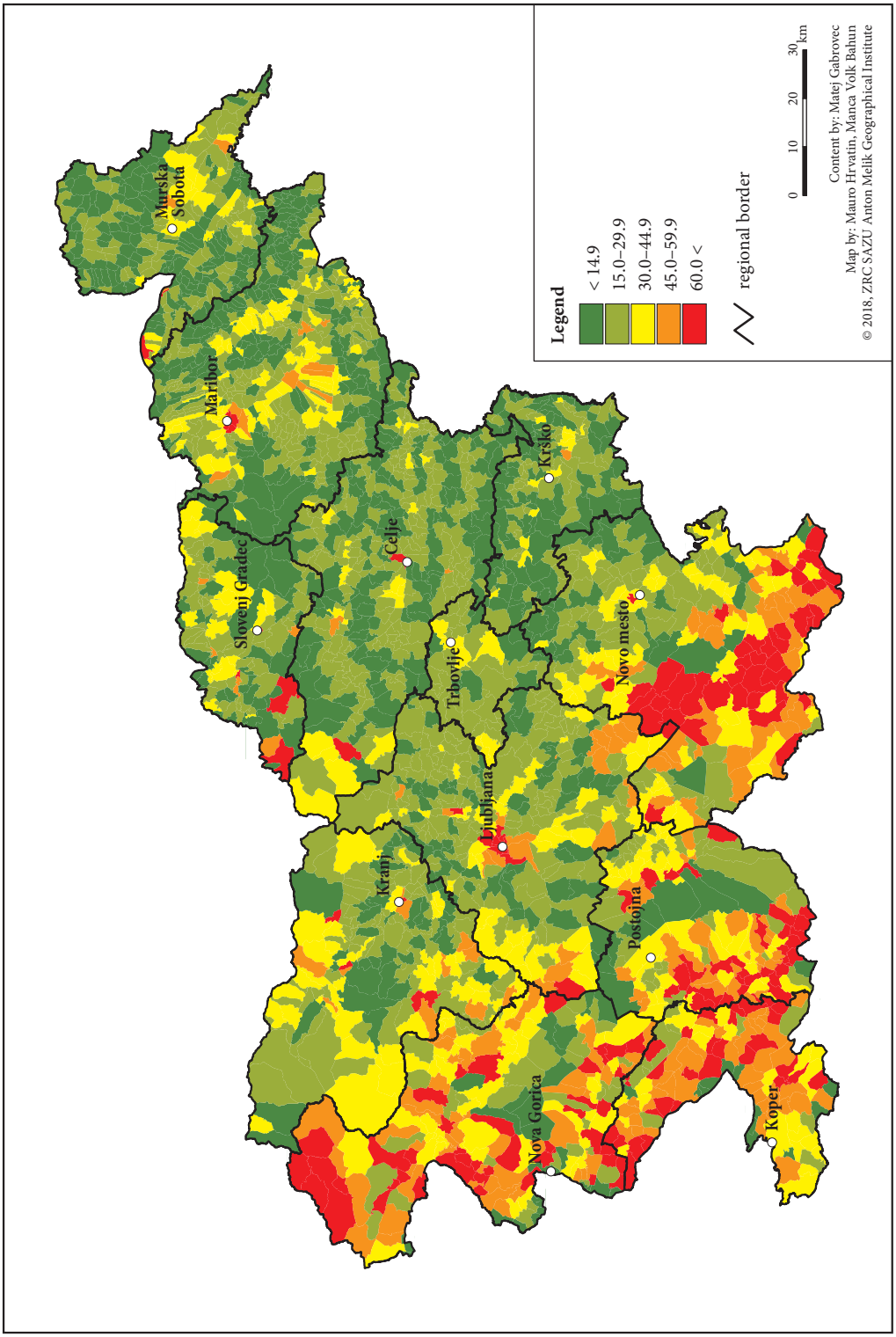
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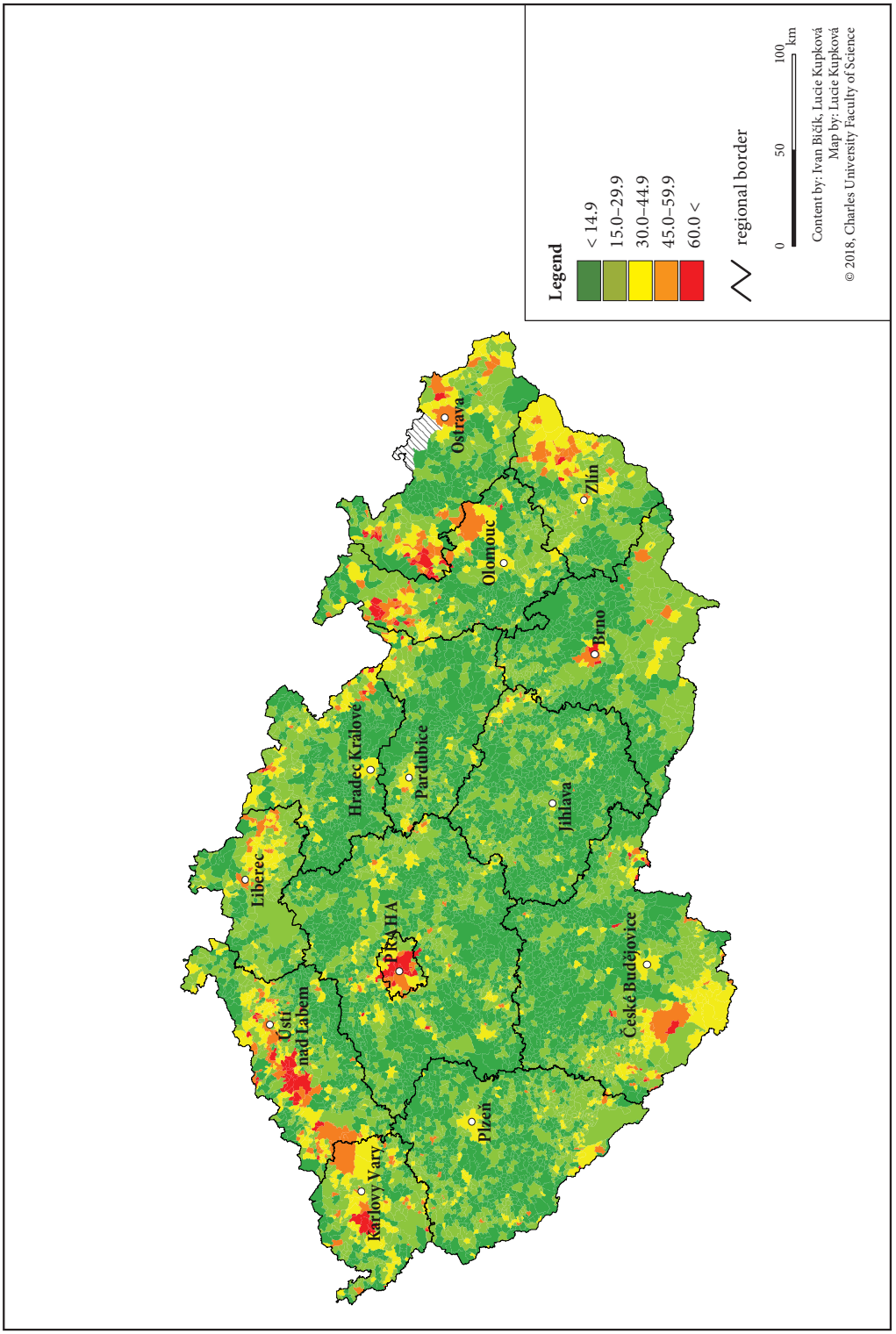
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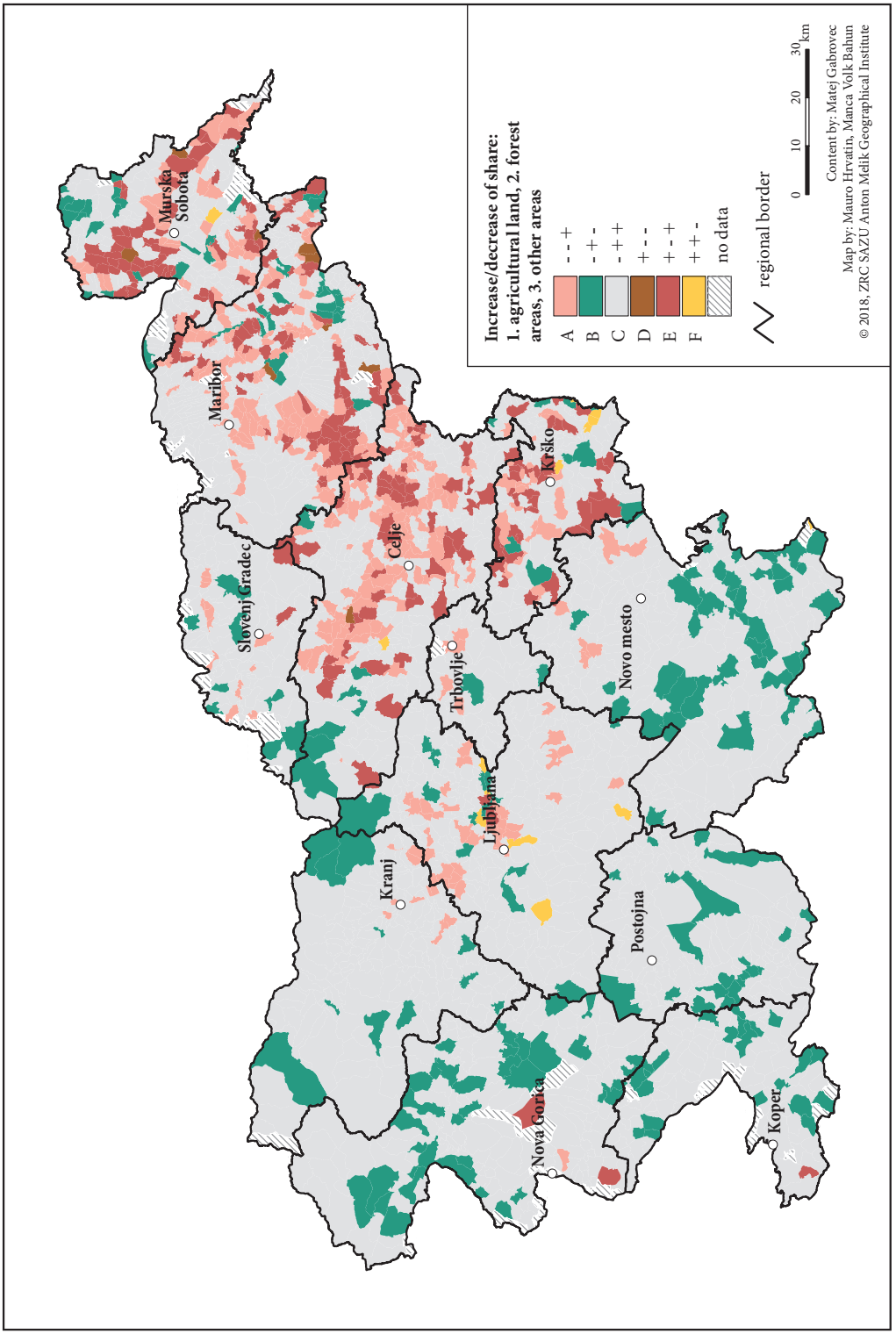
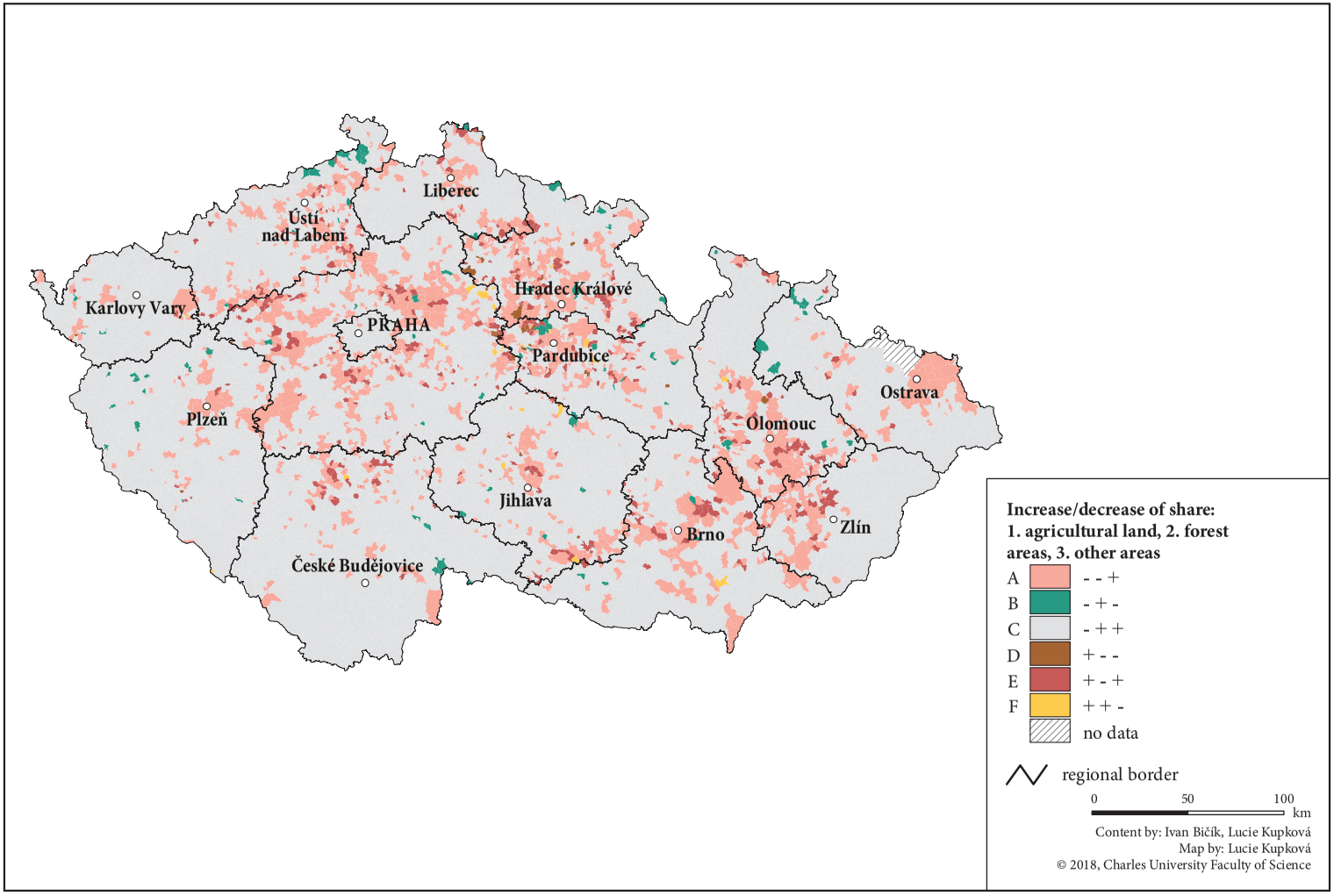
PRAHA
Ústí nad Labem
České Budějovice
Plzeň
Karlovy Vary


Increase/decrease of share:
1. agricultural land, 2. forest areas, 3. other areas
A - - +
B - + -
C - + +
D + - -
E + - +
F + + -
no data
regional border
0 10 20 30 km
Content by: Matej Gabrovec
Map by: Mauro Hrvatin, Manca Volk Bahun
© 2018, ZRC SAZU Anton Melik Geographical Institute
Murska Sobota
Maribor
Slovenj Gradec
Celje
Trbovlje
Kranj
Ljubljana
Kočevje
Novo mesto
Postojna
Nova Gorica
Koper


Liberec
Ústí
nad Labem
Karlovy Vary
Hradec Králové
PRAHA
Pardubice
Ostrava
Plzeň
Olomouc
Jihlava
Brno
Zlín
České Budějovice
Increase/decrease of share:
1. agricultural land, 2. forest
areas, 3. other areas
A - - +
B - + -
C - + +
D + - -
E + - +
F + + -
no data
regional border
0
50
100
km
Content by: Ivan Bičík, Lucie Kupková
Map by: Lucie Kupková
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