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Fotografija na naslovnici: Kamniti most čez reko Rak na obrobju kraškega polja Rakov Škocjan, ki je sicer bolj znano po čudovitih naravnih mostovih (fotografija: Matej Lipar).

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LAND-USE CHANGES IN SLOVENIA FROM THE FRANCISCEAN CADASTER UNTIL TODAY

Matej Gabrovec, Peter Kumer

PETER KUMER

Extensification of agriculture and afforestation in Kanomlja Valley in the Alpine region.

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Land-use changes in Slovenia from the Franciscean Cadaster until today

ABSTRACT: The Franciscean Cadaster from the first half of the nineteenth century is an excellent source for studying land use and its changes. However, to date it has only rarely been used in geographical and historical research at the regional or national level. Setting up a digital database of land use recorded in the Franciscean Cadaster at the level of cadastral municipalities covering all of Slovenia and incorporating it into a geographic information system has provided an opportunity for detailed studies of land-use changes spanning two centuries. This article presents the first analyses of changes in individual land-use types and the typology of changes across two centuries.

KEY WORDS: geography, land-use, land-cover, Stable Cadaster, Central Europe

Spremembe rabe zemljišč v Sloveniji od franciscejskega katastra do danes

POVZETEK: Franciscejski kataster iz prve polovice 19. stoletja je odličen vir za preučevanje rabe zemljišč in njenih sprememb. Kljub temu je bil doslej v geografskih in zgodovinskih znanstvenih razpravah redko uporabljen za raziskave na regionalni ali državni ravni. Z vzpostavitvijo podatkovne baze o rabi zemljišč franciscejskega katastra na ravni katastrskih občin za ozemlje celotne Slovenije v digitalni obliki in njeno vključitvijo v geografski informacijski sistem se odpirajo možnosti poglobljenih študij sprememb rabe zemljišč v časovnem razponu dveh stoletjih. V prispevku so prikazane prve analize sprememb posameznih vrst rabe in tipologija sprememb v obdobju dveh stoletij.

KLJUČNE BESEDE: geografija, raba zemljišč, pokrovnost zemljišč, stabilni kataster, Srednja Evropa

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1 Introduction

A high-quality set of land-use data spanning two centuries is available for the territory of the former Austrian monarchy in central Europe. The Franciscean or Stable cadaster from the first half of the nineteenth century is unique in the world because, in addition to written records, it also includes 1:2,880 cadastral maps showing land use (Bičík et al. 2015). The majority of Slovenian territory was covered in the cadaster as early as in the 1820s, with the exception of Prekmurje, which belonged to the Hungarian part of the monarchy and was included in the cadaster around 1860 (Petek and Urbanc 2004). Land use in the Franciscean Cadaster was elaborately inventoried for the needs of the tax administration (Jeleček 2006). The nineteenth-century cadaster has been used (with certain modifications) until the present regardless of political changes, which makes it possible to compile a high-quality land-use database, incorporate it into a geographic information system, and determine the factors influencing land-use changes (Harvey, Kaim and Gajda 2014).

Land-use changes are influenced by many interdependent factors arising from the relationship between people and their needs on the one hand, and the environment and its characteristics on the other. Changes in this relationship occur in various times and places, depending on how the society is organized and connected with the environment (Briassoulis 2000; Lambin and Geist 2006). In the nineteenth century, differences in the processes related to land-use changes in Austria-Hungary were largely connected with different natural conditions, whereas in the twentieth century they were largely the result of different political systems in the newly established countries. Hence, because of the reliable data available and the differences in the natural and social conditions, this territory is a perfect laboratory for exploring land-use changes.

Even though the Franciscean Cadaster is one of the most important historical sources, until recently it was overlooked in scholarly research; this was especially true of its written part (Drobesch 2013b). The **graphic part** was often used because its large scale (1:2,880) allows detailed analyses of factors influencing local land-use changes. These types of studies conducted in Slovenia, including many bachelor's theses (Gabrovec 1995; Petek and Urbanc 2004; Domijan 2006; Urbanc 2009; Erjavec 2009; Božič 2010; Paušič and Čarni 2012; Prelog 2013; Verderber 2013; Ažman Momirski and Gabrovec 2014; Golob 2014; Šmid Hribar 2016), and in the Czechia (Rašín and Chromý 2010; Bičík, Kupkova and Štych 2012; Štych et al. 2012) facilitated the interpretation of these processes at the national level. Outside central Europe, a larger set of high-quality cadastral maps is available in Sweden, where land-use changes spanning three hundred years were examined in a 6 km^2 study area (Cousins 2001).

The **written part** was first used at the national level by Czech geographers, who created a land-use database covering the period from the mid-nineteenth century to 2010 and used it to study the factors influencing land-use changes (Bičík, Jeleček and Štěpánek 2001; Bičík et al. 2015). In Austria, the Franciscean Cadaster data were used by Krausmann (2001; 2006) in his articles on factors affecting land-use changes, but he only explored them at the national level and partly at the level of municipalities. Historians prepared a comprehensive publication and analysis of the cadaster's material for Austrian Carinthia (Drobesch 2013a; Rumpler 2013) and Bukovina (Rumpler, Scharr and Ungureanu 2015). Petek (2005a, 2005b) used the cadaster's written part in his analyses of land-use changes across the entire Slovenian Alps.

This article presents new methods that can be used to compare land use in Slovenian cadastral municipalities when the Franciscean Cadaster was made and in later periods. In addition, it presents the first results of applying this method. Compared to Gabrovec and Kladnik (1997), this article examines a significantly longer period and uses different techniques in cases where the borders of the cadastral municipalities have changed.

2 Data and methods

2.1 Input data

The written part of the Franciscean Cadaster was the main source for this study and was used to gather data on land use in the first half of the nineteenth century. The study used data collected at the level of cadastral municipalities. The written part of the land cadaster is presented in a table (a land-use statement) for each cadastral municipality separately, featuring the areas of individual land-use types. The spatial measures are provided in *Joch* and *Klafter*, and therefore all of the data were first converted into the metric system. The forms for Carniola, Carinthia, Styria, and part of the Littoral are provided in German and

envisage the entry of twenty-nine land-use categories (marked green in Table 1). The surveyors also added new categories to the majority of cadastral municipalities, whereby they struck out the categories that did not appear in a given cadastral municipality and added new ones on the printed form. The most frequent categories added included meadows or pastures with trees or shrubs. The forms used for some cadastral municipalities in the Littoral region were adapted to a more detailed classification of Mediterranean crops. These tables were lost for some of the cadastral municipalities. In this case, we used the table from an assessment report prepared later, during the 1830s, in which the division of land-use categories was simpler. Based on a comparison of data in the selected cadastral municipalities for which both tables were available, we conclude that the data are comparable. In Prekmurje, which belonged to the Hungarian part of the monarchy, the cadaster was not produced until around 1860, and the form used includes forty-six land-use categories. The data for Carinthia, Carniola, Styria, and Prekmurje are kept by the Slovenian Archives (Franciscejski kataster za Koroško 1823–1869; Franciscejski kataster za Kranjsko 1823–1869; Franciscejski kataster za Štajersko 1823–1869; Kataster za Prekmurje 1858–1860), and the data for Gorizia and Istria (Catasto franceschino 1818–1840) are kept by the Trieste State Archives.

We were only able to examine the changes in land use once we compared the land use recorded in the Franciscean Cadaster with current land use. Despite political changes, the concept of the land cadaster has not changed to this day. However, a significant change in terms of land-use data occurred in 2011 with the enforcement of a provision from the 2006 Real Estate Recording Act (Zakon o evidentiranju nepremičnin 2006) requiring that the land-use data entered in the land cadaster be taken from the Land Use data base. Therefore, the 2016 data were taken directly from the Land Use data base (Evidenca dejanske rabe … 2016). Žiberna (2013) reports that this database provides an excellent source for studying land-use changes after 2000.

2.2 Establishing comparable spatial units for land-use data from two different time periods

The key problem in comparing land use in two different periods is the variable size and different borders of cadastral municipalities. Any change in their borders means that the data for different years are no longer comparable. Previous comparable studies (Kladnik 1985; Gabrovec and Kladnik 1997 for Slovenia; Bičík, Jeleček and Štěpánek 2001; Bičík et al., 2015 for the Czech Republic) did not pay much attention to this issue and simply solved it by combining two or more cadastral municipalities and obtaining the least common multiple. However, with longer time intervals, comparable units become increasingly larger and increasingly less useful for comparative analyses due to their internal heterogeneity.

Slovenian cadastral municipalities were established in the nineteenth century, whereby each comprised one or several villages with appertaining land (Vrišer 1987). They are considered the most stable spatial unit and they have largely retained their original size and borders until today (Gabrovec and Kladnik 1997). Our research shows that changes in this regard primarily occurred due to 1) political changes or 2) urban expansion. When political changes occurred, the new national borders often did not correspond to the borders of cadastral municipalities. On the Italian border this happened in the Breginj in 1866, when Venetian Slovenia was annexed to Italy; after the First World War it happened in Rateče and Inner Carniola between Idrija and the Croatian border, when part of Carniola was awarded to Italy; and after the Second World War this occurred in the area between the Goriška brda Hills and the Muggia/Milje Peninsula. After the First World War, the new border with Austria divided many cadastral municipalities in places where it did not run along the old provincial borders. Similarly, the new border between Hungary and Yugoslavia cut through the cadastral municipalities east of Lendava and at Domanjševci. After the Second World War, a completely new border with Croatia was established in Istria, where in some places it also did not run along the borders of the cadastral municipalities, and a similar situation occurred on the southern edge of the Gorjanci Hills in Bela krajina and along the Mura River. The expansion of cities primarily led to border changes in the central part of the country. These changes largely occurred after the Second World War.

This study achieved the comparability of land-use data from two different periods by relying on the original sizes of cadastral municipalities. This is the level at which data provided in the Franciscean Cadaster were gathered, whereas data on current land use provided in the Slovenian Land Use data base (Evidenca dejanske rabe … 2016) are gathered at the level of parcels. The latter can be converted to any spatial unit or, in this case, to the original size of cadastral municipalities. Hence, the 2016 data were depicted by area of cadastral municipalities as recorded in the early nineteenth century. The greatest challenge in doing this

was the time-consuming process of compiling a digital database of the sizes and borders of the original cadastral municipalities (Figure 1).

We used the current borders for cadastral municipalities whose size has not changed significantly, and for others we adjusted the borders using 1 : 115,200 index maps (Uibersichts … 1829; Uibersichts … 1890; Übersichts … 1850). To some extent, we also used later index maps (e.g., Pregledna karta … 1960). In individual cases, where the border changed before these index maps were published or these were not sufficiently precise, we adjusted the border using the graphic part of the cadaster or the sketches of the borders and location of the cadastral municipalities featured in the written part of the cadaster. We edited the borders of historical cadastral municipalities using *ArcGIS 10* software.

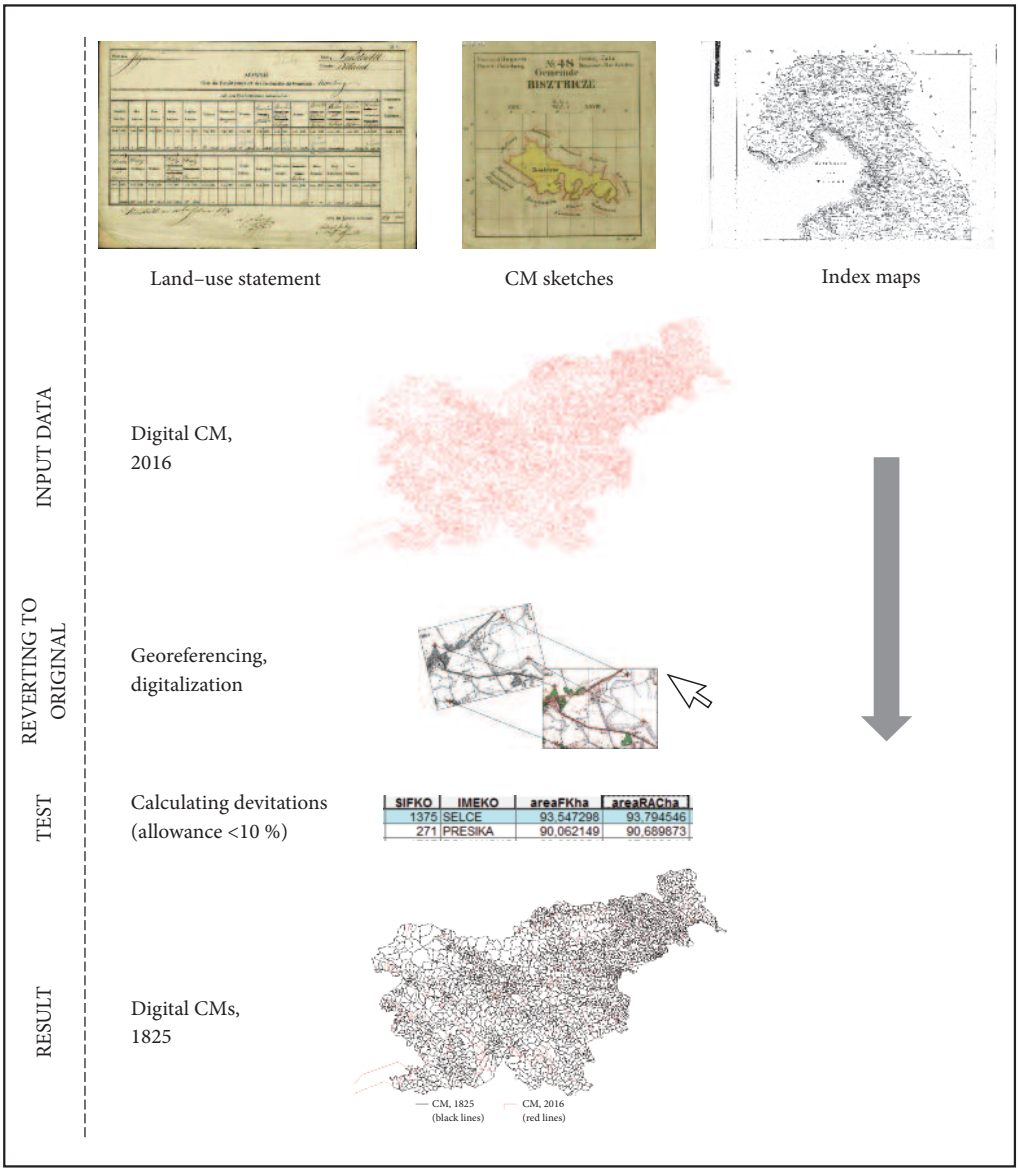


Figure 1: Compiling the digital database of sizes and borders of original cadastral municipalities (CMs).

2.3 Achieving the comparability of land-use categories from two different time periods

After we compiled the digital database, we analyzed the changes in land use. This was the first attempt at using the database compiled. The 2016 data were obtained from the Land Use data base (Evidenca dejanske rabe … 2016), where land use is presented in twenty-five categories (Interpretacijski ključ … 2013). The Franciscean Cadaster used a different land-use typology than today's Land Use data base, and therefore we combined the individual categories of both sources to obtain shared comparable categories (Table 1). Petek (2005a) combined land-use categories in a similar way, with the exception of extensive orchards, which he classified under grassland. The Franciscean Cadaster categorizes these orchards as meadows with fruit trees. For 1896 this category is shown together with meadows, and so in his analysis, which also included this year, Petek had no other choice but to address meadows and extensive orchards together. He combined intensive orchards with arable land, under which he also classified permanent crops.

Table 1: Land-use types in the Franciscean Cadaster and the Slovenian Land Use data base (with the standard types in the Franciscean Cadaster marked green).

Land Use data base			Franciscean Cadaster
Group of land-use types	Code	Land-use type	Land-use type
Arable land	1100	Arable land	Vegetable garden
			Ornamental garden
			Arable land
			Arable land with chestnuts
			Arable land with meadows
			Arable land with trees
			Newly cleared land (*Rottacker*)
	1160	Hop plantation	Hop plantation
	1190	Greenhouse	–
Permanent crops	1211	Vineyard	Vineyard
			Arable land with grapevines
			Arable land with trees and grapevines
			Arable land with fruit trees and grapevines
			Arable land with grapevines and mulberries
			Vineyard with fruit trees
			Vineyard with fruit trees and chestnut trees
			Arable land with fruit trees, grapevines, and olive trees
			Arable land with grapevines and olive trees
			Vineyard with olive trees
			Meadow with fruit trees and grapevines
			Meadow with grapevines
			Pasture with fruit trees and grapevines
			Pasture with grapevines and olive trees
			Pasture with grapevines
	1221	Intensive orchard	–
	1222	Extensive or meadow orchard	Orchard
			Meadow with fruit trees
			Pasture with fruit trees
			Arable land with fruit trees
			Pasture with mulberries
	1230	Olive grove	Arable land with olive trees
			Olive grove
			Pasture with olive trees
	1240	Other permanent crops	–

Grassland	1300	Permanent grassland	Meadow
			Pasture
			Mountain pasture
			Common pasture
	1321	Swampy meadow	Wet meadow
			Wet pasture
	1800	Farmland with forest overgrowth	Meadow with trees
			Meadow with shrubs
			Meadow with shrubs and trees
			Wet meadow with trees
			Pasture with trees
			Pasture with shrubs
			Pasture with shrubs and trees
			Pasture with chestnuts
			Wet pasture with trees
			Wet pasture with shrubs
Other agricultural land	1410	Old-field succession	–
	1420	Forest plantation	–
	1500	Trees and shrubs	Shrubs
	1600	Uncultivated farmland	Abandoned land
Forest	2000	Forest	Forest
			Deciduous forest
			Coniferous forest
			Mixed forest
			Young-growth forest
			Oak forest
			Willow forest
			Chestnut forest
			Riparian forest
			Walnut plantation
Other non-farmland	3000	Built and similar land	Gravel pit
			Clay pit
			Quarry
			Buildings
			Roads
	4100	Bog	–
	4210	Reed bed	Swamp with reeds
			Reed bed
			Wet meadow with reeds
	4220	Other swampy land	Swamp
	5000	Dry, open land with specific plant cover	–
	6000	Open land without or with insignificant plant cover	Bare rock
	,		Gravel bed
	7000	Water	Rivers and creeks
			Lakes and ponds
			Salt pans
			Common fishing ground
			Sea channel
			Embankments (in the sea)

2.4 The typology of land-use changes

The synthetic map of the typology of land-use changes was based on the method developed by Medved (1970), who used it to show the typology of changes between 1954 and 1967. He distinguished between the following four main processes:

- Afforestation: farmland changing into forest;
- Grass overgrowth: arable land changing into meadows or pastures or an increase in grassland area;
- Urbanization: increase in building land for the needs of urbanization; and
- Intensification: increase in the area of arable land and permanent crops.

A modified version of this method was used in many studies in Slovenia and the Czech Republic (Kladnik 1985; Gabrovec and Kladnik 1997; Gabrovec, Petek and Kladnik 2001; Petek 2005a; Bičík, Kupkova and Štych 2012) because it allows a good comparison of processes in different periods. The Slovenian studies mentioned only covered the twentieth century, whereas this article compares land use in the early nineteenth century with land use in the early twenty-first century. The maps show the predominant processes in individual cadastral municipalities. The significance of each process is presented at three levels. A strong process refers to over 75% of all changes, a moderate one to 50 to 75% of all changes, and a weak one to less than half of all changes, although it is still the predominant process in the cadastral district.

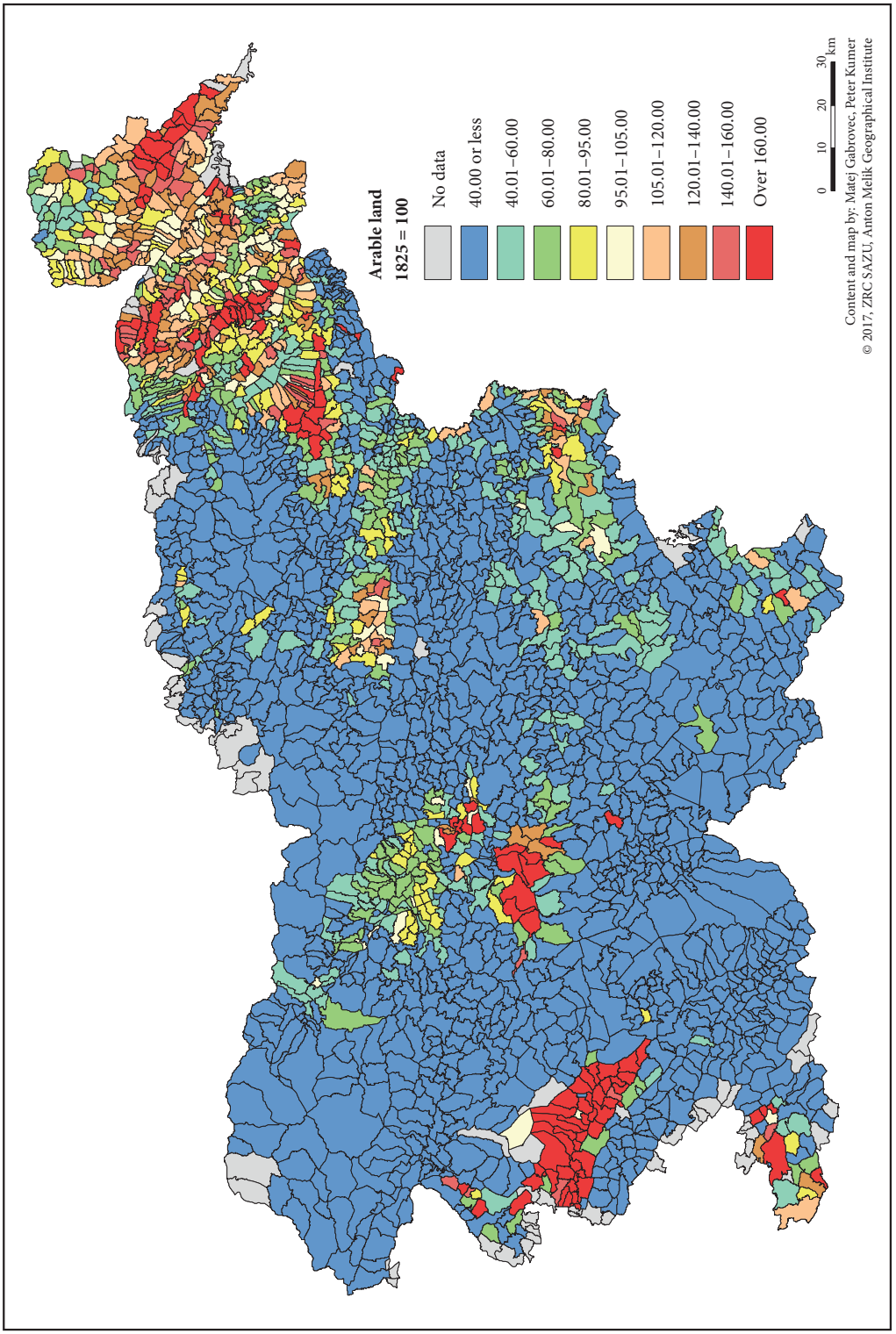
3 Results

Within the available space limits, this section highlights the differences in the processes of land-use changes by Slovenian regions, resulting from Slovenia's exceptional landscape diversity (Perko 1998; Perko, Hrvatin and Ciglič 2017). However, we do not explore the social-geographical factors influencing land-use changes in Slovenia by individual historical periods because these were already presented on a timeline for the period from 1800 to 2000 by Petek (2005a). Kladnik and Andrič (Jepsen et al. 2015) discuss the resulting changes in land management systems. In individual historical periods, these factors were similar across all of Slovenia, except in western Slovenia, which was part of Italy during the interwar period.

In the early nineteenth century, arable land covered 16% of what is now Slovenia. Land use at that time points to the predominantly subsistence farming typical of the preindustrial period. Based on the farming methods used at that time, approximately 1.3 ha of farmland per capita were required for sufficient food production (Krausmann 2006; Gabrovec, Komac and Zorn 2012). Farmers optimized the use of land at the local level, and the area covered by farmland (especially tilled fields) depended more on the number of inhabitants than natural conditions. Therefore, the differences in the share of arable land between individual Slovenian regions were smaller than today. Within two centuries, the area covered by arable land decreased to 9%. In the majority of cadastral municipalities, this decrease was even greater, but in some the area covered by arable land increased significantly (even by more than 60%; Figure 2). All cases involved flatland, but differences can also be seen between individual cases of flatland. The greatest increase in arable land can be observed on wetland or floodplains that were drained during the period studied. The most typical example is Ljubljansko barje (the Ljubljana Marsh), where drainage began as early as the nineteenth century (Melik 1927). In other areas, such as the Vipava Valley or the Pesnica and Ščavnica valleys in the Slovenske gorice Hills, land amelioration was carried out in the second half of the twentieth century, and in the wetland area on the Drava Plain hydroamelioration was carried out as late as the 1980s (Žiberna 2010).

Vineyards cover only 1% of Slovenia's territory today, but they play an important economic and visual role in the Mediterranean and Pannonian cultural landscapes. They account for less than half of the area they covered in the first half of the nineteenth century. During the nineteenth century, winegrowing was already market-oriented and hence economic and political changes had a stronger impact on it than on other agricultural activities. At the end of the nineteenth century, a large portion of vineyards were destroyed by grape diseases. Despite their later renovation, they never covered an area as large as they did in the mid-nineteenth century. Figure 3 shows a decrease in the share of vineyards across all of Slovenia. This decrease was less significant in the Mediterranean landscapes, as shown in Figure 3, because they were characterized by mixed crops, which are also listed in the land register. In our analysis, all land-use categories that

Figure 2: Index of changes in the area covered by arable land between 1825 and 2016. ►


Arable land
1825 = 100
No data
40.00 or less
40.01–60.00
60.01–80.00
80.01–95.00
95.01–105.00
105.01–120.00
120.01–140.00
140.01–160.00
Over 160.00
0
10
20
30
km
Content and map by: Matej Gabrovec, Peter Kumer
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also included grapevines were included under vineyards, and so the nineteenth-century areas that we calculated for vineyards are larger than the ones that actually existed, subsuming areas also planted with olives in particular. The development of winegrowing in the Koper countryside was analyzed in detail by Titl (1965) and in the Haloze Hills (in Pannonian Slovenia) by Bračič (1967). During the period studied, the area covered by vineyards increased only in individual cadastral municipalities. This increase resulted more from local initiatives for vineyard renovation and expansion than from natural conditions. The most significant increase can be observed in the Bizeljsko Hills.

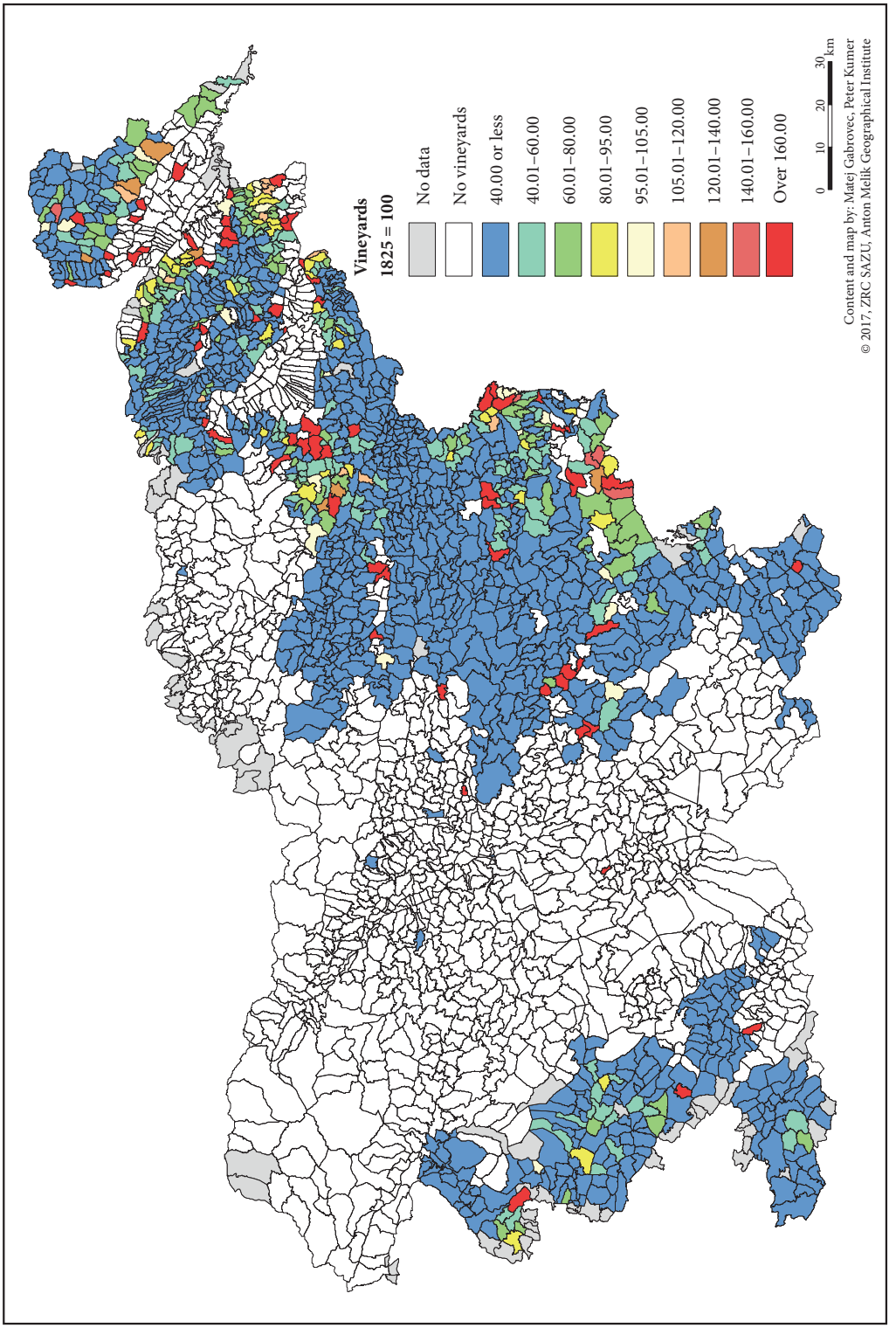
Grassland now covers 18% of Slovenia, which is also less than in the nineteenth century, when it covered a third of Slovenian territory. Changes in grassland area are connected with natural landscape elements (Figure 4). In mountainous and karst landscapes, the decrease in grassland results from old-field succession. This process is typical of a major portion of the Dinaric and Alpine macro-region of western Slovenia and is especially pronounced in the Soča Valley, the Karst Plateau, and the Kočevje region. In the case of the Kočevje region, it is connected not only with unfavorable natural conditions, but also with the relocation of the Kočevje (Gottschee) Germans during the Second World War (Mares, Rasin and Pipan 2013). On the Pannonian plains of eastern Slovenia, the decrease in grassland is the result of agricultural intensification, which is reflected in the growth of arable land at the expense of grassland. A reverse process is typical of the hills in eastern Slovenia, where an increased share of meadows is the result of the agricultural extensification, or a decrease in arable land.

The area covered by forests increased the most among all of the land-use types analyzed (Figure 5). Forests covered 39% of Slovenian territory in the first half of the nineteenth century and a full 61% in 2015. The increased share of forests in the hills and mountains of the alpine macro-region is connected with the abandonment of farmland and old-field succession. The Franciscean Cadaster shows that among all Slovenian regions natural forest vegetation was cleared the most on the Kras. In some cadastral municipalities forest was not even recorded at all, and so at that time the Kras was synonymous with the barren and desolate karst landscape. Today forest covers more than half of the Kras, 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 afforestation of meadows and pastures. Forests also grew in size in certain places on the plains, most notably on the Drava Plain, where the needs for cultivated farmland decreased as early as the nineteenth century due to the abolition of the fallow land requirement and people began to abandon their fields in areas with the shallowest soil (Pak 1969; Žiberna 2010).

The greatest relative increase can be observed with built-up land, which covered only 1.4% of the territory in the early nineteenth century, whereas now its share is over 5%. Figure 6 shows a predominance of cadastral municipalities with an index of changes over 160. An above-average increase can be observed in major cities and their surroundings, and along the main roads. Built-up land decreased only in the Kočevje region due to the eviction of the Kočevje (Gottschee) Germans during the Second World War. Roads cover a larger area than buildings in terms of built-up land types. The Franciscean Cadaster distinguishes between these two types, which also allows interesting comparisons with later periods (Gabrovec and Bole 2013).

In individual cadastral municipalities, changes in specific land-use types occur in different shares of their total area. The predominant process is presented on the map of typology of land-use changes (Figure 7), which was produced based on Medved's methodology described above (Medved 1970). Considering the increase in the area covered by forests during the period studied, it is logical that afforestation is the predominant process. This contrasts with urbanization in western Slovenia, the only exception being Ljubljansko barje (the Ljubljana Marsh), which is experiencing intensification. Eastern Slovenia is more diverse. Grass overgrowth predominates on the lower hills and afforestation dominates in the eastern Goričko Hills. In eastern Slovenia, strong urbanization is typical primarily in the Lower Savinja Valley and in Maribor and its surroundings and intensification is common on the Mura Plain and in wet meadows that were drained in the twentieth century.

Figure 3: Index of changes in the area covered by vineyards between 1825 and 2016. ►
Figure 4: Index of changes in the area covered by grassland between 1825 and 2016. ► p. 74
Figure 5: Index of changes in the area covered by forests between 1825 and 2016. ► p. 75
Figure 6: Index of changes in the built-up area between 1825 and 2016. ► p. 76
Figure 7: Types of land-use changes between 1825 and 2016. ► p. 77


Vineyards
1825 = 100
No data
No vineyards
40.00 or less
40.01–60.00
60.01–80.00
80.01–95.00
95.01–105.00
105.01–120.00
120.01–140.00
140.01–160.00
Over 160.00
0 10 20 30 km
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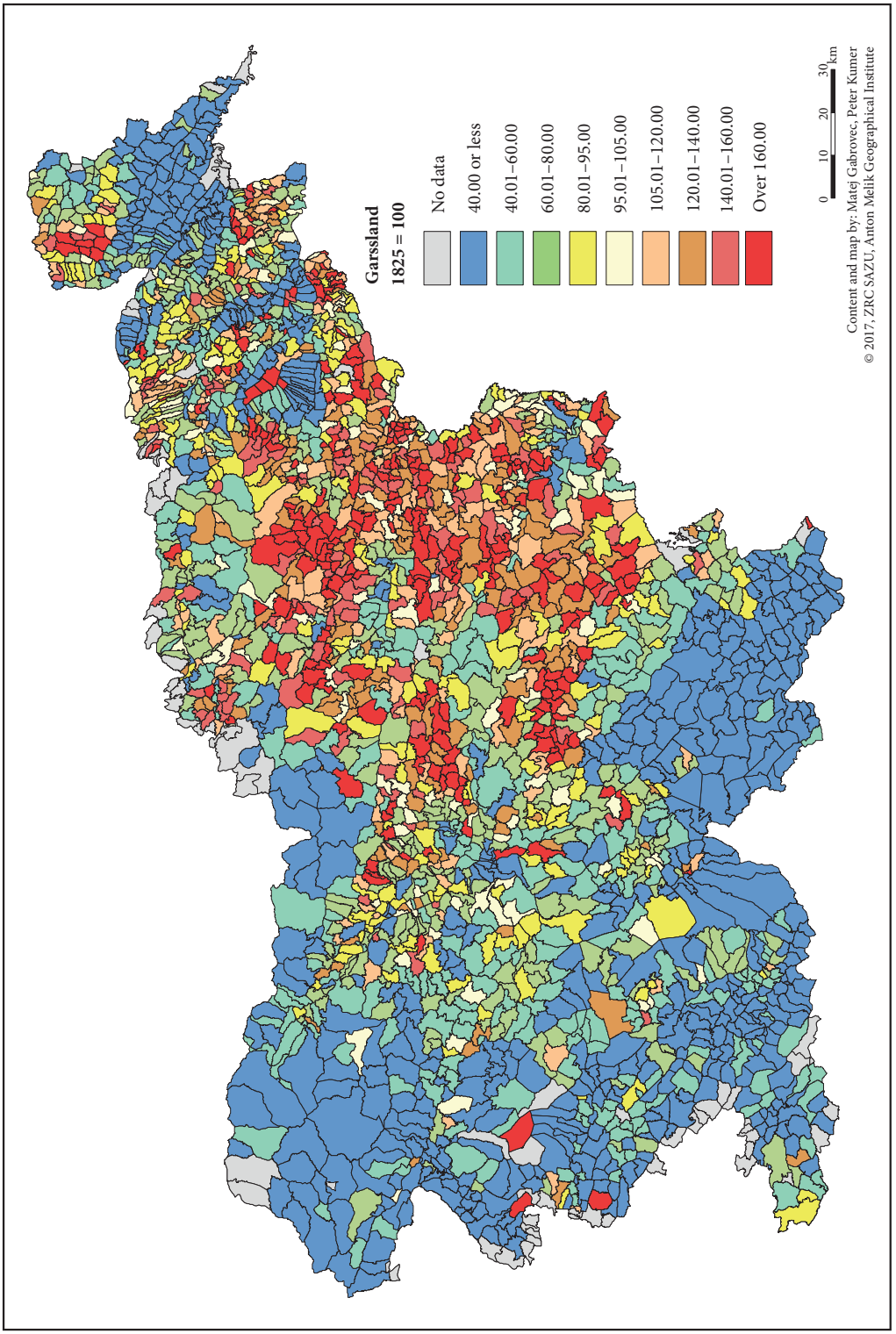
Garssland
1825 = 100
No data
40.00 or less
40.01–60.00
60.01–80.00
80.01–95.00
95.01–105.00
105.01–120.00
120.01–140.00
140.01–160.00
Over 160.00
0
10
20
30 km
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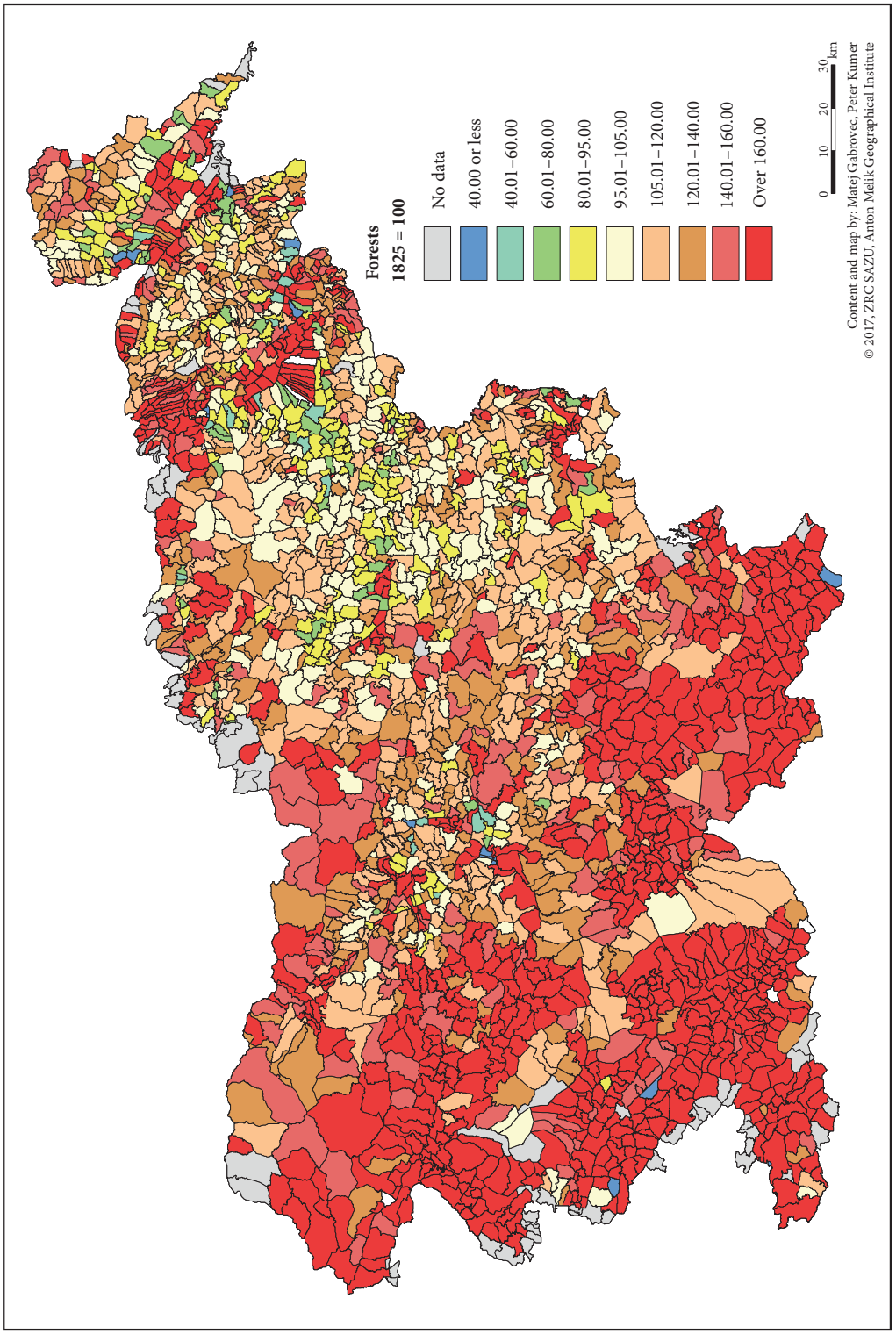
Forests
1825 = 100
No data
40.00 or less
40.01–60.00
60.01–80.00
80.01–95.00
95.01–105.00
105.01–120.00
120.01–140.00
140.01–160.00
Over 160.00
0 10 20 30 km
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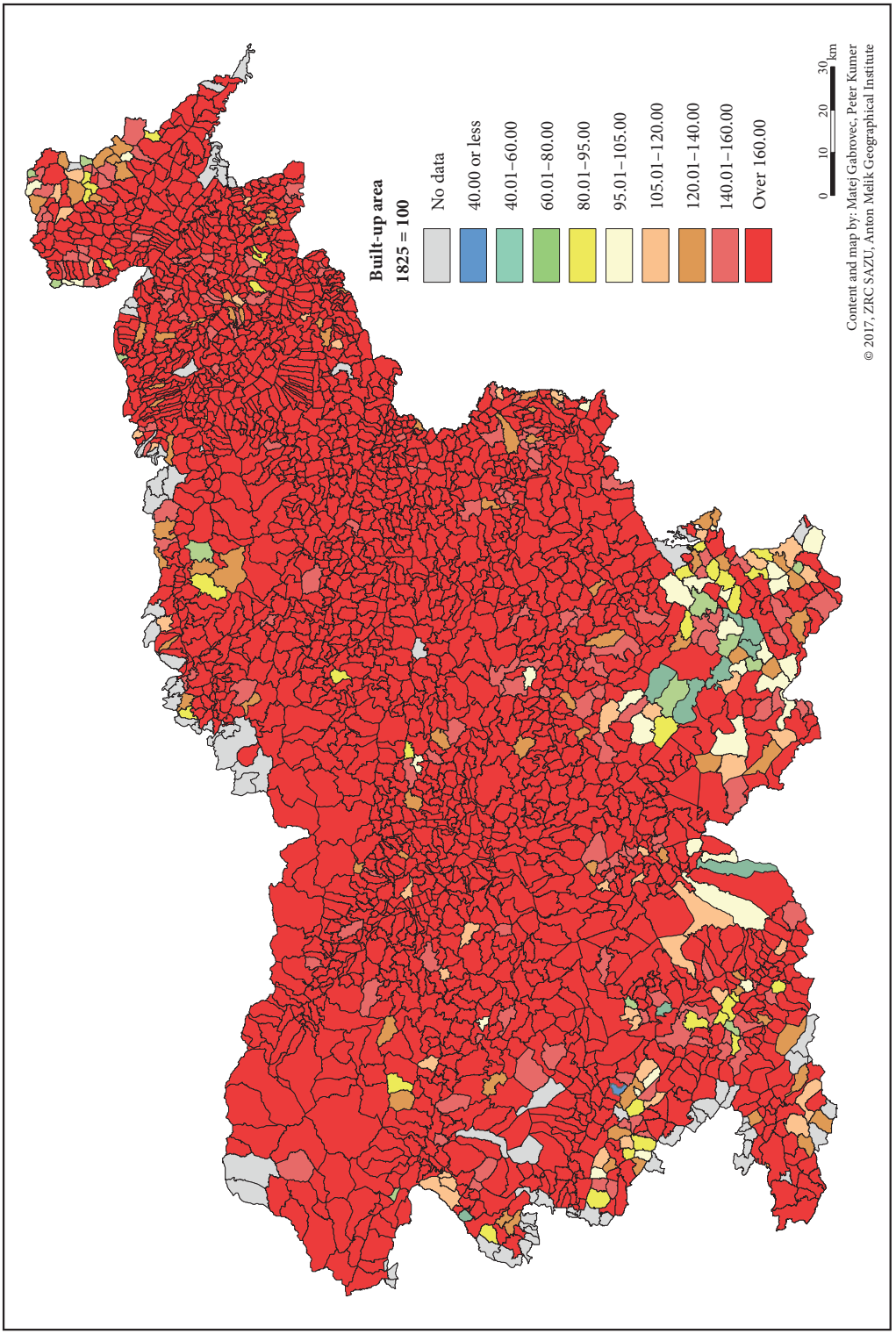
Built-up area
1825 = 100
No data
40.00 or less
40.01–60.00
60.01–80.00
80.01–95.00
95.01–105.00
105.01–120.00
120.01–140.00
140.01–160.00
Over 160.00
0
10
20
30
km
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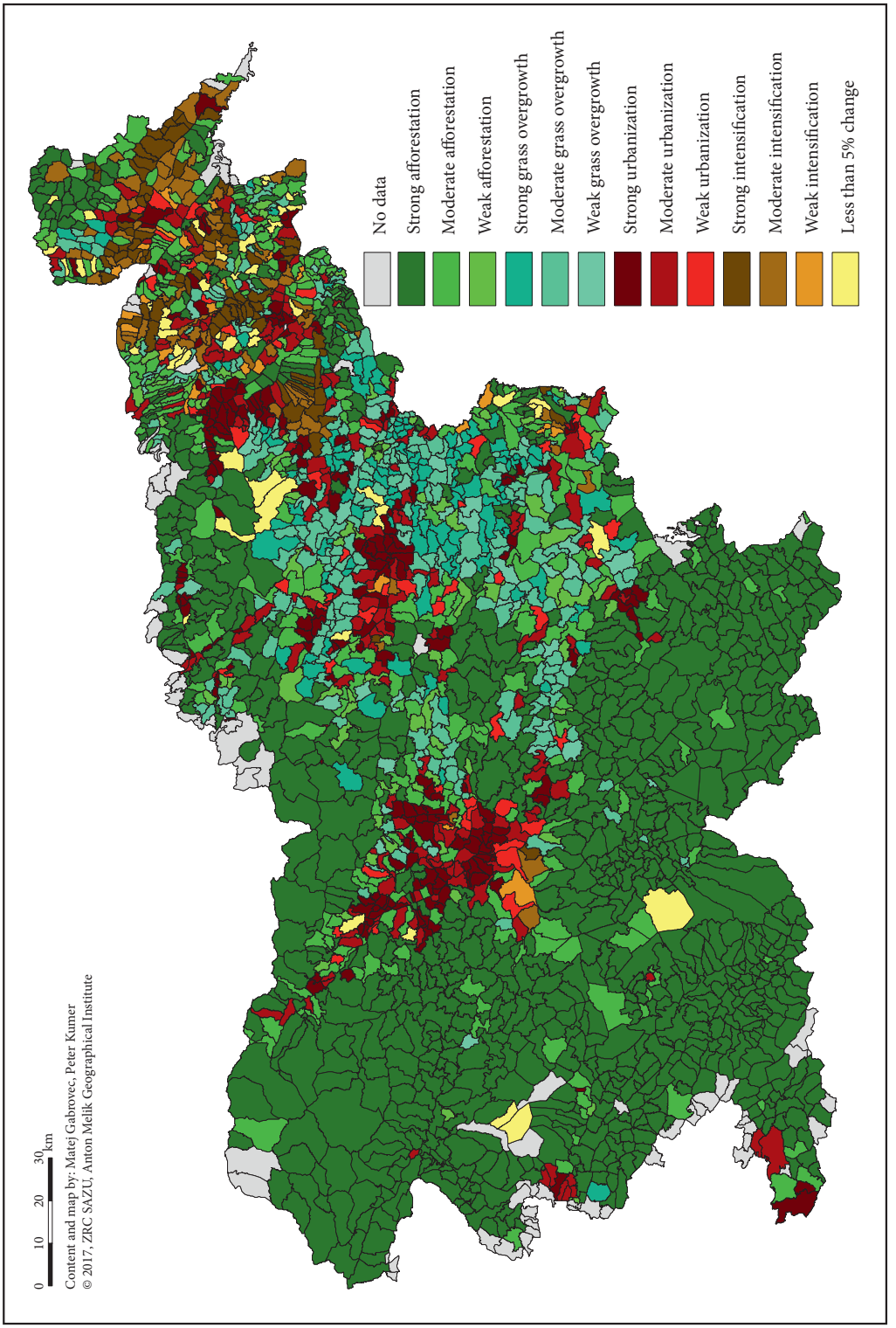
No data
Strong afforestation
Moderate afforestation
Weak afforestation
Strong grass overgrowth
Moderate grass overgrowth
Weak grass overgrowth
Strong urbanization
Moderate urbanization
Weak urbanization
Strong intensification
Moderate intensification
Weak intensification
Less than 5% change
0 10 20 30 km
Content and map by: Matej Gabrovec, Peter Kumer
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4 Discussion

Our analysis was intentionally limited to the period for which a high-quality data source (i.e., the Franciscean Cadaster) is available for all of Slovenia. Land-use data of similar quality are not available for Slovenia for older periods, although land use during the second half of the eighteenth century can be deduced from the Josephine military maps (Zorn 2007; Ribeiro, Burnet and Torkar 2013). Outside Slovenia, these maps were often used as a source of data on the nineteenth- and eighteenth-century land use in countries that had no cadastral or other statistical data available (Mishina 2015; Kaim et al. 2016). There are no maps of sufficient quality available for the period before the eighteenth century and land use for that time can only be estimated based on the number of inhabitants (Goldewijk 2001; Gabrovec, Komac and Zorn 2012).

In recent decades, satellite images have been key for obtaining land-use data and in Europe the CORINE Land Cover database makes it possible to perform comparative studies between countries (Feranec et al. 2010). Unfortunately, due to the different methodology used for collecting data, the comparability of this data with older data provided in the cadasters has been limited.

Two centuries is a long period, during which the factors leading to changes in land use changed several times. Two opposing processes might have alternated in the same cadastral district. It would also be vital to include data for individual years in the database in order to better interpret the factors affecting land-use changes. These data are actually available for individual years (Kladnik 1985; Gabrovec and Kladnik 1997; Gabrovec, Petek and Kladnik 2001), but their comparability with previous and later periods is limited due to changes in the cadastral municipalities' borders. Therefore, in the future it would make sense to also include the cadastral borders for individual years in a uniform geographic information system.

With its detailed land-use typology, the Franciscean Cadaster makes it possible to conduct in-depth research. Individual subcategories, such as pastures and meadows with trees and/or shrubs, allow a detailed explanation of forest development in Slovenia. The written part of the cadaster also has great potential for future research. Until now, it has only been used for case studies at the level of settlements, mentioned above. If the 1:2,880 cadastral maps, which are already available in digital form, were converted into vector format, changes in land use could be examined at the national or regional level, which would yield higher-quality results. This is especially relevant to studying the links between natural geographical factors and land use.

5 Conclusion

The Franciscean Cadaster is an invaluable historical source for studying nineteenth-century land use. The land-use tables provided in the written part of the cadaster were used to compile a database of nineteenth-century land use by Slovenian cadastral municipalities. Changes in land use over the past two centuries were analyzed, in which the focus was on the changes resulting from differences in natural geographical conditions. Afforestation predominates in western Slovenia, whereas eastern Slovenia is more diverse in terms of processes involving land-use changes: agricultural intensification predominates on the plains and grass overgrowth dominates in the hills, although afforestation also takes place in certain natural geographical regions less favorable for agriculture. Urbanization is the predominant process around major cities across all of Slovenia. The nineteenth-century land-use database produced provides the basis for further detailed research into factors influencing land-use changes and this article presents the procedures for setting up the database and the first analysis results.

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